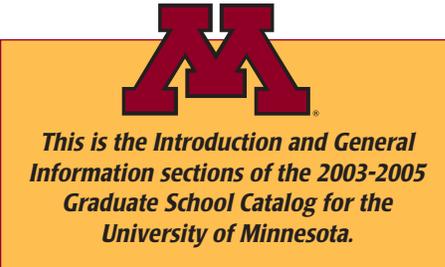


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# Introduction

## Graduate School Location

The Graduate School's main administrative offices are on the East Bank of the University of Minnesota's Twin Cities campus in Johnston Hall, 101 Pleasant Street S.E., Minneapolis, MN 55455. See Campus Maps at the end of this catalog. Johnston Hall is wheelchair accessible.

## Publications

**Graduate School Catalog**—Prospective and current graduate students are responsible for all the information contained in this catalog that is pertinent to graduate study and their specific field.

The first section, General Information, is the official source of information about Graduate School policies and procedures. The next section, Majors and Degrees, lists approximately 150 degree programs offered through the Graduate School.

The largest sections, Degree Programs and Faculty, and Courses, list contact names and addresses for the degree programs (Program Offices), faculty who teach in each discipline (Graduate Faculty) and present requirements and course descriptions for the various programs offering graduate degrees. At the beginning of the Courses section, the Course Numbers and Symbols page explains the numbering system, punctuation, department designators, and symbols used throughout the course descriptions. The short section that follows is Duluth Degree Programs.

At the back is a complete set of Campus Maps and Course Designators.

The catalog is available in the Graduate School (outside 309 Johnston Hall) and online at [www.catalogs.umn.edu/grad/index.html](http://www.catalogs.umn.edu/grad/index.html).

**Updates to Catalog Information**—Changes in Graduate School policies and procedures relating to admission, registration, financial assistance, and commencement are accessible online at [www.grad.umn.edu](http://www.grad.umn.edu).

**Other Publications**—The *Class Schedule* lists courses, class hours, locations, instructors, and basic costs and regulations. It is available online at <http://onestop.umn.edu/schedule/html/tc.html>. Separate catalogs are printed for the College of Continuing Education, the Duluth campus, and other University units.

## Policies

**Catalog Use**—The information in this catalog and other University catalogs, publications, or announcements is subject to change without notice. University offices can provide current information about possible changes.

This publication is available in alternative formats on request. Contact the Office of Admissions, University of Minnesota, 240 Williamson Hall, 231 Pillsbury Drive S.E., Minneapolis, MN 55455 (612-625-2008; [admissions@umn.edu](mailto:admissions@umn.edu)).

**Equal Opportunity**—The University of Minnesota is committed to the policy that all persons shall have equal access to its programs, facilities, and employment without regard to race, color, creed, religion, national origin, sex, age, marital status, disability, public assistance status, veteran status, or sexual orientation.

In adhering to this policy, the University abides by the Minnesota Human Rights Act, Minnesota Statute Ch. 363; by the Federal Civil Rights Act, 42 U.S.C. 2000e; by the requirements of Title IX of the Education Amendments of 1972; by Sections 503 and 504 of the Rehabilitation Act of 1973; by the Americans With Disabilities Act of 1990; by Executive Order 11246, as amended; by 38 U.S.C. 2012, the Vietnam Era Veterans Readjustment Assistance Act of 1972, as amended; and by other applicable statutes and regulations relating to equality of opportunity.

The Office of Equal Opportunity and Affirmative Action helps students and employees with concerns about possible discrimination, and provides consultations regarding nepotism and consensual relationships. Staff members can discuss issues, help resolve or investigate complaints, and provide training programs. Inquiries regarding compliance may be directed to Julie Sweitzer, Director, Office of Equal Opportunity and Affirmative Action, University of Minnesota, 419 Morrill Hall, 100 Church Street S.E., Minneapolis, MN 55455 (612-624-9547).

**Disability Services**—The University's mission is to provide optimal educational opportunities for all students. The University recognizes that students with disabilities sometimes have unique needs that must be met for them to have access to campus programs and facilities. In general, University policy calls for accommodations to be made on an individualized and flexible basis. It is the responsibility of students to seek assistance at the University and make their needs known.

The first place to seek assistance is Disability Services (DS). This office promotes program and physical access, which means ensuring the rights of students with disabilities and assisting the University in meeting its obligations under federal and state laws. DS provides direct assistance such as information, referral, support, and academic accommodations for enrolled and prospective students, as well as consultation to faculty and staff to ensure access to their programs and facilities. The office also assists students with disabilities in obtaining services from other University or community resources and serves as a liaison between the University and the Division of Rehabilitation Services. Campus accessibility maps also are available from DS and building accessibility information is printed in the *Student-Staff Directory*. For more information, contact Disability Services, University of Minnesota, 180 McNamara Alumni Center, 200 Oak Street S.E., Minneapolis, MN 55455 (612-626-1333 voice or TTY).

**Access to Student Educational Records**—In accordance with Regents policy on access to student records, information about a student generally may not be released to a third party without the student's permission. (Exceptions under the law include state and federal educational and financial aid institutions.) The policy also permits students to review their educational records and to challenge the contents of those records.

Some student information—name, address, electronic (e-mail) address, telephone number, dates of enrollment and enrollment status (full time, part time, not enrolled, withdrawn and date of withdrawal), college and class, major, adviser, academic awards and honors received, and degrees earned—is considered public or directory information. Students may prevent the release of public information. To do so, they must request suppression from the records office on their campus.

**Additional  
information about  
the Graduate School  
is available online at  
[www.grad.umn.edu](http://www.grad.umn.edu).**

Students have the right to review their educational records. The Regents policy, including a directory of student records, is available for review at 200 Fraser Hall, Minneapolis and at records offices on other campuses of the University. Questions may be directed to the One Stop Services Center, 200 Fraser Hall (612-624-1111).

**Immunization**—Students born after 1956 who take more than one University course are required under Minnesota law to submit a Student Immunization Record form.

The form, which is sent along with the official Graduate School admission letter, should be filled out and returned to Boynton Health Service as soon as possible, but absolutely no later than 45 days after the beginning of the first term of enrollment, in order for students to continue registering for courses at the University. Complete instructions accompany the form.

**Smoke-Free Campus Policy**—Smoking is prohibited in all facilities of the University of Minnesota, Twin Cities campus except for designated private residence hall rooms.

**E-Mail**—E-mail is the University's official means of communication with students. Students are responsible for all information sent via their University e-mail account. Students who forward their University e-mail account are still responsible for all information, including attachments, sent to the account.

## The Campus and Community

On the Twin Cities campus, Graduate School students enjoy the vast academic and cultural opportunities of a major university and a unique metropolitan area.

**Two Campuses in One**—The Twin Cities campus, the largest and oldest in the University system, is technically two separate campuses: one just east of downtown Minneapolis on the Mississippi River, the other just west of the State Fairgrounds a couple of miles from downtown St. Paul.

The Mississippi River divides the Minneapolis campus into two banks connected by the double-decker Washington Avenue Bridge. The picturesque mall of the main East Bank is bordered by stately traditional buildings—including Johnston Hall, home of the Graduate School. Next door is Northrop Auditorium and its plaza. On the other end of the mall, Coffman Memorial Union offers a good place to relax between classes. Nearby are unique underground facilities and the health sciences complexes.

Just across the river is the West Bank. Newer and smaller, it boasts sleek brick buildings like the main library, the Humphrey Institute of Public Affairs, Mondale Hall (formerly the Law Center), the Ted Mann Concert Hall, and the Carlson School of Management.

Three miles away and connected by a free express transit way, is the St. Paul campus, whose animal barns, croplands, flowers, and wooded areas evoke a small college atmosphere.

**Urban Diversity**—The Dinkytown, Stadium Village, Seven Corners, and Cedar-Riverside areas near the Minneapolis campus, and the St. Anthony Park neighborhood alongside the St. Paul campus, all feature shops and restaurants tailored to students' interests and budgets.

Minneapolis (the largest city in Minnesota) and St. Paul (the state capital) are both flourishing centers of commerce and industry, where grandiose historic buildings complement bold new skyscrapers. Focal points of a progressive metropolitan area of 2.3 million people, the two downtowns offer many opportunities for entertainment, research, volunteer or part-time work, internships, and careers.

**Arts and Entertainment**—The Twin Cities are renowned for their innovative and varied cultural attractions, such as the Guthrie Theater, Ordway Music Theater, Orchestra Hall, Science Museum and Omnitheater, and Brave New Workshop. Northrop Auditorium, the campus centerpiece, hosts performances by popular musical and dance artists and outstanding University bands and ensembles. Students can see or star in plays at the Rarig Center. Or they can enjoy the Walker Art Center and the Minneapolis Institute of Arts, the Minnesota and Como Zoos, the Mall of America, the Renaissance Festival and Valleyfair, and the Minneapolis Aquatennial and St. Paul Winter Carnival. Overlooking the Mississippi River is the University's Frederick R. Weisman Art Museum, with award-winning design by Frank Gehry.

**Recreation and Sports**—The Recreational Sports program, one of the largest of its kind on any campus in the country, offers curling, cycling, racquetball, crew, ballroom dance, juggling, and 100 other teams, clubs, and fitness activities. Sports fans can view Golden Gophers or Vikings football and Twins baseball at the Metrodome, Timberwolves basketball at the Target Center and Wild hockey at the Xcel Energy Center. Many women's and men's intercollegiate athletic events also take place right on campus.

Outdoor enthusiasts can explore the Twin Cities' 150 parks and 200 lakes, ideal for picnicking, hiking, biking, swimming, canoeing, sailing, fishing, rollerblading or ice skating, cross-country or downhill skiing, or simply sitting and thinking. The Boundary Waters Canoe Area Wilderness, one of the most unsullied wilderness treasures in the entire nation, is only a few hours drive north.

The warmth of spring, greenery of summer, and bright colors of autumn are followed by at least three months of winter snow, but even then, daytime temperatures generally average an invigorating 10 to 30 degrees above zero.

## University Counseling & Consulting Services

University Counseling & Consulting Services (UCCS), 109 Eddy Hall on the East Bank and 199 Coffey Hall on the St. Paul campus (612-624-3323 for both), offers counseling for academic, career, personal, or relationship concerns. Besides counseling, UCCS features a variety of services. The Career Development Center and the Learning and Academic Skills Center offer workshops, courses, and materials for career development or academic skills improvement. UCCS offers a series of workshops for graduate students as well as ongoing dissertation support groups. The Organizational Development Program offers consultation, assessment, team building, conflict mediation, training, and workshops. UCCS's Office of Measurement Services (OMS) scores exams, surveys, and research instruments and provides consultation to University faculty and staff. The Testing Center administers computerized national tests. For more information, see <[www.ucs.umn.edu](http://www.ucs.umn.edu)>.

## Libraries and Research Opportunities

The University of Minnesota, Twin Cities Libraries, with a collection of more than 5.7 million catalogued volumes and over 45,000 serials, ranks 17th in size among American universities. Included in the system are the *Bio-Medical Library* (health sciences); *Magrath Library* (agriculture, biological sciences, human ecology); *Science and Engineering Library* (in Walter Library); and *Wilson Library* (social sciences, humanities, education, psychology, special collections). Other campus libraries include those for architecture, entomology, fisheries and wildlife, forestry, horticulture, journalism, law, mathematics, music, plant pathology, and veterinary medicine. Many specialized libraries and archives, such as the Children's Literature Research Collections and the Immigration History Research Center Archives, are located in the *Elmer L. Andersen Library*. In addition to strong comprehensive research collections, the system offers a full range of reference and information services, including specialized reference assistance, interlibrary loan service, database literature searching, and library user instruction. LUMINA, the library's online system, may be accessed from residence halls, offices, and other locations at [www.lib.umn.edu](http://www.lib.umn.edu).

Research support is provided by the Offices of the Vice President for Research and Dean of the Graduate School as well as by the public and private sectors. The Graduate School distributes a total of \$6 million annually in competitive fellowship awards to students. Another \$6 million annually is awarded competitively to faculty for research support and endowed professorship support. The University also ranks among the top research universities receiving federal research money.

## Use of Human or Animal Subjects in Research

All research on the Twin Cities, Duluth, Morris, and Crookston campuses that involves the use of human or animal subjects must be reviewed and approved before initiation by the Institutional Review Board: Human Subjects Committee (IRB) or the Institutional Animal Care and Use Committee (IACUC). This policy, approved by the University Senate and Board of Regents, applies to funded and nonfunded faculty, staff, and student research. All research, including Plan B projects, theses, and dissertations, that involves human or animal subjects must be approved by the appropriate committee to ensure that the rights and welfare of the subjects are protected. For more information, contact the Research Subjects Protection Office, University of Minnesota, MMC 820, 420 Delaware Street S.E., Minneapolis, MN 55455 (612-626-5654; fax 612-626-6061).

## University Research Centers

The University has numerous research centers and institutes. A partial list can be found at [www.mbbnet.umn.edu/res.html](http://www.mbbnet.umn.edu/res.html).

## Administration

### University Regents

Maureen K. Reed, At Large, *Chair*  
David R. Metzen, Congressional District 4, *Vice Chair*  
Clyde Allen, Congressional District 7  
Anthony R. Baraga, Congressional District 8  
Peter Bell, Congressional District 5  
Frank R. Berman, At Large  
Dallas Bohnsack, Congressional District 2  
John Frobenius, Congressional District 6  
William E. Hogan II, Congressional District 3  
Richard McNamara, At Large  
Lakeesha K. Ransom, At Large  
Patricia Simmons, Congressional District 1

### University Administrators

Robert H. Bruininks, President  
Christine Maziar, Executive Vice President and Provost  
Frank B. Cerra, Senior Vice President for Health Sciences  
Kathryn Brown, Vice President and Chief of Staff  
Carol Carrier, Vice President for Human Resources  
Sandra Gardebring, Vice President for University Relations  
David Hamilton, Interim Vice President for Research  
Robert Jones, Vice President and Executive Vice Provost for Faculty and Academic Programs  
Charles Muscoplat, Vice President for Agricultural Policy  
Kathleen O'Brien, Vice President for University Services  
Mark B. Rotenberg, General Counsel

### Graduate School Administrators

Victor A. Bloomfield, Ph.D., Interim Dean of the Graduate School  
TBA, Assistant Vice President for Research and Associate Dean of the Graduate School  
Shirley Nelson Garner, Ph.D., Associate Dean of the Graduate School  
George D. Green, Ph.D., Associate Dean of the Graduate School  
Stephen C. Hedman, Ph.D. Associate Dean of the Graduate School, Duluth

### McKnight Land-Grant Professorship Winners for 2003-05

The goal of this program is to advance the careers of the University's most promising junior faculty at a crucial period in their professional lives. Recipients are honored with the title McKnight Land-Grant Professor, an endowed chair which they will hold for two years. The award consists of a \$25,000 research grant in each of two years, summer support, and a research leave in the second year. Profiles of the 10 recipients follow.

#### Vinay K. Gidwani, Geography

Mapping the links between globalization, labor circulation, and national and subnational politics in India

#### William M. Gray, Plant Biology

The molecular mechanisms of the plant hormone auxin

#### Kathryn J. Kohnert, Communication Disorders

Primary language disorders and second language learning by children

#### Erika Lee, History

Asian immigration history in the Americas, 1880-1940

#### Tian-Jun Li, Mathematics

Manifold topology

#### Krishnan Mahesh, Aerospace Engineering and Mechanics

Computational fluid mechanics

#### Paul G. Mermelstein, Neuroscience

How neurons integrate and respond to the stimuli that trigger long-term changes in brain function

#### Fernando Porté-Agel, Civil Engineering

Environmental fluid dynamics: land-atmosphere interactions

#### Natalia Y. Tretyakova, Medicinal Chemistry

Mapping carcinogen-induced DNA damage within critical genes by mass spectrometry

#### Byeong-Uk Yi, Philosophy

Plurals: their logic and semantics

### Distinguished McKnight University Professorship Winners for 2003

Once a year, the Graduate School selects four University professors to receive the Distinguished McKnight University Professorship. Winners are chosen on the merit of their scholarly achievements and the potential for greater attainment in the field; the extent to which their achievements have brought distinction to the University of Minnesota; the quality of their teaching and advising; and their contributions to the wider community.

The four recipients for 2003 are:

**Christopher J. Cramer**  
Chemistry

**Ann S. Masten**  
Child Development

**Peter B. Reich**  
Natural Resources

**Victor Reiner**  
Mathematics

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# General Information

The Graduate School provides advanced training in a variety of fields and promotes research in an atmosphere of freedom of inquiry.

The Graduate School administrative structure includes six policy and review councils, consisting of faculty and students, in the areas of biological sciences; education and psychology; health sciences; language, literature, and the arts; engineering, physical and mathematical sciences; and social sciences. These councils, together with an Executive Committee, are responsible for making general policy for the Graduate School. The Executive Committee is composed of the Graduate School dean; chairpersons of the policy and review councils, the Graduate School Research Advisory Committee, the Biomedical Research Advisory Committee, and the Fellowship Committee; and representatives from the Duluth Graduate Faculty Committee, Graduate School administration and staff, and the Council of Graduate Students.

## Tuition and Fees

Tuition for the various categories of Graduate School registration and fees are listed in the *Class Schedule* online at <[http://onestop.umn.edu/Finances/tuition\\_and\\_fees.html](http://onestop.umn.edu/Finances/tuition_and_fees.html)>. Summer session tuition and fees are listed in the *Summer Session Catalog*.

**Residence**—Because the University is a state institution, Minnesota residents pay lower tuition than nonresidents. For more information on eligibility requirements for resident status, contact the Resident Classification and Reciprocity Office, University of Minnesota, 240 Williamson Hall, 231 Pillsbury Drive S.E., Minneapolis, MN 55455 (612-625-6330).

**Reciprocity**—For residents of North Dakota, South Dakota, Wisconsin, or Manitoba who qualify for reciprocity privileges, tuition rates are lower than for nonresidents and are, in some cases, comparable to resident rates. For more information, contact the Resident Classification and Reciprocity Office (see above).

**Resident Tuition Benefit**—For information on resident tuition for graduate assistants, fellows, and trainees, see Assistantships and Fellowships on page 10. For information on the benefit for underrepresented and educationally disadvantaged students, see Office of Graduate School Outreach on page 11.

## Basic Admission Requirements

Any student with a U.S. bachelor's degree or a comparable foreign degree from a recognized college or university may apply to the Graduate School dean for admission. Applicants with the necessary background for their chosen major field, an excellent scholastic record from an approved college or university, and appropriate professional qualifications may be admitted for graduate work on recommendation of the graduate faculty in the proposed major field and approval of the Graduate School dean. The Graduate School operational standard for admission is an undergraduate grade point average (GPA) of 3.00. Many programs require a higher GPA. Applicants should consult the program to which they are applying for more specific information about admission standards.

For more information on admission requirements and application procedures, contact the proposed major field at the address or phone number listed with each program in the Degree Program and Faculty section of this catalog.

## Application Procedure

Applicants are encouraged to apply online at <[www.grad.umn.edu/prospective\\_students/apply\\_online.html](http://www.grad.umn.edu/prospective_students/apply_online.html)>. Requests for paper application materials should be sent to the director of graduate studies in the individual program (see the contact information listed with each program in the Degree Programs and Faculty section). Requests should specify the applicant's proposed major field and emphasis, degree objective, and date of entry.

Applicants are encouraged to apply for admission well in advance of the term in which they wish to enter the Graduate School (but no more than one year in advance of the proposed entry date). The Graduate School application, complete with all required materials, must be submitted by the following deadlines.

*Fall semester*—June 15

*Spring semester*—October 15

*Summer session*—March 15

Deadlines that fall on a holiday or weekend will be extended through the next regular workday.

*Many major fields have established deadlines earlier than those listed above and also require additional application and supporting materials. It is the applicant's responsibility to obtain information about those deadlines and requirements from the director of graduate studies for the proposed major.*

*Note:* More detailed and up-to-date information regarding the application fee, transcripts, and test data is included in the instructions accompanying the Graduate School Application for Admission.

**Transcripts**—Official transcripts of previous academic study must be submitted.

Experience at the University of Minnesota has been that often during the course of the program of study a student has need of a complete set of official credentials covering previous college and university training. Applicants are urged to request two sets of official credentials when preparing their admission application—one to be submitted for permanent filing in the Graduate School and the other for personal use.

**International Applicants**—All international applicants must submit complete credentials. Details on the types of transcripts required are given in the Graduate School Application for Admission instructions.

**Test Data**—One or more of the following tests may be required as part of the application process (in addition, consult the individual program requirements under Degree Programs and Faculty).

**Graduate Record Examination (GRE)**—Most major fields request the GRE. It would be wise, therefore, for applicants to complete this test either in the senior year of undergraduate work or before filing an admission application.

For information about the test, contact the Educational Testing Service, CN 6000, Princeton, NJ 08541. Official scores must be sent to the Graduate School office from the testing service.

**Graduate Management Admission Test (GMAT)**—See the business administration program description under Degree Programs and Faculty. For information on registering for the GMAT, write to the Educational Testing Service, CN 6108, Princeton, NJ 08541.

*Test of English as a Foreign Language (TOEFL), International English Language Testing System (IELTS), and Michigan English Language Assessment Battery (MELAB)*—The operational standard for admission to the Graduate School is a TOEFL score of 550 (213 on the computer-based test), an IELTS score of 6.5, or MELAB score of 80; individual programs may require a higher score. One of these tests is required of all international applicants whose native language is not English, except those who will have completed 24 quarter or 16 semester credits (within the past 24 months) in residence as a full-time student at a recognized institution of higher learning in the United States before entering the University of Minnesota. These transfer students, however, may be asked to take locally administered English tests after arrival on campus.

*Foreign Medical Graduate Examination in the Medical Sciences (FMGEMS)*—Applicants seeking admission to graduate study in clinical medical fields whose medical degrees or qualifications were conferred by medical schools outside the United States, Puerto Rico, or Canada must submit certification by the Educational Commission for Foreign Medical Graduates or evidence of a full and unrestricted license to practice medicine issued by a state or other territory under U. S. jurisdiction that is authorized to license physicians. For more information on certification and the FMGEMS, write to the Educational Commission for Foreign Medical Graduates, 3624 Market Street, Philadelphia, PA 19104, USA or phone 215-386-5900.

**Additional Information**—The Graduate School and individual programs within it reserve the right to request additional information when they believe it is necessary.

## Special Applicant Categories

**University of Minnesota Undergraduates**—University of Minnesota students who have no more than seven semester credits or two courses to complete for their bachelor's degree (including both distribution and total credit requirements), if they are admitted, may register in the Graduate School to begin a graduate program while simultaneously completing their baccalaureate work. A final bachelor's transcript must be submitted before the second term of registration.

**Professional Development**—Applicants who wish to enroll in a field in the Graduate School but are not interested in a graduate degree may apply for admission for "professional development coursework." Applicants for professional development courses must complete the usual application materials and meet existing deadlines and admission standards. Because some major fields restrict admission to those planning on pursuing an advanced degree, applicants are advised to consult with the director of graduate studies in their proposed major field before completing application materials.

**Academic Staff**—University of Minnesota staff holding academic appointments above the rank of instructor or research fellow are normally not permitted to complete a graduate degree at the University. Those who wish to register for courses and transfer them elsewhere may apply for admission for "professional development coursework."

**Committee on Institutional Cooperation Traveling Scholar Program**—The University of Minnesota participates in the Traveling Scholar Program for graduate students enrolled in Committee on Institutional Cooperation (CIC) institutions. The 14 participating

universities are the members of the "Big Ten," the University of Chicago, the University of Illinois at Chicago, and the University of Wisconsin-Milwaukee.

The program enables doctoral students at any CIC university to take advantage of educational opportunities—specialized courses, unique library collections, unusual laboratories—at any other CIC university without change in registration or increase in fees. Students may take advantage of these educational opportunities for three quarters or two semesters.

Graduate students interested in graduate course offerings not available at the University of Minnesota should confer first with their major department and major adviser concerning which of the cooperating institutions to select for program enrichment and diversification. Information on procedures for participating in the Traveling Scholar Program is available in the Graduate School Admissions Office, 309 Johnston Hall (612-625-3014).

## Assistantships and Fellowships

**Resolution of the Council of Graduate Schools in the United States**—Acceptance of an offer of financial aid (such as a graduate scholarship, fellowship, traineeship, or assistantship) for the next academic year by an enrolled or prospective graduate student completes an agreement that both student and graduate school expect to honor. When a student accepts an offer before April 15 and subsequently desires to withdraw, the student may submit a written resignation for the appointment at any time through April 15. However, an acceptance given or left in force after April 15 commits the student not to accept another offer without first obtaining a written release from the institution to which a commitment was made. Similarly, an offer made by an institution after April 15 is conditional on presentation by the student of a written release from any previously accepted offer. It is further agreed by the institutions and organizations subscribing to this resolution that a copy of the resolution should accompany every scholarship, fellowship, traineeship, and assistantship offer.

**Graduate Assistantships**—Graduate assistantships are academic appointments reserved for graduate and professional students. Appointments to teaching assistant, research assistant, or administrative fellow positions are offered through various departments. A teaching assistant helps teach students in a specified course or courses under the general supervision of the academic staff and may be assigned primary responsibility for an entire course. A research assistant carries out activities connected with research studies assigned by the supporting department or principal research investigator. An administrative fellow performs duties of a specialized nature connected with academic administration.

*To be eligible to hold one of these appointments, a student must have been admitted to the Graduate School or a professional school and be registered in the Graduate School or professional school each term of the appointment; this applies to appointments of any percentage or any number of hours. For more specific information, refer to the Graduate Assistant Employment Area in the Office of Human Resources (612-624-7070) or its Web site <[www1.umn.edu/ohr/gao](http://www1.umn.edu/ohr/gao)>.*

Information about the GRE and GMAT, including practice tests and online registration, can be found on the Educational Testing Services Web site at <[www.ets.org/](http://www.ets.org/)>.

**Benefits**—All graduate assistants holding appointments as teaching assistants, research assistants, and administrative fellows may become eligible for the following benefits:

**Tuition Benefits**—Upon reaching minimum qualification for eligibility (refer to the graduate assistant office Web site above), students receive a tuition benefit equal to twice the percentage of time worked. For example, a 40 percent appointment for the full payroll semester period includes an 80 percent tuition benefit, which applies only to tuition costs. The maximum benefit is 100 percent and applies to a maximum of 14 credits each academic term. The tuition benefit does not cover course or student services fees.

**Resident Rate Privilege**—Upon reaching minimum qualification for eligibility (refer to the graduate assistant office Web site above), students receive a resident rate break, which is credited on the fee statement before the tuition benefit. This privilege applies concurrently to members of the immediate family (spouse or domestic partner, children, and parents).

**Extended Resident Rate Privilege**—When a graduate assistant has completed two qualifying terms of assistantship, the resident rate break continues for the number of terms the appointments were held, up to a maximum of six terms. This privilege applies also to the student's immediate family. *Note:* For the student and family, this privilege does not extend beyond three years from the termination of the last or most recent qualifying appointment.

Each department sets its own financial aid application deadline. Unless otherwise noted, students should apply by January 15 for appointments for the ensuing academic year; applications received after January 15 are considered for available vacancies.

Graduate assistants are compensated according to a pay range established each year by the University's central administration and approved by the Board of Regents. The current pay range for graduate assistants is available from the department or the University of Minnesota Job Center. Graduate students may not hold appointments for which there is no monetary compensation, nor are they allowed to hold appointments for which they receive only course credit or resident tuition rates.

More information may be obtained from either the head of the department offering the appointment or the Job Center, which maintains the graduate assistant office Web site and *Grapevine*, a newsletter for graduate assistants. More information about the assistantship program at the University may be obtained from the Job Center, University of Minnesota, 200 Donhowe Building (first floor for walk-in assistance), 319 15th Avenue S.E., Minneapolis, MN 55455 (612-624-7070; fax 612-625-9801; [gaoinfo@umn.edu](mailto:gaoinfo@umn.edu)).

**Graduate Assistant Health Care Plan**—University-subsidized health insurance is available to most Graduate School or professional school students who hold an appointment as a teaching assistant, research assistant, or administrative fellow (some other fellows and trainees enrolled in the Graduate School are also eligible). For these students, the University pays 50 to 100 percent of the insurance premium during the academic year (fall through spring), the percentage depending on the level of appointment. To receive this coverage, eligible students must apply for it by the end of the second week of classes. To apply and for more information, contact the Graduate Assistant Insurance

Office, N-323 Boynton Health Service, 410 Church Street S.E., Minneapolis, MN 55455 (612-625-6936; [gradins@bhs.umn.edu](mailto:gradins@bhs.umn.edu); <[www.bhs.umn.edu](http://www.bhs.umn.edu)>).

**General College Assistantships**—Graduate students are eligible to apply for teaching assistantships in General College in mathematics, natural sciences, social sciences, writing, ESL, oral communication, and the humanities. The General College program consists of developmental and general education courses that enable underprepared students to later transfer to degree-granting colleges. Approximately 35 percent of the students in the college are from Asian/Pacific American, African American, Native American, and Hispanic ethnic groups.

All graduate teaching assistantships for General College are posted for at least five days in the Job Center, University of Minnesota, 319 15th Avenue S.E., Minneapolis, MN 55455. Notices of vacancies in General College are routinely sent to related academic departments in other University colleges.

**Graduate Fellowships**—Graduate fellowships, awards based on academic merit, are available to new and currently enrolled graduate students. The Graduate School Fellowship Office, 314 Johnston Hall, administers several fellowship programs; a number of individual academic departments also administer field-specific fellowships. Entering students should contact their prospective graduate program. Currently enrolled students should consult the Fellowship Office and their graduate program office for current information on fellowship opportunities. The Fellowship Office also processes applications for several international competitions, such as Fulbright Grants for graduate study abroad.

Contact the Graduate School Fellowship Office for additional information at 612-625-7579 or [gsfellow@umn.edu](mailto:gsfellow@umn.edu).

**Resident Benefit for Graduate Fellows and Trainees**—Graduate students who hold fellowships or traineeships are eligible for resident tuition rates, provided the award is administered by the University and the stipend is at least equal to a 25-percent-time graduate assistantship. This eligibility also extends to members of the immediate family (i.e., parent, spouse, child, or ward). For details and updates on this policy, contact the Graduate School Fellowship Office, 314 Johnston Hall, 612-625-7579.

## For New Graduate Students

**Graduate School Fellowships**—Intended for recruiting outstanding new students to the University's graduate programs, these fellowships provide approximately \$15,000 for the academic year plus tuition for up to 14 credits per term and subsidized health insurance. Prospective students must be nominated by their chosen major field in early February through procedures announced by the Graduate School during fall semester. Applicants should contact the director of graduate studies in their major field in advance.

**Fellowships and Scholarships Administered Through Departments**—Many academic departments have fellowships and awards from private endowment income, gifts, and other sources. Complete information is available on award amounts and purposes, deadlines, and the application process from individual departments. Students should inquire directly.

**Fellowships Available For Underrepresented and Educationally Disadvantaged Students**—Because eligibility varies depending on the fellowship, students should contact the appropriate program office to see if they are eligible. Information can also be obtained from the Office of Graduate School Outreach, 333 Johnston Hall (612-625-6858; [gsoeo@umn.edu](mailto:gsoeo@umn.edu)).

**Diversity of Views and Experiences Fellowship (DOVE)**—Students planning to enter the Graduate School for the first time in the fall semester are eligible for these one-year fellowships, which

provide a stipend of approximately \$15,000 plus tuition and health insurance (fees not included) for the academic year. Departmental support following the fellowship year is included. All applicants must be nominated by the graduate program they plan to enter. About 10 fellowships are awarded by the Graduate School each year.

**Other Available Fellowships**—The availability of other fellowships for underrepresented and educationally disadvantaged students changes yearly. They include the Ford Foundation Predoctoral and Dissertation Fellowships for Minorities, the GEM Master's Fellowship, the GEM Ph.D. Engineering and Natural Science Fellowship, the MacArthur Scholars Fellowship, the National Physical Science Consortium Fellowships for Minorities and Women in the Physical Sciences, and others. Contact the Office of Graduate School Outreach, 333 Johnston Hall, for information. In addition, underrepresented and educationally disadvantaged students should check all regular sources of support described in this catalog.

## Other Financial Assistance

**Student Employment**—The University's Job Center (part of the Office of Human Resources) offers graduate students a wide range of nonacademic employment opportunities both on campus and throughout the Twin Cities area. All jobs are posted at the Job Center, 200 Donhowe Building, 319 15th Avenue S.E., Minneapolis, MN 55455 (612-625-2000). Contact the Job Center for more information, including registration requirements for graduate student eligibility.

In addition to University (on-campus) employment, the Center offers programs for off-campus employment: the Job Location and Development (JLD) Program helps locate career-related opportunities with private and public employers in the Twin Cities; Community Service Programs helps arrange employment on and off campus with nonprofit organizations and agencies.

Students who prefer more flexibility may apply for short-term, on-campus temporary positions through the Student Temporary Service (STS). STS also offers free microcomputer training and temporary job placement through the Microcomputer Training Program. Training is provided on Macintosh and IBM microcomputers. Once qualified, students are placed in temporary, on-campus microcomputer-related jobs at competitive wages.

**Office of Student Finance (OSF)**—To apply for financial aid, graduate students must complete the Free Application for Federal Student Aid (FAFSA), available from the financial aid office each year. Graduate students are considered for the following programs, according to their degree program, student status, and other qualifying criteria: Ford Federal Direct Subsidized and Unsubsidized Loans; Federal Perkins Loans; Student Educational Loan Fund (SELF); University Trust Fund Loan (UTFL); University of Minnesota scholarships and fellowships; regular student employment and Work-Study; Health and Human Services Health Care Professions Grants; Minnesota Medical Foundation Scholarship; Minnesota Tuition Offset for Health Professions; Peters Pharmacy Scholarship; University of Minnesota Medical School Scholarships; Health Professions Student Loan (HPSL); Loans for Disadvantaged Students (LDS) for health professions; Nursing Student Loan (NSL); Primary Care Loan (PCL) for medical students; and private loans. International graduate students must contact International Student and Scholar Services for financial aid opportunities (see next column).

Most awards are based on financial need and full-time enrollment status. Aid from the UTFL, Perkins, and Work-Study programs is awarded as applications become complete and until all funds have been spent.

Students who submit their FAFSAs early to the federal processor receive first priority consideration for limited funds. Prospective students may apply before admission to the University.

For detailed information, students should obtain the most recent edition of the *Scholarships and Financial Aid Handbook*, a comprehensive guide to the financial aid process at the University of Minnesota. The handbook is accompanied by the FAFSA, which must be completed for aid consideration. Students may write to the Office of Student Finance at either University of Minnesota, 210 Fraser Hall, 106 Pleasant Street S.E., Minneapolis, MN 55455, or University of Minnesota, 130 Coffey Hall, 1420 Eckles Avenue, St. Paul, MN 55108, or call 612-624-1665 or, July-September, 1-800-400-UofM (8636); the fax number is 612-624-9584 and the e-mail address is [helpingu@umn.edu](mailto:helpingu@umn.edu). To receive disability accommodations when in Fraser Hall or information in an alternative format, call the disability services liaison for financial aid at 612-625-9578; TTY telephone is 612-626-0701.

**International Students and Scholars**—International Student and Scholar Services (ISSS) provides counseling, advising, educational and career services to students and scholars from other countries. ISSS staff members offer counseling and advising services regarding visa requirements and other immigration issues; social, personal, and financial matters; international and intercultural educational opportunities; academic issues; and English language requirements.

International students new to the University of Minnesota must participate in ISSS's International Student Orientation Program, which introduces students to academic, social, and practical matters relevant to their study in the United States. In addition, ISSS coordinates many cross-cultural training programs and events for students, faculty, staff, and the Twin Cities communities. All admitted international students and scholars are mailed materials pertaining to pre-arrival, arrival, and transition to the University system. Prospective student inquiries may be addressed to International Student and Scholar Services, 190 Hubert H. Humphrey Center, 301 19th Ave. S., Minneapolis, MN 55455 (612-626-7100) or visit the Web site [www.issss.umn.edu](http://www.issss.umn.edu).

**Army and Air Force ROTC**—Graduate students may pursue a two-year Army or Air Force ROTC program. For information, see the University's *Undergraduate Catalog* for the Twin Cities campus or call the Army ROTC (612-624-7300) or Air Force ROTC (612-624-2884).

## Office of Graduate School Outreach

The Office of Graduate School Outreach (OGSO) (333 Johnston Hall, 612-625-6858, [gsoeo@umn.edu](mailto:gsoeo@umn.edu)) works closely with other University of Minnesota offices that are concerned with diversity and multiculturalism. The office

- provides service to prospective and currently enrolled graduate students, faculty, funding representatives, and university colleagues;
- provides information about the University of Minnesota and its commitment to enrolling a diverse student population;

- supports a diverse student body in recruiting, funding, retention, and graduation with strategies for clarifying goals; selecting an appropriate graduate program; preparing the best possible graduate school application; and funding graduate work through assistantships and fellowships;
- serves as the administrative unit for funding programs that support a diverse graduate student body;
- promotes professional development and scholarship across disciplines and works toward creating the institutional environment necessary for facilitating the academic achievements of graduate and professional students, and
- encourages undergraduate students to consider graduate study by participating in research and other academic projects outside of their regular coursework.

## Student Grievance Procedures

**Academic Grievances**—An all-University Student Academic Grievance Policy exists to resolve “complaints brought by students regarding the University’s provision of education and academic services affecting their role as students.” Copies of the policy and information about its implementation are available from the Grievance Office, 658 Heller Hall, Twin Cities campus (612-624-1030).

**Sexual Harassment**—Policies pertaining to sexual harassment are contained in the Regents policy adopted December 11, 1998. The policy defines sexual harassment in the following manner.

“Sexual harassment means unwelcome sexual advances, requests for sexual favors, and/or other verbal or physical conduct of a sexual nature when: 1) submission to such conduct is made either explicitly or implicitly a term or condition of an individual’s employment or academic advancement in any University activity or program; 2) submission to or rejection of such conduct by an individual is used as the basis of employment or academic decisions affecting this individual in any University activity or program; or 3) such conduct has the purpose or effect of unreasonably interfering with an individual’s work or academic performance or creating an intimidating, hostile, or offensive working or academic environment in any University activity or program.”

Individuals seeking information and guidance in matters involving sexual harassment should contact the Office of Equal Opportunity and Affirmative Action, 419 Morrill Hall (612-624-9547).

**Crime Statistics**—Crime statistics can be found on the University of Minnesota Police Web site at [www1.umn.edu/umpolice/crime.htm](http://www1.umn.edu/umpolice/crime.htm).

## Housing

At the current time, the University guarantees housing fall term to freshmen that apply before May 1. Graduate and professional students can be housed in residence halls/apartments usually during the spring term and will have an option of renewing for the following year. Students interested in living in a residence hall on campus or in off-campus housing in Minneapolis or St. Paul should contact Housing & Residential Life, Comstock Hall-East, 210 Delaware Street S.E., Minneapolis, MN 55455 (612-624-2994; fax 612-624-6987; [housing@umn.edu](mailto:housing@umn.edu)). Listings of apartments, duplexes, houses, sleeping rooms, shared units, and sublets are maintained in the office as well as on the

Web. Information on temporary housing, living costs, transportation, and day-care centers in the Twin Cities area is also available.

For more information, visit the Housing & Residential Life Web site at [www.umn.edu/housing](http://www.umn.edu/housing). For information on University family housing, contact Commonwealth Terrace Cooperative, 1250 Fifield Avenue, St. Paul, MN 55108 (651-646-7526), or Como Student Community, 1024 27th Avenue S.E., Minneapolis, MN 55414 (612-378-2434).

## Orientation to the Twin Cities Campus

Designed for all incoming new graduate students in fall and spring semesters, Graduate Student Orientation (GSO) offers a wide variety of informational sessions and workshops to assist student transition into the University of Minnesota system. Sessions include “How to Navigate the U” and “The Nuts and Bolts of Graduate School” as well as basic resources such as “How to get your Student I.D.” All incoming graduate students (except those with foreign addresses) are mailed a brochure outlining the GSO schedule for that semester; F1 and J1 visa students receive information from International Student and Scholar Services (612-626-7100). For more information, contact Orientation and First-Year Programs at 612-624-1979 or 800-234-1979 or visit their Web site at [www.ofyp.umn.edu](http://www.ofyp.umn.edu).

In addition to this University-wide orientation service, many graduate programs may offer orientation sessions specifically for their respective fields. For more information, students should contact the director of graduate studies in their major field.

## Council of Graduate Students

The Council of Graduate Students (COGS) is the official governing body representing graduate students at the University. COGS provides opportunities for graduate students to participate actively in University and Graduate School administrative and policy decisions. Graduate students in each degree-granting program are entitled to elect one representative to serve on COGS. COGS also recruits student representatives for the Graduate School Policy and Review Councils, the University Senate, and many College of Liberal Arts and University-wide committees. In addition, COGS assists in providing ombuds services for graduate students and disseminates information, primarily through the *Gradletter*, the EXTRA! (graduate student listserv), and through general meetings held throughout the academic year. Information on University governance and grievance procedures is available from the COGS office.

Students may contact COGS at University of Minnesota, 405 Johnston Hall, 101 Pleasant Street S.E., Minneapolis, MN 55455 (612-626-1612; [cogs@umn.edu](mailto:cogs@umn.edu); [www.cogs.umn.edu](http://www.cogs.umn.edu)).

## Preparing Future Faculty

Preparing Future Faculty (PFF) welcomes graduate and postdoctoral participants from all disciplines. PFF helps participants acquire information about the teaching and learning process and the faculty role at a variety of institutions of higher education; gain a realistic perspective on the skills required for success as a faculty member; examine their fit with a teaching career in higher education; work with a faculty mentor in a

teaching opportunity at a local college or university; demonstrate, document, and reflect on their teaching skills; and market themselves for faculty or other professional positions.

To receive a letter of recognition and certificate of program participation from the Graduate School, participants must complete Grad 8101—Teaching in Higher Education and Grad 8102—Practicum for Future Faculty. Other credit courses on teaching and learning or the faculty role may be recognized by PFF as substitutes for Grad 8101 or Grad 8102.

PFF is a program of the Graduate School, administered through the Center for Teaching and Learning Services (CTLS) in the Office of Human Resources. For information on program enrollment, contact PFF at 612-625-3811 or [pff@umn.edu](mailto:pff@umn.edu), drop by CTLS in 120 Fraser Hall, or visit [www.umn.edu/ohr/pff](http://www.umn.edu/ohr/pff).

## Registration

**Registration Deadlines**—All graduate students must register before the term-specific, University-wide registration deadline. For University calendar and registration deadline information and the University-wide policy governing cancel/adds, refer to <http://onestop.umn.edu/registrar/calendars/>. For information about the summer term, including registration deadlines, refer to the *Summer Session Catalog* or the Web site above. Exceptions to University-wide registration deadlines will be considered only by written request to the Graduate School; such requests are not routinely granted.

All graduate students must register before the first day of the term to avoid a late registration fee.

**Registration Requirements**—To maintain their active status, graduate students must register every fall and spring term. Those who do not register in the Graduate School every fall and spring are considered to have withdrawn and their Graduate School records are deactivated. Deactivated students may not register for courses, take examinations, submit degree program or thesis proposal forms, file for graduation, or otherwise participate in the University community as Graduate School students. Those who wish to resume graduate work must request readmission to the Graduate School and, if readmitted, must register in the Graduate School for the term of readmission to regain their active status. For further information about the Graduate School's registration requirements, refer to [www.grad.umn.edu/current\\_students/registration/](http://www.grad.umn.edu/current_students/registration/).

Graduate students holding appointments as teaching assistants, research assistants, or administrative fellows must be registered for credit each term of their appointment; this applies to appointments of any percentage or any number of hours. See Graduate Assistantships under Assistantships and Fellowships on page 9 for more information.

Students receiving other types of financial aid from the University or other agencies, international students with certain types of visas, and students who wish to use various University services and facilities may have specific registration requirements; these students are responsible for obtaining information about such requirements from the appropriate offices.

## Special Registration Categories

**Grad 999**—Grad 999 is a zero-credit, zero-tuition, non-graded registration option for Graduate School students who must register *solely* to meet the Graduate School's registration requirement. *Grad 999 does not meet any other internal/external departmental or agency requirements.* Other than requiring Graduate School students to hold active student status, the Graduate School does not impose any eligibility requirements on Grad 999 registrations. However, individual graduate programs may establish their own eligibility criteria. Students considering registering for Grad 999 should first check with their graduate program. For more information on Grad 999, visit [www.grad.umn.edu/current\\_students/](http://www.grad.umn.edu/current_students/).

## Registration Categories for Advanced Graduate Students

Advanced master's students and advanced doctoral candidates (i.e., students who have completed all their program coursework and required thesis credits, but are still working full-time on the research or writing of their thesis, papers, capstone project, or dissertation) may be eligible for special registration categories that enable them to be certified as "full-time" students when registered for one credit.

"Full-time status with one credit registration" courses are available *only* to advanced master's (8333) and doctoral (8444) students who have met eligibility criteria. Eligibility criteria are specific to advanced master's and advanced doctoral applicants. Students must meet eligibility criteria and application deadlines to qualify.

For further information concerning eligibility requirements, deadlines, and application forms, contact the Graduate School, 316 Johnston Hall, the Graduate Assistantship Office, or [www.grad.umn.edu/current\\_students/](http://www.grad.umn.edu/current_students/).

## Readmission and Other Changes

Requests for readmission, change of major, track or degree objective, or change of campus within the Graduate School should be made on the Change of Status/Readmission application (G.S. Form 72), available outside the Graduate School Admissions Office, 309 Johnston Hall. Payment of a \$40 fee must accompany the form.

**Readmission**—To maintain their active status, *graduate students must register every fall and spring term.* Previously registered students who do not register in the Graduate School of the University of Minnesota every fall and spring term will be considered to have withdrawn and must apply for readmission in order to resume graduate work. More detailed information and specific examples are located at [www.grad.umn.edu/current\\_students/registration/](http://www.grad.umn.edu/current_students/registration/).

**Change of Major, Track, or Degree Objective**—Students currently enrolled in the Graduate School who intend to change their major, track, or degree objective from that originally approved by the Graduate School should request a change of status. Students who have already been awarded a degree in the Graduate School must request a change of status if they wish to pursue another degree.

For information  
about new student  
orientation plus  
writing and library  
research workshops,  
contact the Graduate  
Student Orientation  
program coordinator  
at 612-624-0666.

**Change of Campus**—Students currently enrolled in the Graduate School on one campus who wish to complete their studies on another campus should request a change of status. Graduate study is currently available on the Twin Cities campus and on the Duluth campus.

## Grading System

The Graduate School uses two grading systems: A-B-C-D-F (with pluses and minuses) and S-N. Students have the option of choosing the system under which they will be graded, except in courses in which grading has been restricted to one system with approval of the Graduate School. Students choose their grading system at the time of initial registration. 5xxx and 8xxx courses with grades of A, B, C (including C-), and S may be applied to a Graduate School degree program; changes in grading option are not allowed after the second week of the term. Under some circumstances and with approval of the student's major field, 4xxx, 6xxx, and 7xxx courses may also be applied to a Graduate School degree. *At least two-thirds of the total number of course credits included on any degree program form must be taken A-F.* Individual major fields have the option of specifying more stringent requirements regarding the application of S-N courses to a degree program. All A-F registrations in the Graduate School, regardless of course level, will be calculated in the cumulative GPA.

**Incomplete Grades**—The symbol "I" may be assigned by an instructor to indicate "incomplete," in accordance with provisions announced in class at the beginning of the semester, when in the instructor's opinion there is a reasonable expectation that the student can successfully complete the work of the course. An "I" remains on the transcript until the instructor replaces it with a final A-F or S-N grade. Course instructors may, at their discretion, establish a time limit for the removal of incomplete grades. The maximum number of credits of incompletes allowable at any given time is established by each major field for its graduate students. Students should refer to the Graduate School's Web site <[www.grad.umn.edu](http://www.grad.umn.edu)> for further information.

**Retaking Courses**—The Graduate School discourages the retaking of courses to improve grades. If a course is retaken, appropriate tuition and fees will be assessed. All registrations and grades for the course remain on the student's transcript and are calculated into the cumulative GPA.

**Grade Changes**—To preserve the integrity of the graduate transcript as an accurate record of a student's academic progress, the Graduate School does not approve requests to change final grades assigned to students in prior semesters.



## Satisfactory Progress Toward the Degree

In addition to fulfilling the Graduate School requirements, students should consult their major program's graduate studies handbook for program-specific criteria for satisfactory progress toward their degree.

## Termination of Graduate Student Status

When performance is unsatisfactory in terms of grades or normal progress toward the student's degree objective, graduate student status may be terminated. All guidelines stated in this catalog are minimum requirements, and each program is free to set more specific terms by which progress is measured for purposes of continuation. Students are encouraged to check with the director of graduate studies in their major field for complete information about academic performance and degree progress standards and the procedures used to monitor these standards.

Students who do not register in the Graduate School every fall and spring term are considered to have withdrawn; their Graduate School records are deactivated (see Registration Requirements on page 13).

## Postbaccalaureate Certificates

The Graduate School offers postbaccalaureate certificates that recognize graduate-level training beyond the award of the bachelor's degree. Certificates may be coupled with a master's or doctoral degree under special circumstances and with the approval of the graduate faculty in the degree-granting field. Postbaccalaureate certificates offered through the Graduate School require a minimum of 12 credits. Regular Graduate School application procedures and admission requirements apply. Refer to the list of Majors and Degrees for the fields in which postbaccalaureate certificates are offered. For specific Graduate School requirements for postbaccalaureate certificates, refer to the Graduate School Web site at <[www.grad.umn.edu/current\\_students](http://www.grad.umn.edu/current_students)>, for specific program requirements, see Degree Programs and Faculty in this catalog.

## Master's Degree

The master's degree is awarded in recognition of academic accomplishment as demonstrated by a coherent program of coursework, passing of the required examinations, and preparation of a thesis or project(s).

**Two Plans for the Master's Degree**—The Graduate School offers the master's degree under two plans: Plan A, requiring a thesis, and Plan B, which substitutes additional coursework and special projects for the thesis. For plans offered in each major, see Degree Programs and Faculty in this catalog.

**Registration Requirement for the Master's Degree**—Master's degree students are required by the Graduate School to complete at least 60 percent of the coursework for their official degree programs (excluding thesis credits) as registered University of Minnesota Graduate School students; individual major fields may require a higher percentage. With approval of the adviser, director of graduate studies in the major (and director of graduate studies in the minor, if the courses are for a designated minor), and Graduate School, transfer

coursework may make up the remaining 40 percent (maximum) of the degree coursework (see Transfer of Credits for the Master's Degree below).

Master's Plan A students must enroll for a minimum of 10 thesis credits (8777) before receiving the degree.

**Double Counting**—Students may have a maximum of 8 credits in common between two master's-level degrees.

**Transfer of Credits for the Master's Degree**—Unless otherwise specified under a student's major in Degree Programs and Faculty, the following rules apply to transfer of credits.

Master's degree students are required by the Graduate School to complete at least 60 percent of the coursework for their official degree programs (excluding thesis credits) as registered University of Minnesota Graduate School students. With approval of the adviser, director of graduate studies in the major (and director of graduate studies in the minor, if the courses are for a designated minor), and Graduate School, the transfer of up to 40 percent of the degree program coursework from any combination of the following is permitted.

1. Other recognized graduate schools;
2. University of Minnesota coursework meeting specific registration criteria (see "Registering for Graduate Credit" at <<http://onestop.umn.edu/registrar/registration/gradcredit.html>> for registration instructions);
3. Registrations through other University of Minnesota units (e.g., College of Education and Human Development, Law School) in pursuit of graduate-level degrees that were not awarded;
4. Adult special, summer session, and College of Continuing Education registrations at the University of Minnesota *before spring semester 2001*.

In all cases, official transcripts of the work must be attached to the degree program form, unless they have already been included in the student's Graduate School file.

Individual graduate programs have the option of specifying a lower percentage of coursework for transfer.

Work to be transferred must be graduate level (postbaccalaureate) and have been taught by faculty authorized to teach graduate courses. It is the student's responsibility to provide appropriate course documentation (e.g., course syllabi, faculty status information) supporting proposed transfer credits to the program.

In the case of a transfer from a non-U.S. institution, the credits must have been earned in a program judged by the Graduate School to be comparable to a graduate degree program in a graduate school of a regionally accredited institution in the United States.

*Regarding the transfer of coursework from either a U.S. or non-U.S. institution, if conditions are placed on a student's admission to exclude certain coursework from transfer to a Graduate School degree program, that coursework may not be transferred regardless of the level of the coursework or the status of the school or college in which it was earned.*

Credits are transferred by including the courses in the proposed degree program. Credits not accepted as part of a student's degree program cannot be transferred to the Graduate School transcript.

Courses taken before the awarding of a baccalaureate degree cannot be transferred.

**Time Limit for Earning the Master's Degree**—All requirements for the master's degree must be completed and the degree awarded within seven years. The seven-year period begins with the earliest coursework included on the official degree program form, *including* any transfer work. The graduate faculty in a specific program may set more stringent time requirements.

Students who are unable to complete the degree within the seven-year limit may petition the Graduate School for an extension of up to one additional year. *Extensions beyond one year are considered only in the most extraordinary circumstances.* To ensure timely consideration, petitions should be filed early in the term in which the time limit expires.

If a petition is approved, the student is notified of the expectations for progress and completion of the degree. If the petition is denied, the student is terminated from the graduate program.

Students who have been terminated under such circumstances may apply for readmission to the Graduate School; *however, readmission under these circumstances is not assured.* The faculty in the major field and the Graduate School set any readmission conditions on the student's resumption of work toward the degree, such as registering for additional coursework, retaking written examinations, completing the degree within a specified time period, or other appropriate terms.

For more information about the master's degree time limit and petitioning procedure, visit <[http://www.grad.umn.edu/current\\_students/forms/](http://www.grad.umn.edu/current_students/forms/)>.

**Official Program for the Degree**—By the time students have completed 10 credits, they must file an official degree program with the Graduate School. The degree program form is available from the Graduate School, 316 Johnston Hall or online at <[www.grad.umn.edu/forms/](http://www.grad.umn.edu/forms/)>. Students list all coursework, completed and proposed, that will be offered in fulfillment of degree requirements, including transfer work (see Transfer of Credits for the Master's Degree above). If a foreign language is required for the degree, it also is specified on the degree program form. The members of a student's final examining committee (who are the thesis reviewers for Plan A) are appointed by the dean of the Graduate School on recommendation of the faculty in the major field at the time the student's official degree program is approved.

The minimum credit requirements for the program are specified under the Plan A and Plan B sections below.

A degree program approved by the Graduate School must be on file before reviewers report, examination, or graduation forms can be released to the student.

**Changes in Approved Program**—Once approved, the degree program must be fulfilled in every detail to meet graduation requirements. Program changes should be requested by completing a Graduate School petition form. The petition form is available from the Graduate School, 316 Johnston Hall, or online at <[www.grad.umn.edu/current\\_students/forms/](http://www.grad.umn.edu/current_students/forms/)>.

**Minimum Grade Requirements**—The Graduate School requires a minimum GPA of 2.80 (on a 4.00 scale) for courses included on any official master's degree program form. Courses with grades of A, B, C (including C-), and S may be included in the official degree program, but grades of S are not calculated in the GPA. Students pursuing a Plan A master's degree are required to register for thesis credits (8777); these

registrations are not graded and therefore cannot be used to meet course credit requirements. *At least two-thirds of the program form must be taken A-F.*

Individual major fields have the option of setting higher grade requirements and specifying more stringent requirements regarding the application of S-N courses to a degree program; students should be familiar with any special requirements in their major field.

**Language Requirement**—See Degree Programs and Faculty to determine the language requirement, if any, for a specific major field. The Graduate School monitors the fulfillment of language study when a major field requires a language. Information on how to demonstrate proficiency, and on conditions under which proficiency is recorded on the official transcript, is available from the Graduate School, 316 Johnston Hall, or online at [www.grad.umn.edu/forms](http://www.grad.umn.edu/forms).

**More Information**—Students who have questions about the master's degree after reading this entire section (including the following on Plan A and Plan B) may review online information at [www.grad.umn.edu/current\\_students](http://www.grad.umn.edu/current_students) or contact the Graduate School by e-mail ([gsmast@umn.edu](mailto:gsmast@umn.edu)). *Note:* Some commonly used forms are available on the Graduate School Web site at [www.grad.umn.edu/forms](http://www.grad.umn.edu/forms).

### Plan A: Master's Degree With Thesis

**Minimum Credit Requirements**—Students must complete an approved program of coursework consisting of a minimum of 14 credits in the major field and a minimum of 6 credits in one or more related fields outside the major. All credits included on the official degree program form must be in graduate-level courses. A 2.80 minimum GPA must be maintained for all courses on the program form. Students must also register for a minimum of 10 master's thesis credits (8777); these registrations are not graded and therefore cannot be used to meet course credit requirements.

Students who wish to complete a designated minor (which is certified on the transcript—unlike the related fields option, which is not) must complete 6 or more credits in a single field. A designated minor must be approved by the director of graduate studies in the minor field. Minors generally are declared when the degree program form is filed, but must be declared prior to the final examination.

For majors in clinical branches, the minor or related fields must be in nonclinical fields that will serve as a basis for the proposed clinical specialization. This fundamental work should be taken early in the program. Familiarity with those phases of the nonclinical disciplines essential to proficiency in the major specialty is required.

**Thesis Credits**—Students must enroll for a minimum of 10 master's thesis credits (8777) before receiving the degree. Students cannot include thesis credits in the total program credits when determining maximum transfer allowed (see Transfer of Credits for the Master's Degree on page 15). They also cannot transfer thesis credits from other graduate institutions, double-count thesis credits between two master's degrees, or use thesis credits to meet the minimum major and related field coursework requirements for the degree.

### Master's Thesis

Students must demonstrate familiarity with the tools of research or scholarship in their major field, the ability to work independently, and the ability to present the results of their investigation effectively, by completing a master's thesis.

**Language of the Thesis**—Theses must normally be written in English or in the language of instruction. *If a thesis is to be written in a foreign language, including a language of instruction other than English, a letter should be attached to the degree program form when it is submitted to the Graduate School.* This letter should confirm that the recommended thesis reviewers (including the outside reviewer) are qualified to read, comprehend, and criticize a thesis in the foreign language.

**Published Work Included in or in Lieu of the Thesis**—The thesis may include materials that students have published while University of Minnesota graduate students, provided the research was carried out under the direction of the graduate faculty and approved by the adviser for incorporation into the thesis. Such publication is welcomed as the best demonstration of quality in a student's research, and the Graduate School encourages the practice. The adviser should notify the Graduate School in writing of the intention to publish part of the thesis material, but the Graduate School's approval is not required.

In cases where the thesis research is to be presented to the examining committee in the form of one or more articles that have been published, or are in a form suitable for publication, the student should contact the Graduate School, 316 Johnston Hall, for information on accommodating such a presentation to the required thesis format.

**Thesis Reviewers**—The thesis is read by the entire examining committee, which is appointed by the dean of the Graduate School on recommendation of the faculty in the major field at the time the student's official degree program is approved. This examining committee consists of at least three members: two representatives from the major field and one from the minor or a related field. Committee members cannot represent more than one field simultaneously.

*To permit faculty to allocate sufficient time to read the thesis and decide whether it is ready for defense, students must notify their adviser and other members of the final oral committee at least two weeks in advance that the thesis will be delivered on a particular date. All members of the examining committee must then have at least two weeks to read the thesis after it has been delivered.* These are minimum standards; individual programs may establish other standards for their students.

The entire committee must be unanimous in certifying that the thesis is ready for defense, as indicated by their signatures on the thesis reviewers report form. The thesis reviewers report form, part of the graduation packet, is requested online at [www.grad.umn.edu/forms](http://www.grad.umn.edu/forms). This form will be released only if the student has a degree program form approved by the Graduate School and has maintained active status (see Registration Requirements under Registration on page 13). When the signed form is returned to the Graduate School, 316 Johnston Hall, the student is provided with the final examination report form.

**Final Examinations**—Candidates for the master's degree, Plan A, must pass a final oral examination; a final written examination may also be required at the discretion of the graduate faculty in the major field. If

both a written and an oral examination are specified, the written examination must precede the oral examination. The final examinations cover the major field and the minor or related fields, and may include any work fundamental to these fields. The final oral for the master's degree is conducted as a closed examination, attended by only the student and the examining committee.

Final examinations are coordinated by the chair of the student's examining committee. All committee members must be present at the examination; *the absence of any member results in an invalid examination*. The results of the examinations are reported to the Graduate School on the final examination report form. *A majority vote of the committee, all members present and voting, is required to pass the examination*. A student who fails the examination may be terminated from the graduate program or may be allowed, on unanimous recommendation of the examining committee, to retake the examination, *providing the reexamination is conducted by the original examining committee*.

**Changes in the Examining Committee**—Substitutions on the examining committee may be necessitated by such circumstances as a faculty member's temporary absence on leave from the University. The adviser or the director of graduate studies must request the Graduate School's approval of such substitutions well in advance of the examination. *Substitutions for an oral examination that are necessitated by emergency situations must also be approved in advance. In such cases, the adviser should consult with the Graduate School staff by telephone before the start of the examination.*

**Preparation and Submission of the Thesis**—Two copies of the thesis must be submitted to the Graduate School. *The student's adviser(s) must sign both copies of the thesis to confirm that they are complete and satisfactory in all respects and that all revisions required by the final examining committee have been made.* Instructions for the preparation of the thesis, including format specifications and adviser's signature requirements, should be obtained from the Graduate School, 316 Johnston Hall, or online at [www.grad.umn.edu/forms](http://www.grad.umn.edu/forms).

## Plan B: Master's Degree Without Thesis

**Minimum Credit Requirements**—Students must complete an approved program of coursework consisting of a minimum of 14 credits in the major field and a minimum of 6 credits in one or more related fields outside the major. The balance of credits to be completed to meet the 30-credit minimum requirement for the degree is chosen by agreement between the adviser and the student, subject to whatever restrictions the graduate faculty in the major field may place on that choice. All credits included in the official degree program must be in graduate-level courses. A 2.80 minimum GPA must be maintained for all courses included in the program.

Students who wish to complete a designated minor (which is certified on the transcript—unlike the related fields option, which is not) must complete 6 or more credits in a single field. A designated minor must be approved by the director of graduate studies in the minor field.

**Plan B Project(s)**—Students must demonstrate familiarity with the tools of research or scholarship in their major field, the ability to work independently, and the ability to present the results of their investigation

effectively, by completing at least one Plan B project. The graduate faculty in each major field may require as many as three such projects.

The Plan B project(s) should involve a combined total of approximately 120 hours (the equivalent of three full-time weeks) of work. The graduate faculty in each major field specifies both the nature and extent of the options available to satisfy this requirement, and whether the requirement is to be satisfied in conjunction with or independent of the courses in the student's program.

**Final Examinations**—The Graduate School requires a final examination for Plan B candidates; this may be written, oral, or both, at the discretion of the graduate faculty in the major field. The final examinations cover the major field and the minor or related fields, and may include any work fundamental to these fields. Students should make the Plan B project(s) available to the examining committee for its review well in advance of the final examination. If a final oral examination is held, it is conducted as a closed examination, attended by only the student and the examining committee. All committee members must be present at the oral examination; *the absence of any member results in an invalid examination*.

A committee of at least three examiners is appointed by the dean of the Graduate School upon recommendation of the faculty in the major field at the time the official degree program is approved. This committee consists of two representatives from the major field and one from the minor or a related field. Committee members cannot represent more than one field simultaneously. The examination is coordinated by the chair of the student's examining committee. The results of the examination are reported on a form the student must obtain from the Graduate School, 316 Johnston Hall, or by requesting a graduation packet online at [www.grad.umn.edu/forms](http://www.grad.umn.edu/forms) before the examination is held. This form will be released only if the student has a degree program form approved by the Graduate School and has maintained active status (see Registration Requirements under Registration on page 13). *A majority vote of the committee, all members present and voting, is required to pass the examination*. A student who fails the examination may be terminated from the graduate program or may be allowed, on unanimous recommendation of the examining committee, to retake the examination, *providing the reexamination is conducted by the original examining committee*.

**Changes in the Examining Committee**—Substitutions on the examining committee may be necessitated by such circumstances as a faculty member's temporary absence on leave from the University. The adviser or the director of graduate studies must request the Graduate School's approval of such substitutions well in advance of the examination. *Substitutions for an oral examination that are necessitated by emergency situations must also be approved in advance. In such cases, the adviser should consult with the Graduate School staff by telephone before the start of the examination.*

**More Information**—Students who have questions about the master's degree may review online information at [www.grad.umn.edu/current\\_students](http://www.grad.umn.edu/current_students) or contact the Graduate School by e-mail ([gsmast@umn.edu](mailto:gsmast@umn.edu)). *Note:* Some commonly used forms are available on the Graduate School Web site at [www.grad.umn.edu/forms](http://www.grad.umn.edu/forms).

**Graduate students must file an official degree program. Forms are available from the Graduate School, 316 Johnston Hall.**

## Professional Master's Degree in Engineering

A number of engineering departments offer programs, with emphasis on design methods, leading to a designated professional master's degree in engineering. The design emphasis of the program is on applications rather than development of engineering methods or material behavior, and on application of knowledge and methods of the physical and social sciences as well as of engineering. The programs are primarily for students who have already earned a bachelor's degree in a related engineering field. Students normally are expected to be recent graduates of bachelor of science in engineering programs accredited by the Engineers' Council for Professional Development (ECPD). Full-time students should be able to complete a program in one calendar year. The professional master's degree in engineering is considered a terminal degree. Students should also note that only under exceptional circumstances will the Graduate School and the participating programs permit students to transfer from this program to a M.S. program.

**Fields in Which the Program is Offered**—Refer to the appropriate engineering department sections under Degree Programs and Faculty for information about the fields in which the professional master of engineering program is offered.

Regular Graduate School application procedures should be followed. Applicants should designate the master of engineering as their degree objective, to distinguish it from the master of science degree also available in the engineering fields.

**Two Options for the Professional Master's Degree in Engineering**—The Graduate School offers the professional master's degree in engineering with two options depending on the major field: a design project option and a coursework only option.

**Design Project Option**—This option requires 14 credits in the major field, a minimum of 6 credits in one or more related fields outside the major, and a design project measured as a minimum of 10 (8777) credits. Students who wish to complete a designated minor must complete 6 or more credits in a single field. The design project emphasizes problem solving based on engineering design criteria extant in industry. Performance of professional caliber is expected which can be subjected to the scrutiny and critique of senior design engineers in industry as well as engineering faculty.

**Coursework Only Option**—This option requires a minimum of 30 semester credits distributed to include 14 credits in the major field, a minimum of 6 credits in one or more related fields outside the major, and the remaining credits to be determined by the student and adviser subject to whatever guidelines the graduate faculty in the major field may place on such elective choices. Students who wish to complete a designated minor must complete 6 or more semester credits in a single field. No projects or papers specific to this track are required.

For information regarding degree completion requirements, which includes the submission of a final examination report form for both the design project and coursework only options, the student may contact the Graduate School by e-mail at [gsmast@umn.edu](mailto:gsmast@umn.edu).

## Master of Fine Arts

Admission to master of fine arts programs is limited to students with the bachelor's degree or its equivalent from an accredited university or college who demonstrate exceptional promise as creative artists in one or more of the subfields in their major area. For a list of the subfields and for specific program requirements, see Art; Creative Writing; Design, Housing, and Apparel; and Theatre Arts under Degree Programs and Faculty.

## Specialist Certificate in Education

The Graduate School offers two-year specialist certificates in several education fields (see Educational Policy and Administration, Educational Psychology—Counseling/Personnel, Educational Psychology—School Psychology, and Educational Psychology—Special Education under Degree Programs and Faculty for descriptions). The specialist certificate requires a minimum of 60 credits.

**Transfer of Credits**—With approval of the adviser, director of graduate studies in the major, and Graduate School, transfer of up to 50 percent of the degree program coursework from any combination of the following is permitted.

1. Other recognized graduate schools;
2. University of Minnesota coursework meeting specific registration criteria (see "Registering for Graduate Credit" at <http://onestop.umn.edu/registrar/registration/gradcredit.html> for registration instructions);
3. Registration through other University of Minnesota units (e.g., College of Education, Law School) in pursuit of graduate-level degrees;
4. Adult special, summer session, and College of Continuing Education registrations at the University of Minnesota *before spring semester 2001*.

Individual graduate programs have the option of specifying a lower percentage of coursework for transfer.

Work to be transferred must be graduate level (postbaccalaureate) and have been taught by faculty authorized to teach graduate courses. It is the student's responsibility to provide appropriate course documentation (e.g., course syllabi, faculty status information) supporting proposed transfer credits to the program.

In the case of a transfer from a non-U.S. institution, the credits must have been earned in a program judged by the Graduate School to be comparable to a graduate degree program in a graduate school of a regionally accredited institution in the United States.

*Regarding the transfer of coursework from either a U.S. or non-U.S. institution, if conditions are placed on a student's admission to exclude certain coursework from transfer to a Graduate School degree program, that coursework may not be transferred regardless of the level of the coursework or the status of the school or college in which it was earned.*

Credits are transferred by including the courses in the proposed degree program. Credits not accepted as part of a student's degree program cannot be transferred.

*Courses taken before the awarding of a baccalaureate degree cannot be transferred.*

**Degree Requirements**—Students pursuing the specialist certificate ordinarily complete the requirements for the master's degree with a major in the field of the specialty as the first year of the program. All first-year students must meet regular admission, candidacy, and examination requirements for the master of arts degree and should specify as their degree objective the master's degree on the application. A decision regarding continuation beyond the master's degree in a specialist program depends on an evaluation of performance in meeting the master's requirements.

**Time Limit for Earning the Specialist Certificate**—The specialist certificate can be completed in two years but must be completed and awarded in 12 years. The 12-year period begins with the earliest coursework included on the program form, including any transfer work. Graduate credits earned before the 12-year span are evaluated by the faculty in the area of specialization and may be recommended to the Graduate School for acceptance on a full or partial basis. Students who expect to exceed the 12-year limit may petition the Graduate School for an extension of time; contact the Graduate School, 316 Johnston or see [www.grad.umn.edu/current\\_students](http://www.grad.umn.edu/current_students) for more information.

**Final Examinations**—The Graduate School requires a final examination for specialist certificate candidates; this may be written, oral, or both, at the discretion of the graduate faculty in the major field. A committee of at least four examiners is appointed by the dean of the Graduate School upon recommendation of the faculty in the major field at the time the official degree program is approved. This committee must include two members from the student's major field and two members from outside the major field. Committee members cannot represent more than one field simultaneously.

The examination is coordinated by the chair of the student's examining committee. The results of the examination are reported on the final examination form that the student must obtain from the Graduate School, 316 Johnston, or by requesting a graduation packet online at [www.grad.umn.edu/forms](http://www.grad.umn.edu/forms) before the examination is held. This form will be released only if the student has a degree program form approved by the Graduate School and has maintained active status (see Registration Requirements under Registration on page 13). A majority vote of the committee, all members present and voting, is required to pass the examination. A student who fails the examination may be terminated from the graduate program or may be allowed, on unanimous recommendation of the examining committee, to retake the examination *providing the reexamination is conducted by the original committee.*

Except as noted in this section, the requirements and procedures for completing the specialist certificate are comparable to those described under Plan B: Master's Degree Without Thesis on page 17.

A degree program approved by the Graduate School must be on file before the examination or graduation forms can be released to the student.

**More Information**—Students who have questions about the specialist certificate after reading this entire section may review online information at [www.grad.umn.edu/current\\_students](http://www.grad.umn.edu/current_students) or e-mail [gsmast@umn.edu](mailto:gsmast@umn.edu). *Note:* some commonly used forms are available on the Graduate School Web site at [www.grad.umn.edu/forms](http://www.grad.umn.edu/forms).

## Doctor of Philosophy Degree

The doctor of philosophy degree is awarded chiefly in recognition of high attainment and ability in a special subject field as demonstrated by passing the required examinations covering both a candidate's general and special subject fields, and by preparing and successfully defending a thesis based on original research that makes a significant contribution to knowledge in the student's field.

**Registration Requirement for the Doctoral Degree**—Doctoral students are generally required to register for major field and minor or supporting program coursework. Students should consult their graduate program to determine whether coursework completed while pursuing a University of Minnesota master's degree may be used to meet their doctoral coursework requirement.

Doctoral students are required to enroll for a minimum of 24 thesis credits (8888) while writing the doctoral thesis. Students may not register for thesis credits until the semester *after* they have passed their preliminary oral examination.

**Doctoral Pre-Thesis Credits (8666)**—These credits are available for doctoral students who have not yet passed their preliminary oral examination but need to be registered in the Graduate School to meet requirements of agencies or departments outside the Graduate School (e.g., loan agencies). Doctoral pre-thesis credits are not graded. *Note:* Registration for doctoral pre-thesis credits cannot be used to meet any Graduate School degree requirements other than to maintain active status (refer to Registration Requirements).

**Transfer of Credits for the Doctoral Degree**—Students may request from the Graduate School the transfer of the following types of course credits by including the courses on the proposed degree program form. In all cases, official transcripts of the graded work must be attached to the degree program form, unless they have already been included in the student's Graduate School file. Transfer of graduate credit is not allowed for courses taken before the awarding of a baccalaureate degree.

*From other graduate institutions*—Graduate credits earned at other recognized graduate institutions may be applied to doctoral degrees if the coursework is graduate level and was taught by faculty authorized to teach graduate courses. The number of credits accepted for transfer is determined by the graduate program faculty.

*From other University of Minnesota graduate-level degrees*—Graduate credits earned while admitted to pursue University of Minnesota graduate-level degrees (offered by a unit other than the Graduate School) may be applied to doctoral degrees. The number of graduate credits accepted for transfer is determined by the graduate program faculty.

In the case of a transfer from a non-U.S. institution, the credits must have been earned in a program judged by the Graduate School to be comparable to a graduate degree program of a regionally accredited institution in the United States.

*In the case of a transfer from either a U.S. or non-U.S. institution, if conditions are placed on a student's admission to exclude certain coursework from transfer to a Graduate School degree program, that coursework may not be transferred regardless of the level of the coursework or the status of the school or college in which it was earned.*

*From other registration categories—A maximum of 12 semester credits of completed graduate-level coursework, in any combination of the specific registration categories listed below, may be considered for transfer.*

*Registration for graduate credit by non-admitted students—Students may be able to register for graduate credit when not admitted to a graduate program. Non-admitted students interested in taking graduate-level courses must work with the respective departments (generally the director of graduate studies or his/her designee) to gain admission to non-degree status. The registration procedure outlined in the current Class Schedule, “Registering for Graduate Credit,” must be followed for courses to be considered for transfer by the Graduate School.*

*Adult special, summer session, and College of Continuing Education (CCE) registrations taken prior to spring semester 2001—The Graduate School will accept only adult special, summer session, and CCE coursework taken at the University of Minnesota before spring semester 2001. Any registration in these categories taken spring semester 2001 or later will not be accepted towards any Graduate School degree requirements.*

**Time Limit for Earning the Doctoral Degree—**All requirements for the doctoral degree must be completed and the degree awarded within five calendar years after passing the preliminary oral examination (see Preliminary Written and Oral Examinations on page 21).

Students who are unable to complete the degree within the five-year limit may petition the Graduate School for an extension of up to one additional year. *Extensions beyond one year are considered only in the most extraordinary circumstances.* To ensure timely consideration, petitions should be filed no later than early in the term in which the time limit expires.

If the petition is approved, the student is notified of the expectations for progress and completion of the degree. If the petition is denied, the student is terminated from doctoral candidacy and from the graduate program.

Students who have been terminated under such circumstances may apply for readmission to the Graduate School; *readmission under these circumstances is not assured, however.* The faculty in the major field and the Graduate School set any readmission conditions on the student’s resumption of work toward the degree, such as registering for additional coursework, retaking written examinations, filing a revised thesis proposal, completing the degree within a specified time period, or other appropriate terms.

For more information about the doctoral degree time limit and petitioning procedure, visit [www.grad.umn.edu/current\\_students/forms/](http://www.grad.umn.edu/current_students/forms/).

**Official Program for the Degree—**Students are expected to file an official program for the degree during their second year of study; the specific semester depends on individual major field requirements. Students should submit their completed degree program forms to the Graduate School at least one semester before the term in which they plan to take the preliminary oral examination. The degree program form is available from the Graduate School, 316 Johnston Hall, or online at [www.grad.umn.edu/forms/](http://www.grad.umn.edu/forms/). The form should list all coursework, completed and proposed, that will be offered in fulfillment of degree requirements in the major field and in the minor field or supporting program, including any transfer work (see Transfer of

Credits for the Doctoral Degree on page 19). If the student’s major field requires proficiency in one or more foreign languages, these should be specified as well. The members of a student’s preliminary oral examining committee are appointed by the dean of the Graduate School on recommendation of the faculty in the major field at the time the student’s official degree program is approved.

A degree program approved by the Graduate School must be on file before the student is permitted to schedule the preliminary oral examination.

**Changes in Approved Program—**Once approved, the program must be fulfilled in every detail to meet graduation requirements and before the final oral examination can be scheduled. Program changes should be requested by completing a Graduate School petition form. The petition form is available from the Graduate School or online at [www.grad.umn.edu/forms/](http://www.grad.umn.edu/forms/).

**Minimum Grade Requirements—**The Graduate School does not define a minimum GPA for courses included on an official doctoral degree program form, although individual programs are free to do so as part of their effort to monitor their students’ academic achievement and degree progress. Courses with grades of A, B, C (including C-), and S may be included in the official degree program, but grades of S are not calculated in the GPA. Students pursuing a doctoral degree must register for doctoral thesis credits (8888); these registrations are not graded and therefore cannot be used to meet course credit requirements. *At least two-thirds of the total number of course credits included in any degree program must be taken A-F.* Individual major fields have the option of specifying more stringent requirements concerning the application of S-N courses to a degree program.

**Major Field Credits—**The Graduate School does not specify a minimum number of credits in the major field for the doctoral degree. Depending on previous preparation and the nature of the research undertaken, the number of credits required for individual students, even within the same major field, may vary considerably.

**Minor Field or Supporting Program Work—**For the doctoral degree, a minimum of 12 credits must be completed in the minor field or supporting program. With a traditional minor, this work is in a single field related to the major; *the minor field must be declared before the student passes the preliminary oral examination.* If the student chooses a supporting program, it must be composed of a coherent pattern of courses, possibly embracing several disciplines. Both the minor and supporting program options may require students to take written preliminary examinations in the fields included, but students electing the supporting program option are not expected to have competency in each of the fields comparable to that of a person with a traditional minor.

*For majors in clinical branches, the minor field or supporting program must be in nonclinical fields that will serve as a basis for the proposed clinical specialization. This fundamental work should be concentrated early in the program. Familiarity with those phases of the nonclinical disciplines essential to proficiency in the major specialty is required.*

**Language Requirement—**See Degree Programs and Faculty to determine the language requirement, if any, for a specific major field. The Graduate School monitors the fulfillment of language study when a major field requires a language. Information on how to demonstrate

proficiency, and on conditions under which proficiency is recorded on the official transcript, is available from the Graduate School, 316 Johnston Hall, or online at [www.grad.umn.edu/forms](http://www.grad.umn.edu/forms).

**Official Doctoral Candidacy**—Doctoral candidacy is established when a student passes the preliminary oral examination (including “pass with reservations”).

**More Information**—Students who have questions about the doctoral degree, including information on examinations and the thesis, may review online information at [www.grad.umn.edu/current\\_students](http://www.grad.umn.edu/current_students) or contact the Graduate School by e-mail at [gsdoc@umn.edu](mailto:gsdoc@umn.edu). *Note:* Some commonly used forms are available on the Graduate School Web site at [www.grad.umn.edu/forms](http://www.grad.umn.edu/forms).

## Preliminary Written and Oral Examinations

**Preliminary Written Examination**—All doctoral students are required to pass a written examination in the major field. This examination covers all work completed in the major field and may include any work fundamental to this field. The results of the examination are reported on the preliminary written examination report form, signed by the student’s adviser and the director of graduate studies in the major field. It is the student’s responsibility to ensure that this form is received by the Graduate School, 316 Johnston Hall, before scheduling the preliminary oral examination.

**Preliminary Oral Examination**—Students take the preliminary oral examination after completing a substantial part of the coursework and passing the preliminary written examination, but before writing the dissertation.

**Preliminary Oral Examining Committee**—The examination is administered by the committee appointed by the dean of the Graduate School on recommendation of the faculty in the major field at the time the student’s official doctoral degree program is approved. The examining committee includes a minimum of four members: three (including the student’s adviser) from the major field and one from the minor field or supporting program. Committee members cannot represent more than one field simultaneously.

All assigned members must be present at the preliminary oral examination; *the absence of any member results in an invalid examination.*

**Changes in the Preliminary Oral Examining Committee**—Substitutions on the examining committee may be necessitated by such circumstances as a faculty member’s temporary absence on leave from the University. The adviser or the director of graduate studies must request the Graduate School’s approval of such substitutions well in advance of the examination. *Substitutions necessitated by emergency situations must also be approved in advance. In such cases, the adviser should consult with the Graduate School staff by telephone before the start of the examination.*

**Scheduling the Preliminary Oral Examination**—It is the responsibility of the student to schedule the preliminary oral with the examiners and with the Graduate School, 316 Johnston Hall, *at least one week in advance*. In certain of the health science fields, however, the faculty requires 30 days’ notice of the date of the preliminary oral.

Preliminary oral examinations should not be scheduled during the summer unless the members of the assigned committee can be assembled without substitution.

Before the oral examination can be scheduled, a degree program form approved by the Graduate School must be on file, along with a written examination report form indicating that the student has passed the preliminary written examination. The Graduate School must also confirm that the student has maintained active status (see Registration Requirements under Registration on page 13).

If these documents are on file and the student has active status, the Graduate School issues the preliminary oral examination report form and instructions for conducting the preliminary oral examination to the chair of the examining committee. A copy of the student’s degree program form is also sent to both the chair of the examining committee and the student; this may be useful to the committee in reviewing the student’s preparation and in confirming the completion of degree requirements, including coursework and any language requirements. The preliminary oral examination may be authorized in spite of deficiencies in these requirements, unless more stringent standards have been established by the major field. All requirements must be completed before the final oral examination may be scheduled.

### Preliminary Oral Examination Content and Outcome

**Outcome**—All doctoral students are required to pass an oral examination in the major field. The preliminary oral examination covers the major field, the minor field or supporting program, and any work fundamental to these areas, including possible plans for thesis research.

*Unlike the final oral examination, the preliminary oral examination is conducted as a closed examination, attended by only the student and the examining committee.*

Immediately before the preliminary oral examination, the committee chair stipulates the objectives of the examination and, in consultation with other members of the examining committee, determines how the examination is to be conducted. Immediately after the examination, the candidate is excused from the room and a written secret ballot is taken before discussing the examination. Following the discussion, a second and final vote is taken, and the participants sign in the appropriate place on the report form, which is to be returned to the Graduate School, 316 Johnston Hall, *no later than the first workday after the examination.*

The outcome of the examination, with all committee members present and voting, is recorded in one of three ways: pass, pass with reservations, or fail. The voting proportions necessary for these decisions are as follows: if the committee consists of four members, a favorable verdict for passing consists of either a unanimous vote or a vote of 3-1; if the committee consists of five members, a unanimous vote or a vote of 4-1 is needed; if the committee consists of six members, a unanimous vote or a vote of 5-1 or 4-2 is needed; and if there are seven members, a unanimous vote or a vote of 6-1 or 5-2 is needed. Candidates who do not earn committee votes in these proportions *fail* the examination. If, to achieve the *minimum* number of votes to reach a verdict of pass, any vote of pass with reservations is included, then the outcome will be recorded as a *pass with reservations*. A vote to pass the student with reservations still constitutes a passing vote.

**Pass With Reservations**—If the student passes the examination with reservations, the student is informed immediately, but the committee is permitted one week in which to convey its reservations to the student in writing, informing the student of the steps that must be taken to remove them. *A copy of this letter must be sent to the Graduate School and should accompany the*

Minors can be earned in a variety of programs. Minors that are not part of a master’s or doctoral program offer even more options. See Majors and Degrees on pages 25 and 26.

*signed oral examination report form.* When the student has satisfied the committee's reservations, a second letter informing the student and the Graduate School that the reservations have been removed and that the student may proceed toward the degree is also required. Both letters should be written by the committee chair. *The final oral examination may not be scheduled until the Graduate School has received a copy of the letter indicating that the reservations have been removed.*

If the committee members disagree as to whether the reservations have been satisfactorily removed, the committee chair asks for another vote, the results of which are subject to the same voting proportions as the initial vote. If the student is unable to satisfy the committee's reservations, his or her doctoral candidacy and graduate student status may be terminated.

**Failure of the Preliminary Oral Examination—**Students who fail the examination may be excluded from candidacy for the degree or may be allowed, on unanimous recommendation of the examining committee, to retake the examination, *providing the reexamination is conducted by the original preliminary oral examining committee.*

In no case may the reexamination take place before 10 weeks have passed. No more than one reexamination is allowed.

**Recess of a Preliminary Oral Examination—**If the preliminary oral examining committee recesses without having determined whether a student has passed the examination, the chair of the committee must send a letter to the dean of the Graduate School explaining the reasons for the recess and noting the date on which the examining committee will reconvene. If the recess will be longer than one week, the examination report form must be returned to the Graduate School, 316 Johnston Hall, and the student must reschedule the examination with the Graduate School one week in advance. A new examination report form will be mailed to the chair of the committee one week before the date on which the committee will reconvene. *The reconvened committee must be composed of the same members as the original preliminary oral examining committee.*

## **Ph.D. Thesis**

The thesis must demonstrate the student's originality and ability for independent investigation, and the results of the research must constitute a contribution to knowledge. The thesis must exhibit the student's mastery of the literature of the subject and familiarity with the sources. The subject matter must be presented with a satisfactory degree of literary skill.

**Thesis Proposal—**Students must file the thesis proposal form with the Graduate School, 316 Johnston Hall, no later than the first semester after passing the preliminary oral examination. The form must include the proposed thesis title and a thesis proposal, about 250 words in length, describing the research to be undertaken and the methods to be employed in carrying it out.

*The thesis reviewers and other members of the final oral examining committee are appointed by the dean of the Graduate School upon recommendation of the faculty in the major field at the time the student's thesis proposal is approved.*

A thesis proposal approved by the Graduate School must be on file before the reviewers report form can be issued to the student.

**Changes in the Thesis Title or the Thesis Proposal—**Changes in the *wording* of the thesis title may be made without special approval, but changes cannot be made after the final thesis copy is submitted to the Graduate School. If substantive changes are made in the nature of the thesis research itself, the student must submit a revised thesis proposal to the Graduate School immediately.

**Language of the Thesis—**Theses must normally be written in English or in the language of instruction. *If a thesis is to be written in a foreign language, including a language of instruction other than English, a letter should be attached to the thesis proposal form when it is submitted to the Graduate School.* This letter should confirm that the recommended thesis reviewers (including the outside reviewer) are qualified to read, comprehend, and criticize a thesis in the foreign language.

**Published Work Included in or in Lieu of the Thesis—**The thesis may include materials that students have published while University of Minnesota graduate students, provided the research was carried out under the direction of the graduate faculty and approved by the adviser for incorporation into the thesis. Such publication is welcomed as the best demonstration of quality in a student's research, and the Graduate School encourages the practice. The adviser should notify the Graduate School in writing of the intention to publish part of the thesis material, but the Graduate School's approval is not required.

In cases where the thesis research is to be presented to the examining committee in the form of one or more articles that have been published, or are in a form suitable for publication, the student should contact the Graduate School, 316 Johnston Hall, for information on accommodating such a presentation to the required thesis format.

**Thesis Reviewers—***All members of the final oral examining committee read the thesis, although only those designated as thesis reviewers sign the report form certifying that the thesis is ready for defense.*

The designated thesis reviewers consist of the adviser, representing the major field, and at least two other members of the final oral examining committee, including at least one representative from the major field and one representative from the minor or supporting program. Part of this group of reviewers should come from outside of the graduate program's thesis advisory committee, if the program uses such a committee. Reviewers cannot represent more than one field simultaneously.

Certification of the thesis as ready for defense is a necessary step toward the final oral examination, but in no way diminishes the significance of that examination.

The thesis reviewers report form is obtained by the student from the Graduate School, 316 Johnston, or by requesting a graduation packet online at [www.grad.umn.edu/forms](http://www.grad.umn.edu/forms). This form will be released only if the student has a Graduate School-approved thesis proposal form on file and has maintained active status (see Registration Requirements under Registration on page 13).

**Delivery of the Thesis to Thesis Reviewers—**At the time the candidate submits a draft of the thesis to the thesis reviewers, copies must also be provided to all other members of the final oral examining committee. The thesis abstract must be included with the thesis when it is distributed to the committee. The abstract

must be signed by the adviser and submitted, with the final thesis copy, to the Graduate School which forwards both to University Microfilms.

*To permit faculty to allocate sufficient time to read the thesis and decide whether it is ready for defense, students must notify their adviser and other members of the final oral committee at least two weeks in advance that the thesis will be delivered on a particular date. All members of the examining committee must then have at least two weeks to read the thesis after it has been delivered.*

When signing the thesis reviewers report form, the reviewers have three options: the thesis is acceptable for defense as presented; the thesis is acceptable for defense with minor revisions; or the thesis requires major revisions and is not acceptable for defense as presented.

The reviewers must be unanimous in certifying that the thesis is ready for defense, whether as presented or with minor revisions. If this is the case, and all other requirements have been met (see Final Oral Examination below), the Graduate School authorizes the final oral examination. In any instance where revisions are required, the committee must inform the student in writing of the revisions required, and all questions concerning such revisions must be resolved before the final copies of the thesis are submitted and the degree is conferred. *It is the adviser's responsibility to ensure that revisions required by the reviewers are satisfactorily made* (see Preparation and Submission of the Copies of the Thesis on the next page).

## Final Oral Examination

All doctoral students are required to successfully defend their theses in a final oral examination and graduate within five calendar years after passing the preliminary oral examination. To be eligible for the final oral examination, a student must have completed all work on the official doctoral degree program form, including the language requirement, if any; must have passed both the written and oral preliminary examinations; must have an approved thesis proposal on file with the Graduate School; must have maintained active status; and must have satisfied the thesis credit requirement. In addition, the thesis must have been certified by the readers as ready for defense.

### Scheduling the Final Oral With the Graduate School

*The student must schedule the examination at least one week in advance with both the committee and the Graduate School (see Clearance for Graduation on the next page). In certain of the health science fields, however, the faculty requires 30 days' notice of the date of the final oral.*

When the examination is scheduled, the student's Graduate School file is checked to determine if the student can be cleared to take the examination as stipulated above. If so, the report form for the final oral examination will be forwarded to the chair of the examining committee. If difficulties are apparent, the Graduate School staff will contact the student immediately.

*A minimum of 10 weeks must intervene between the preliminary oral and the final oral examinations. Also, the final oral should not be scheduled during the summer unless the committee members can be assembled without substitution.*

**Final Oral Examining Committee**—The committee must consist minimally of four members: three (including the student's adviser) from the major field and one from the minor field or supporting program. At

least one committee member from the minor field or supporting program should represent a graduate program (and budgetary unit, if possible) other than that of the student's major. Committee members cannot represent more than one field simultaneously.

Although the student's adviser serves as a member of the final oral examining committee, another member of the committee is designated as the chair and functions in this capacity at the final oral examination. The chair must be a senior member or affiliate senior member of the graduate faculty and may be from either the major field or the minor field or supporting program. *The chair and other members of the final oral examining committee are appointed by the dean of the Graduate School upon recommendation of the faculty in the major field at the time the student's thesis proposal is approved.*

All committee members must be present at the examination; *the absence of any member results in an invalid examination.*

### Changes in the Final Oral Examining Committee

Substitutions on the examining committee may be necessitated by such circumstances as a faculty member's temporary absence on leave from the University. The adviser or the director of graduate studies must request the Graduate School's approval of such substitutions well in advance of the examination. *Substitutions necessitated by emergency situations must also be approved in advance. In such cases, the committee chair should consult with the Graduate School staff by telephone before the start of the examination.*

**Form of the Final Oral Examination**—The final oral examination consists of a seminar in which the candidate presents the thesis and to which the scholarly community is invited. The seminar may take place only after the thesis has been judged ready for defense. The examination is limited to the candidate's thesis subject and relevant areas. It will not exceed three hours. A closed meeting between the candidate and the appointed examining committee immediately follows the thesis presentation. Immediately after the examination, the candidate is excused from the room and a written, secret ballot is taken before discussing the examination. Following the discussion, a second and final vote is taken.

### Reporting the Results of the Final Oral Examination

To be recommended for the award of the doctoral degree, candidates must receive a vote with no more than one dissenting member of the total examining committee. If the student has clearly *passed* or clearly *failed* the examination and all members have signed the final examination report form, the report form must be returned to the Graduate School *no later than the first workday following the examination.*

The adviser should be responsible for ensuring the inclusion of appropriate modifications and required revisions, if any, in the final thesis. The final oral examination report form should not be signed and submitted to the Graduate School until all revisions have been made. *If the form will be held for more than one week, a letter must be sent to the Graduate School stating that the form is being held pending required revisions.*

Once the final report form has been returned to the Graduate School indicating that the student has either passed or failed the final oral examination, a hold is placed on the student's records to prevent further registration in the Graduate School. If the adviser indicates that the student needs additional time to make

minor revisions to the thesis before it is submitted to the Graduate School, the student is permitted to register for one additional semester. Once the thesis has been submitted, no further registration in the Graduate School is permitted unless the student has been admitted to professional development status or to another major field.

**Recess of a Final Oral Examination**—On rare occasions, the examining committee may conclude that the final oral examination should be recessed, to be reconvened at a later date. Guidelines for such circumstances are sent to the chair of each examining committee along with the final oral examination report form.

The Graduate School need not be notified until after the fact of informal recesses of up to a week. In the case of a longer recess, the committee must inform the student *in writing* of the reasons for recessing the examination, including any deficiencies noted in the student's thesis or defense, and must indicate when they expect to reconvene and resume the examination. A copy of this letter must be sent to the Graduate School, along with the unsigned final examination report form. When the student and the committee are ready to reconvene the examination, it should be scheduled in the normal way with the Graduate School. A new examination report form will be mailed to the chair of the committee one week before the date on which the committee will reconvene. *The reconvened committee must be composed of the same members as the original final oral examining committee.*

### Preparation and Submission of the Copies of the Thesis

A copy of the thesis must be submitted to the Graduate School. *The student's adviser(s) must sign the thesis to confirm that it is complete and satisfactory in all respects and that all revisions required by the final examining committee have been made.* Instructions for the preparation of the thesis, including format specifications and adviser's signature requirements, can be obtained from the Graduate School, 316 Johnston Hall, or online at <[www.grad.umn.edu/forms](http://www.grad.umn.edu/forms)>.

### Pursuit of a Second Ph.D. Degree

Students are not permitted to earn two Ph.D. degrees at the same time in two fields using the same program of study and thesis. Although students are generally discouraged from doing so, special circumstances may warrant taking a second Ph.D. degree at a later date, but only when a completely separate program and thesis are involved.

## Doctor of Education

The University of Minnesota awards the doctor of education (Ed.D.), its highest professional degree in educational policy and administration and work, community, and family education, in recognition of satisfactory academic preparation and demonstrated competence for professional activity in those fields.

Standards and procedures for admission, and expectations for scholastic performance, are comparable to those for the Ph.D. A major part of the program must be conducted in full-time residence, including at least one continuous academic year at advanced stages of the program. Rules and procedures governing examinations, candidacy, time limits, appointment of committees, and the thesis for the Ph.D. apply in general to the Ed.D.

For requirements, see Doctor of Philosophy Degree on page 19, or contact the Graduate School by e-mail at [gsdoc@umn.edu](mailto:gsdoc@umn.edu). *Note:* Some commonly used forms are available on the Graduate School Web site at <[www.grad.umn.edu/forms](http://www.grad.umn.edu/forms)>.

## Doctor of Musical Arts

The program for the professional doctor of musical arts (D.M.A.) degree has a performance-teaching orientation. Standards and procedures for admission, and expectations for scholastic performance, are comparable to those for the Ph.D. Emphases offered, and details concerning major and minor requirements for the D.M.A., are included in the Music section under Degree Programs and Faculty. Rules and procedures governing examinations, candidacy, time limits, and appointment of committees for the Ph.D. apply in general to the D.M.A.; in place of the thesis, a project document or paper is required. This document is submitted only to the music graduate program office.

For requirements, see Doctor of Philosophy Degree on page 19, or contact the Graduate School by e-mail at [gsdoc@umn.edu](mailto:gsdoc@umn.edu). *Note:* Some commonly used forms are available on the Graduate School Web site at <[www.grad.umn.edu/forms](http://www.grad.umn.edu/forms)>.

## Joint Degrees

The University offers the opportunity for study toward degrees in the following areas: M.D./Ph.D. program; M.D. and master of health informatics (M.H.I.); master of social work (M.S.W.) and master of public policy (M.P.P.); M.S.W. and master of public health (M.P.H.); M.P.P. and master of science (M.S.) in health services research, policy, and administration; J.D. and M.P.P.; M.P.P. and Ph.D. in political science; M.S. in nursing and M.P.H.; doctor of veterinary medicine (D.V.M.) and M.S./Ph.D. in veterinary medicine; M.S.W. and master of urban and regional planning (M.U.R.P.); M.U.R.P. and master of landscape architecture (M.L.A.); M.U.R.P. and M.S. in civil engineering; and a joint J.D./M.S./Ph.D. program in law, health, and life sciences. For further information, contact the program.

## Clearance for Graduation

Degrees are awarded at the end of each month. To qualify for graduation for a particular month, a student must submit the Application for Degree form on or before the first workday of that month and must complete the examination and all other requirements (including necessary forms and fees) by the last workday of that month.

## Commencement Ceremony

Two Graduate School commencement ceremonies are held each year—in *late spring* and in *late fall*. Graduates are encouraged, but not required, to attend. To make sure their names appear in the program distributed at the commencement ceremony, students must submit the commencement attendance form by the deadline specified at <[http://onestop.umn.edu/registrar/registration/special\\_grad.html](http://onestop.umn.edu/registrar/registration/special_grad.html)>. Commencement information, including deadlines and forms, can be found online at <[www.grad.umn.edu/current\\_students](http://www.grad.umn.edu/current_students)>.

# Majors and Degrees

## Twin Cities Campus

### Research Degrees (Ph.D., M.A., M.S.)

<b>Majors</b>	<b>Degrees Offered</b>	
Aerospace Engineering	M.S.Aero.E., Ph.D.	Industrial Engineering
Agricultural and Applied Economics	M.S., Ph.D.	Interdisciplinary Archaeological Studies
American Studies	M.A., Ph.D.	Japanese
Animal Sciences	M.S., Ph.D.	Kinesiology
Anthropology	M.A., Ph.D.	Linguistics
Applied Plant Sciences	M.S., Ph.D.	Mass Communication
Art History	M.A., Ph.D.	Materials Science and Engineering
Astrophysics	M.S., Ph.D.	Mathematics
Biochemistry, Molecular Biology, and Biophysics	M.S., Ph.D.	Mechanical Engineering
Biomedical Engineering	M.S., Ph.D.	Mechanics
Biomedical Science	Ph.D.	Medicinal Chemistry
Biophysical Sciences and Medical Physics	M.S., Ph.D.	Microbiology, Immunology, and Cancer Biology
Biostatistics	M.S., Ph.D.	Molecular, Cellular, Developmental Biology and Genetics
Biosystems and Agricultural Engineering	M.S.B.A.E., Ph.D.	Molecular Veterinary Biosciences
Business Administration	Ph.D.	Music
Cellular and Integrative Physiology	M.S., Ph.D.	Natural Resources Science and Management
Chemical Engineering	M.S.Ch.E., Ph.D.	Neuroscience
Chemical Physics	M.S., Ph.D.	Nursing
Chemistry	M.S., Ph.D.	Nutrition
Child Psychology	M.A., Ph.D.	Oral Biology
Chinese	M.A., Ph.D.	Otolaryngology
Civil Engineering	M.S., Ph.D.	Pharmaceutics
Classical and Near Eastern Studies	M.A., Ph.D.	Pharmacology
Communication Disorders	M.A., Ph.D.	Philosophy
Communication Studies	M.A., Ph.D.	Physics
Comparative Literature	M.A., Ph.D.	Plant Biological Sciences
Comparative Studies in Discourse and Society	M.A., Ph.D.	Plant Pathology
Computer and Information Sciences	M.S., Ph.D.	Political Science
Conservation Biology	M.S., Ph.D.	Psychology
Control Science and Dynamical Systems	Ph.D.	Rehabilitation Science
Design, Housing, and Apparel	M.A., M.S., Ph.D.	Rhetoric and Scientific and Technical Communication
Ecology, Evolution, and Behavior	M.S., Ph.D.	Scientific Computation
Economics	M.A., Ph.D.	Social, Administrative, and Clinical Pharmacy
Education	M.A., Ph.D.	Social Work
Education, Curriculum, and Instruction	M.A., Ph.D.	Sociology
Educational Policy and Administration	M.A., Ph.D.	Soil Science
Educational Psychology <sup>1</sup>	M.A., Ph.D.	South Asian Languages
Electrical Engineering	M.S.E.E., Ph.D.	Statistics
English	M.A., Ph.D.	Surgery
Entomology	M.S., Ph.D.	Theatre Arts
Environmental Health	M.S., Ph.D.	Toxicology
Epidemiology	M.S., Ph.D.	Veterinary Medicine
Family Social Science	M.A., Ph.D.	Water Resources Science
Feminist Studies	M.A., Ph.D.	Wildlife Conservation
Food Science	M.S., Ph.D.	
French	M.A., Ph.D.	
Geography	M.A., Ph.D.	
Geological Engineering	M.S., Ph.D.	
Geology	M.S., Ph.D.	
Geophysics	M.S., Ph.D.	
Germanic Studies	M.A., Ph.D.	
Health Informatics	M.S., Ph.D.	
Health Services Research, Policy, and Administration	M.S., Ph.D.	
Hispanic and Luso-Brazilian Literatures and Linguistics	Ph.D.	
History	M.A., Ph.D.	
History of Medicine and Biological Sciences	M.A., Ph.D.	
History of Science and Technology	M.A., Ph.D.	
Human Resources and Industrial Relations	M.A., Ph.D.	

### Research Degrees (Master's Only)

<b>Majors</b>	<b>Degrees Offered</b>
Arabic	M.A.
Clinical Laboratory Science	M.S.
Clinical Research	M.S.
Computer Engineering	M.S.
Dentistry	M.S.
East Asian Studies	M.A.
English as a Second Language	M.A.
Hispanic Linguistics	M.A.
Hispanic Literature	M.A.
Italian	M.A.
Landscape Architecture	M.S.
Luso-Brazilian Literature	M.A.
Microbial Engineering	M.S.
Music Education	M.A.
Recreation, Park, and Leisure Studies	M.A.
Russian Area Studies	M.A.

<sup>1</sup> See also Certificate of Specialist in Education offerings near the end of this list.

## Professional Degrees

### Majors

Aerospace Engineering  
 Architecture  
 Art  
 Biological Science  
 Biosystems and Agricultural Engineering  
 Business Taxation  
 Chemical Engineering  
 Civil Engineering  
 Computer and Information Sciences  
 Computer Engineering  
 Creative Writing  
 Dentistry  
 Design, Housing, and Apparel  
 Educational Policy and Administration  
 Electrical Engineering  
 English as a Second Language  
 Experimental Surgery  
 Forestry  
 Geographic Information Science  
 Geological Engineering  
 Geology  
 Health Informatics  
 Health Journalism  
 Human Resources and Industrial Relations  
 Infrastructure Systems Engineering  
 Landscape Architecture  
 Liberal Studies  
 Management of Technology  
 Manufacturing Systems Engineering  
 Materials Science and Engineering  
 Molecular, Cellular, Developmental Biology and Genetics  
 Music  
 Occupational Therapy  
 Physical Therapy  
 Political Science  
 Public Affairs  
 Public Policy  
 Science, Technology, and Environmental Policy  
 Scientific and Technical Communication  
 Social Work  
 Software Engineering  
 Theatre Arts  
 Urban and Regional Planning  
 Work, Community, and Family Education

### Degrees Offered

M.Aero.E.  
 M.Arch.  
 M.F.A.  
 M.B.S.  
 M.B.A.E.  
  
 M.B.T.  
 M.Ch.E.  
 M.C.E.  
 M.C.I.S.  
 M.Comp.E.  
 M.F.A.  
 M.S.  
 M.F.A.  
 Ed.D.  
 M.E.E.  
 M.A.  
 M.S.Exp.Surg.  
 M.F.  
 M.G.I.S.  
 M.Geo.E.  
 M.S.  
 M.H.I.  
 M.A.  
 M.A.  
  
 M.S.I.S.E.  
 M.L.A.  
 M.L.S.  
 M.S.MOT.  
 M.S.M.S.E.  
 M.Mat.S.E.  
 M.S.  
  
 M.M., D.M.A.  
 M.S.  
 D.P.T.  
 M.A.  
 M.P.A.  
 M.P.P.  
 M.S.  
  
 M.S.  
 M.S.W.  
 M.S.S.E.  
 M.F.A.  
 M.U.R.P.  
 Ed.D.

## Certificate of Specialist in Education

Counseling  
 General Educational Administration  
 School Psychological Services  
 Special Education  
 Special Education Administration

### Minor Only

Bioethics  
 Bioinformatics  
 Cognitive Science  
 Complementary Therapies and Healing Practices  
 Conflict Management  
 Development Studies and Social Change  
 Gerontology  
 Human Factors/Ergonomics  
 Human Rights  
 International Education  
 Interpersonal Relationships Research  
 Law  
 Literacy and Rhetorical Studies  
 Medieval Studies  
 Microbial Ecology  
 Museum Studies  
 Nanoparticle Science and Engineering  
 Political Psychology  
 Program Evaluation  
 Public Health  
 Quaternary Paleoecology  
 Religious Studies  
 Social and Philosophic Studies of Education  
 Studies in Africa and the African Diaspora  
 Studies of Science and Technology  
 Sustainable Agriculture Systems

### Postbaccalaureate Certificates

Addictions Studies  
 Applied Developmental Psychology  
 Housing Studies  
 Nursing  
 Policy Issues on Work and Pay  
 Transportation Studies

## Duluth Campus

### Research Degrees (Master's Only)

Majors	Degrees Offered
Applied and Computational Mathematics	M.S.
Biology	M.S.
Chemistry	M.S.
Computer Science	M.S.
Counseling Psychology	M.A.
Electrical and Computer Engineering	M.S.E.C.E.
Engineering Management	M.S.E.M.
English	M.A.
Geological Sciences	M.S.
Physics	M.S.

### Professional Degrees

Majors	Degrees Offered
Art	M.F.A.
Business Administration	M.B.A.
Communication Sciences and Disorders	M.A.
Counseling Psychology	M.A.
Engineering Management	M.S.E.M.
Liberal Studies	M.L.S.
Music	M.M.
Social Work	M.S.W.

### Minor Only

Linguistics



# Degree Programs and Faculty

This is the Degree Program and Faculty section—  
Addictions Studies through Dentistry of the 2003-2005  
Graduate School Catalog for the University of Minnesota.

## Key to Abbreviations

### Faculty

Graduate faculty are listed at the beginning of each degree program. After the faculty name, the home department will be listed (unless the department is the same as the program name), followed by the graduate faculty status in the program. Professors emeriti are identified by “(emeritus).”

### Membership Categories

**Senior Member (SM)**—Authorization to advise students at all levels, including the doctorate; to serve as a thesis reviewer and as an examiner on student examining committees, including service as chair of doctoral committees; to teach courses for graduate credit; and to participate in governance. In fields that also offer a professional doctorate, some senior member appointments may be restricted to the supervision of students seeking the professional degree.

**Affiliate Senior Member (ASM)**—Authorization to assume the same responsibilities as senior member, but not to participate in governance. In fields that also offer a professional doctorate, some affiliate senior member appointments may be restricted to the supervision of students seeking the professional degree.

**Member/Advising (M2)**—Authorization to advise students at the master’s level; to serve as a thesis reviewer at the master’s level and as an examiner on student examining committees at the master’s and

postbaccalaureate certificate levels; to teach courses for graduate credit; and to participate in governance. At the discretion of the appointing program, may also include authorization to co-advise doctoral students with a senior member or affiliate senior member of the graduate faculty, and to serve as a thesis reviewer and examining committee member for doctoral students, but not as chair.

**Affiliate Member/Advising (AM2)**—Authorization to assume the same responsibilities as member/advising, but not to participate in governance.

**Member (M)**—Authorization to serve as a thesis reviewer at the master’s level and as an examiner on student examining committees at the master’s and postbaccalaureate certificate levels; to teach courses for graduate credit; and to participate in governance. At the discretion of the appointing program, may also include authorization to serve as a thesis reviewer and examining committee member for doctoral students, but not as chair.

**Affiliate Member (AM)**—Authorization to assume the same responsibilities as member, but not to participate in governance.

**Examining Status (E)**—Authorization to serve as a thesis reviewer and as an examiner on student examining committees at all levels, but not as chair, and to teach courses for graduate credit. Examining status does not include membership on the graduate faculty and does not confer governance privileges.

### Tests

The following test abbreviations appear throughout graduate program listings.

**ECFMG**—Educational Commission Foreign Medical Graduates

**GMAT**—Graduate Management Admission Test

**GRE**—Graduate Record Examination

**IELTS**—International English Language Testing System

**MELAB**—Michigan English Language Assessment Battery

**SPEAK**—Speaking Proficiency English Assessment Kit

**TOEFL**—Test of English as a Foreign Language

**TSE**—Test of Spoken English

**USMLE**—United States Medical Licensing Examination

For more information about these individual tests, see page 8 in the General Information section.

## Addictions Studies

### Postbaccalaureate Certificate

**Contact Information**—Addictions Studies Certificate, College of Continuing Education, Student Support Services, 150 Wesbrook Hall, 77 Pleasant Street S.E., Minneapolis, MN 55455 (612-624-4000; [adv@cce.umn.edu](mailto:adv@cce.umn.edu); <[www.cce.umn.edu/certificates](http://www.cce.umn.edu/certificates)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### Professor

David C. Hollister, Social Work, M2

#### Associate Professor

Martha A. Rueter, Family Social Science, M  
Ken C. Winters, Psychiatry, M

#### Assistant Professor

Traci Louise Toomey, Epidemiology, M

#### Teaching Specialist

Peter Dimock, Social Work, M

**Curriculum**—The postbaccalaureate addictions studies certificate gives students expertise in the prevention and treatment of addictive disorders relevant to a wide variety of human service, health care, and public

health settings. Two tracks are available: public health and service provider. The public health track focuses on specialization in the epidemiology of addictive disorders and promising prevention approaches. The service provider track allows students to study advanced counseling and therapy skills, models, and intervention techniques related to the treatment of addictive disorders. Students can use the curriculum in this track to qualify for the Alcohol and Drug Counselor license from the Minnesota Department of Health.

**Admission Requirements**—Applicants for either track must have a bachelor’s degree from an accredited postsecondary U.S. institution or its foreign equivalent. A GPA of 3.00 is required. There are additional admissions requirements for the service provider track. Admissions information is available at <[www.cce.umn.edu/certificates](http://www.cce.umn.edu/certificates)>.

**Certificate Requirements**—The public health track consists of 17 core credits and 2 elective credits. To earn a service provider track certificate, students must take 9 core credits and 10 elective credits. However, to sit for the licensure exam, students must also complete additional coursework (15 credits).

## Aerospace Engineering and Mechanics

**Contact Information**—Chair, Graduate Admissions Committee, Department of Aerospace Engineering and Mechanics, University of Minnesota, 107 Akerman Hall, 110 Union Street S.E., Minneapolis, MN 55455 (612-625-8000; fax 612-626-1558; [dept@aem.umn.edu](mailto:dept@aem.umn.edu); <[www.aem.umn.edu](http://www.aem.umn.edu)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### Regents Professor

Daniel D. Joseph, SM

#### Professor

Roger E. A. Arndt, Civil Engineering, SM

Gary J. Balas, SM

Gordon S. Beavers, SM

Graham V. Candler, SM

Roger Fosdick, SM

William L. Garrard, SM

Richard D. James, SM

Perry H. Leo, SM

Ellen K. Longmire, SM

John S. Lowengrub, Mechanics, SM

Mitchell B. Lusk, Mechanics, SM

Thomas Lundgren (emeritus), ASM

Theodore A. Wilson, SM

### **Akerman Professor of Design**

Andrew Vano, AM

### **Associate Professor**

Ivan Marusic, SM  
Thomas W. Shield, SM  
Lev Truskinovsky, SM  
Yiyuan Zhao, SM

### **Adjunct Associate Professor**

Dale F. Enns, SM

### **Assistant Professor**

Demoz Gebre-Egziabher, SM  
Ashley James, SM  
Yohannes Ketema, AM  
Krishnan Mahesh, SM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The department offers graduate study in two major fields, mechanics and aerospace engineering. The graduate programs emphasize engineering sciences that are basic to these fields: fluid mechanics, aerospace systems, and continuum and solid mechanics. Theoretical, analytical, experimental, and computational aspects of these fields are covered by the courses and research opportunities offered by the department.

**Prerequisites for Admission**—A four-year B.S. degree in an engineering, basic science, or mathematics program is required. Admission depends primarily on the applicant's undergraduate record and letters of recommendation.

**Special Application Requirements**—GRE scores are not required but are strongly recommended for students applying for graduate fellowships. In all cases, these test scores are taken into account if provided. Students are admitted fall semester only. Only under unusual circumstances are students allowed to begin their studies at another time during the academic year.

**Courses**—Please refer to Aerospace Engineering and Mechanics (AEM) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Programs can contain no more than two courses at 4xxx.

### **M.Aero.E. Coursework Only and Design Project Degree Requirements**

The M.Aero.E. program emphasizes applications of fluid mechanics, aerospace systems, and continuum and solid mechanics in aerospace engineering. The program must include at least 12 credits of 5xxx or 8xxx courses. In addition to the minimum credit requirement, the student must demonstrate an understanding of aerodynamics and aerospace vehicle mechanics, either from previous study or from additional coursework in the graduate program.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### **M.S.Aero.E. Degree Requirements**

This program emphasizes coursework in engineering sciences that are basic to this field: fluid mechanics, aerospace systems, and continuum and solid mechanics. Plan A requires 30 graduate credits, a minimum of 20 course credits and 10 thesis credits. No seminar credits can be used to satisfy the 20-course credit requirement. Plan B requires 30 credits including the 3 credit plan B project course. Of the remaining 27 credits a minimum of 24 credits of coursework is required and no seminar credits can be used to satisfy this requirement. If seminar credits are used to meet the 30 credit requirement, they must be in one-credit modules.

For both Plan A and Plan B, the program must include at least one sequence of 8xxx courses in aerospace engineering and no more than 8 credits of 4xxx courses. Also, the student must demonstrate an understanding of aerodynamics and aerospace vehicle mechanics, either from prior study or from additional coursework beyond the 30-credit minimum.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—At least one sequence of two 8xxx courses in aerospace engineering is required.

### **M.S. Degree Requirements—Mechanics**

The M.S. program in mechanics emphasizes coursework in fluid mechanics, aerospace systems, and continuum and solid mechanics. Theoretical, analytical, experimental, and computational aspects of these subjects are covered by the courses and research opportunities offered by the department.

Plan A requires 30 credits; a minimum of 20 course credits and 10 thesis credits. No seminar credits can be used to satisfy the 20-course credit requirement.

Plan B requires 30 credits for the degree. This total includes the 3 credit Plan B project course. Of the remaining 27 credits, a minimum of 24 credits of coursework is required and no seminar credits can be used to satisfy this requirement. If seminar credits are used to meet the 30 credit requirement for the degree, the seminar credits must be in one-credit modules.

For both the Plan A and Plan B, the program must include at least one sequence of 8xxx courses in mechanics and no more than 8 credits of 4xxx courses. The student must also demonstrate a breadth of knowledge in mechanics, either from previous study or from coursework, in more than one subfield of mechanics.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—At least one sequence of two 8xxx courses in mechanics is required.

### **Ph.D. Degree Requirements—Aerospace Engineering**

The Ph.D. program emphasizes coursework and research in engineering sciences that are basic to this field. Many of the courses offered by the department serve both major fields: aerospace engineering and mechanics. The difference between these major fields is most apparent in the thesis topics, which for aerospace engineering concern aerodynamics and aerospace systems.

The Ph.D. requires about two years of coursework, but the heart of the program is the thesis research. The program must contain a minimum of 42 credits of approved courses and four semesters of colloquium attendance. Of the 42 credits, a minimum of 36 credits must be in approved coursework, not including seminar credits. If seminar credits are used to meet the 42 minimum credit requirement they must be in one-credit modules. The program also must include at least four 8xxx courses in aerospace engineering (at least four 8xxx courses in mechanics for the Ph.D. in mechanics—see below) and can contain no more than two 4xxx courses. The first year of the Ph.D. program is similar to the master's program and most Ph.D. students receive the master's degree. The second year is devoted to more advanced courses and beginning research. Subsequent years include some coursework with increased focus on research. The time required to complete a research project varies, but most students finish the Ph.D. within five years after the bachelor's degree.

**Language Requirements**—None.

**Minor Requirements for Students Majoring in Other Fields**—At least 12 credits in aerospace engineering are required, including at least one sequence of two 8xxx courses.

### **Ph.D. Degree Requirements—Mechanics**

The Ph.D. program in mechanics emphasizes coursework and research in the subfields of fluid mechanics, aerospace systems, and continuum and solid mechanics. Many courses offered by the department serve both major fields: aerospace engineering and mechanics. The thesis topics for mechanics concern fundamental aspects of dynamical systems, material properties, and fluid and solid behavior.

Ph.D. coursework and credit requirements are the same as those listed for aerospace engineering in the second paragraph above.

**Language Requirements**—None.

**Minor Requirements for Students Majoring in Other Fields**—At least 12 credits in mechanics is required, including at least one sequence of two 8xxx courses.

## Agricultural and Applied Economics

**Contact Information**—Department of Applied Economics, University of Minnesota, 231 Classroom-Office Building, 1994 Buford Ave., St. Paul, MN 55108 (612-625-3777; [dgs@apec.umn.edu](mailto:dgs@apec.umn.edu); [www.apec.umn.edu](http://www.apec.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Regents Professor

Vernon W. Ruttan (emeritus), ASM  
G. Edward Schuh, SM

### Professor

Jeffrey D. Apland, SM  
Sandra O. Archibald, Public Affairs, SM  
K. William Easter, SM  
Vernon R. Eidman, SM  
William C. Gartner, SM  
Robert P. King, SM  
Jean D. Kinsey, SM  
Richard A. Levins, SM  
George W. Morse, SM  
Kent D. Olson, SM  
Philip G. Pardey, SM  
Claudia A. Parliament, SM  
Glenn D. Pederson, SM  
Stephen Polasky, SM  
Terry L. Roe, SM  
C. Ford Runge, SM  
Benjamin H. Senauer, SM  
Delane E. Welsch (emeritus), ASM

### Associate Professor

Brian L. Buhr, SM  
Jay S. Coggins, SM  
Jeremiah E. Fruin, SM  
Paul W. Glewwe, SM  
Frances R. Homans, SM  
Terrance M. Hurley, SM  
William F. Lazarus, SM  
Donald J. Liu, SM  
Gerard McCullough, SM  
Pamela J. Smith, SM  
Rodney B. Smith, SM  
Thomas F. Stinson, SM  
Steven J. Taff, SM  
David Trechter, AM

### Assistant Professor

Elizabeth E. Davis, SM  
Laura T J Kalambokidis, SM  
Margaretha V. Rudstrom, SM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Graduate study requires an operational knowledge of economic theory and modern methods of quantitative analysis as well as practical application in specialized fields of inquiry, which include consumer behavior and household economics; development, trade, and policy; natural resource and environmental economics; production and marketing economics; and community development.

**Prerequisites for Admission**—A GPA of 3.00 in an undergraduate program and in graduate level work is the minimum standard for admission. Applicants with a bachelor's degree are, except in a few special cases, considered only for admission to the M.S. program. The following coursework is

considered the minimum preparation for admission to the M.S. program: intermediate-level microeconomic and macroeconomic theory, statistics, calculus, and linear algebra. Applicants to the Ph.D. program should also have completed courses in microeconomic and macroeconomic theory at the master's level. Students lacking background in economics or quantitative methods may be required to complete deficiencies before being accepted into the program.

**Special Application Requirements**—GRE scores are required for all students, domestic and foreign. A TOEFL score of 550 (paper) or 213 (computer) is also required for all international applicants whose native language is not English. This includes applicants with other academic study in the United States. TOEFL scores will be waived for applicants who have completed a degree from a United States institution within the last two years. Applicants should provide evidence of superior scholarship, professional experience, and general aptitude for graduate study. Students are admitted any semester but should keep in mind that most assistantships are allocated by the end of February for the following fall semester. Applicants seeking fellowships should submit all application materials by December 15.

**Courses**—Please refer to Applied Economics (ApEc) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses toward degree requirements is not permitted, with the exception of Stat 4101-02 for the M.S. degree only.

### M.S. Degree Requirements

The M.S. prepares students for employment opportunities in the public and private sector and for further graduate study. M.S. students are required to complete graduate level courses in microeconomic theory, macroeconomic theory, and econometrics or statistics, or to have completed equivalent courses prior to entry into the program. Students are also required to participate in a 1 credit M.S. seminar. Both Plan A and B require at least 30 credits, of which at least 14 credits must be in the major field and at least 6 credits must be in a related field or minor. The major field must include a minimum of 7 credits in applied economics (excluding thesis and special topics, independent study, and the M.S. seminar). Plan A requires 10 thesis credits. Plan B requires a 4- to 6-credit project. A minimum GPA of 3.00 in program courses is required for graduation.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—M.S. students must complete at least 9 credits of 5xxx or 8xxx courses in applied economics. Courses for the minor are approved by the director of graduate studies in the Department of

Applied Economics. All courses in the minor must be taken A-F and completed with a GPA of 3.00 or better.

### Ph.D Degree Requirements

The Ph.D. degree program prepares students for research, teaching, and extension positions and for research and administrative posts in public and private sector organizations.

The only specific credit or course requirements for the Ph.D. a 1-credit seminar, the Graduate School requirement of a supporting field or minor of 12 to 18 credits, and registration for 24 doctoral thesis credits. Ph.D. students follow a study program that includes coursework in microeconomic theory, macroeconomic theory, econometrics, and two fields of specialization. One field may be replaced by an approved minor in another graduate program. A typical program involves at least ten semester courses totaling at least 35 credits. Courses in economics may be counted in the major field or as part of the supporting field. A minimum GPA of 3.00 in program coursework is required for graduation. Preliminary written exams cover microeconomic theory and fields in agricultural and applied economics. Oral exams are required for approval of the dissertation proposal and for its defense.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—Ph.D. students must complete at least 15 credits of 5xxx or 8xxx courses in applied economics. Courses for the minor are approved by the director of graduate studies in the Department of Applied Economics. All courses in the minor must be taken A-F and completed with a GPA or 3.00 or higher.

## Agricultural Engineering

See Biosystems and Agricultural Engineering.

## American Studies

**Contact Information**—Department of American Studies, University of Minnesota, 104 Scott Hall, 72 Pleasant Street S.E., Minneapolis, MN 55455 (612-624-4190; [amstudy@umn.edu](mailto:amstudy@umn.edu); <http://cla.umn.edu/american/>).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Patricia C. Albers, American Indian Studies, SM  
Ronald R. Aminzade, Sociology, SM  
Hyman Berman, History, SM  
David O. Born, Preventive Sciences, SM  
Hazel Dicken-Garcia, Journalism and Mass Communication, SM  
Mary G. Dietz, Political Science, SM  
Sara M. Evans, History, SM  
James Farr, Political Science, SM  
Philip J. Gersmehl, Geography, SM  
Edward M. Griffin, English, SM  
Karen N. Hoyle, Library Collection Development/Management (Children's Literature Research Collection), AM  
Mary Jo Kane, Kinesiology, SM

Sally J. Kenney, Public Affairs, SM  
Sally G. Kohlstedt, Geology and Geophysics, SM  
Richard D. Leppert, Cultural Studies and Comparative Literature, SM  
Alex J. Lubet, Music, SM  
Karyl Ann R. Marling, Art History, SM  
Judith A. Martin, Urban and Regional Planning, SM  
Elaine Tyler May, SM  
Lary L. May, SM  
Russell R. Menard, History, SM  
Ellen Messer-Davidow, English, SM  
John D. Nichols, American Indian Studies, SM  
David W. Noble, SM  
John A. Powell, Law School, SM  
Riv-Ellen Prell, SM  
Paula Rabinowitz, English, SM  
Nancy L. Roberts, Journalism and Mass Communication, SM  
Steven Ruggles, History, SM  
Harvey B. Sarles, Cultural Studies and Comparative Literature, SM  
Eric Sheppard, Geography, SM  
Dennis N. Valdes, Chicano Studies, SM  
Rudolph J. Vecoli, History, SM  
David E. Wilkins, American Indian Studies, SM  
Gayle Graham Yates, SM  
Jack D. Zipes, German, Scandinavian, and Dutch, SM

### Associate Professor

Lisa Albrecht, General College, SM  
W. John Archer, Cultural Studies and Comparative Literature, SM  
Bruce P. Braun, Geography, M2  
Rose M. Brewer, African American and African Studies, SM  
Robert "Robin" Brown, Cultural Studies and Comparative Literature, SM  
Brenda J. Child, SM  
Patricia Crain, English, AM  
Maria Damon, English, SM  
Lisa J. Disch, Political Science, SM  
John M. Dolan, Philosophy, SM  
Penny A. Edgell, Sociology, SM  
Kirsten Fischer, History, SM  
George D. Green, History, SM  
Douglas Hartmann, Sociology, SM  
Josephine D. Lee, English, SM  
Carol A. Miller, SM  
Roger P. Miller, Geography, SM  
Lisa A. Norling, History, SM  
Jean M. O'Brien-Kehoe, History, SM  
Joanna O'Connell, Spanish and Portuguese Studies, SM  
Jennifer L. Pierce, SM  
Guillermo Rojas, Chicano Studies, SM  
Thomas M. Scanlan, Rhetoric, SM  
Robert B. Silberman, Art History, SM  
Katherine M. Solomonson, Architecture, SM  
Barbara Welke, History, SM  
John S. Wright, English, African American and African Studies, SM  
Jacquelyn N. Zita, Women's Studies, SM

### Assistant Professor

Thomas Augst, English, M2  
David Chang, History, M2  
Catherine C. Choy, M2  
Tracey Ann Deutsch, History, M2  
Roderick Ferguson, M2  
Collette Gaiter, Mass Communications, M2  
Vinay Gidwani, Geography, M2  
Karen Zouwen Ho, M2  
Erika Lee, History, M2  
David Martinez, American Indian Studies, M2  
Keith A. Mayes, African American and African Studies, M2  
Patrick McNamara, History, M2  
Kevin P. Murphy, History, M2  
Daniel J. Philippon, Rhetoric, M2  
Jani Scandura, English, M2  
Data Z. Strolovitch, Political Science, M2  
Eden Torres, Women's Studies, M2  
David Treuer, English, M2  
Haidee S. Wasson, Cultural Studies and Comparative Literature, M2

### Senior Fellow

Harry C. Boyte, Public Affairs, AM

### Other

Colleen J. Sheehy, Weisman Art Museum, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—American studies is an interdisciplinary, interdepartmental program. The American studies graduate faculty consists of American studies core faculty members and graduate faculty members drawn from a wide number of departments. Students create a field of concentration and also pursue broad training in analyzing the development of cultural and historical processes that shaped the nation and its diverse cultures, as well as analyzing contemporary practices.

**Prerequisites for Admission**—An undergraduate major in a field related to American studies or other preparation acceptable to the Admissions Committee for American studies is required.

**Special Application Requirements**—The following should be sent to the department office: a special application form available through the department office, a personal statement, three letters of recommendation, an academic writing sample, scores from the General (Aptitude) Test of the GRE that are less than five years old, and transcripts of all college work. Applications must be submitted by December 15. Entry is only in fall semester.

**Courses**—Please refer to American Studies (AmSt) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—One 4xxx course in American studies, English, history, American Indian studies, comparative studies in discourse and society or another appropriate program, may be included as one of the seminars to meet the one-semester specialty requirement in American studies.

### M.A. Degree Requirements

The master's degree is not designed as a terminal degree and students are not admitted to it. A Ph.D. student may elect to pursue the M.A. All coursework is applicable to the Ph.D.

Plan A and B require American studies core seminars—AmSt 8201, 8202 (6 credits); a two-semester research course in American studies or in another department with approval of the director of graduate studies (6 credits); a comparative cultural course covering international or non-U.S. subjects (3 credits) and two adviser-approved courses in the field of concentration including one focused on cultural pluralism within the U.S. (6 credits).

Plan A requires 10 thesis credits for a total of 31 credits and a written thesis.

Plan B requires three additional adviser-approved courses in the field of concentration. (9 credits) for a total of 30 credits. The student is required to write three Plan B papers, each approved by a member of the graduate faculty. The papers are usually expanded seminar papers.

**Language Requirements**—Reading knowledge of one foreign language is required.

### Minor Requirements for Students

**Majoring in Other Fields**—For a master's minor, students are expected to choose courses consistent with or complementary to their major. Students should complete either AmSt 8201 or 8202 and two more courses in American studies.

### Ph.D. Degree Requirements

A minimum of 45 credits (15 courses) is required, distributed as follows: introductory seminars AmSt 8201 and 8202 (6 credits); practicum in American studies 8401; dissertation seminar 8801; three one-semester courses from the American studies specialty seminars or from other units approved by the director of graduate studies, one of which must be original research (9 credits); one comparative culture course covering international or non-U.S. topics (3 credits); and seven adviser-approved field of concentration courses, including cultural pluralism courses (21 credits). Twenty-four thesis credits are also required. Ph.D. students may register for 0999 no more than two semesters total without approval from their adviser and the director of graduate studies.

**Language Requirements**—Reading knowledge of one foreign language is required.

### Minor Requirements for Students

**Majoring in Other Fields**—For a doctoral minor, students must complete at least 12 credits of courses consistent with or complementary to their major, including four 5xxx or 8xxx courses in American studies, one of which must be AmSt 8201 or AmSt 8202.

## Anatomy

Contact the Graduate School for information about the status of this program.

## Ancient and Medieval Art and Archaeology

See Classical and Near Eastern Studies.

## Animal Sciences

**Contact Information**—Department of Animal Science, University of Minnesota, 305 Haecker Hall, 1364 Eckles Avenue, St. Paul, MN 55108 (612-624-3491; fax 612-625-5789; [renox001@umn.edu](mailto:renox001@umn.edu); [www.ansci.umn.edu](http://www.ansci.umn.edu)).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### **Professor**

David R. Brown, Veterinary Pathobiology, SM  
 Brian A. Crooker, SM  
 William R. Dayton, SM  
 Mohamed E. El-Halawani, SM  
 Douglas N. Foster, SM  
 Esther M. Gallant, Veterinary Pathobiology, SM  
 Leslie B. Hansen, SM  
 Marcia R. Hathaway, SM  
 Alan G. Hunter, SM  
 Dennis G. Johnson, M  
 Lee J. Johnston, SM  
 Mathur S. Kannan, Veterinary Pathobiology, SM  
 Benjamin S. Leung, Obstetrics and Gynecology, SM  
 James G. Linn, SM  
 George D. Marx, M2  
 Sally L. Noll, SM  
 Scott M. O'Grady, SM  
 F. Abel Ponce de Leon, SM  
 Jeffrey K. Reneau, M2  
 Anthony James Seykora, SM  
 Gerald C. Shurson, SM  
 Marshall D. Stern, SM  
 Roger D. Walker, M  
 Jonathan E. Wheaton, SM  
 Michael E. White, SM

#### **Adjunct Professor**

Hans-Joachim G. Jung, Agronomy and Plant Genetics, SM

#### **Associate Professor**

Mitchell S. Abrahamsen, Veterinary Pathobiology, SM  
 Hugh Chester-Jones, M2  
 John Deen, Clinical and Population Sciences, SM  
 Alfredo DiCostanzo, SM  
 Scott C. Fahrenkrug, SM  
 Graham C. Lamb, SM

#### **Assistant Professor**

Sam K. Baidoo, SM  
 Yang Da, Veterinary Pathobiology, SM  
 Marcia Endres, M2  
 Oladele S. Gazal, M2  
 William A. Head, Jr., SM  
 Jacqueline P. Jacob, SM  
 Laura J. Mauro, SM  
 Deborah L. Roeber, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Students concentrate on one of the animal sciences subdisciplines: genetics, growth biology, nutrition, physiology, or production systems. Students have the option of tailoring their program to include study in more than one subdiscipline and to emphasize basic or applied science.

**Prerequisites for Admission**—A bachelor's degree in agriculture or a biological field with training in biology, chemistry, physics, and mathematics is required.

#### **Special Application Requirements**—

A complete set of transcripts in addition to that required by the Graduate School, three letters of recommendation evaluating the applicant's potential, and a statement of career goals are required. The minimum GPA generally required for admission is 3.00 for the M.S. and 3.20 for the Ph.D. GRE scores are required. Applicants are admitted every semester.

**Courses**—Please refer to Animal Science (AnSc) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Certain 4xxx courses may be included on the program form with prior approval by the student adviser and the director of graduate studies.

#### **M.S. Degree Requirements**

Plan A requires a minimum of 14 semester credits in the major and 6 credits in a designated minor, or related fields outside the major. Selection of courses to fulfill this requirement and development of the thesis project are primarily the responsibility of the student and faculty adviser. Students also must register for a minimum of 10 thesis credits. An official program of study, listing coursework to be completed and a thesis title, is submitted to a Graduate Faculty Program Committee and the director of the animal sciences graduate program for review and then forwarded to the Graduate School for approval.

Plan B requires a minimum of 30 credits. These must include 14 or more credits in the major area and at least 6 credits in one or more related fields outside the major. The balance of credits is chosen by agreement between the adviser and student. In addition to coursework, a project(s) is to be conducted that requires approximately 120 hours to complete. The nature and extent of the project is agreed upon in advance by the student and faculty adviser.

**Language Requirements**—None.

**Final Exam**—The final exam consists of a public seminar followed by an oral examination.

#### **Minor Requirements for Students**

**Majoring in Other Fields**—Requirements are designed to fit the student's needs. A master's minor requires 6 credits in areas not closely related to the major; no more than 2 of these credits may be in research or special problems.

#### **Ph.D. Degree Requirements**

The Ph.D. degree is granted chiefly in recognition of the candidate's achievements and knowledge in a specific field. Although there is no minimum number of credits required, students typically complete 40-50 credits to develop competency in their field of interest. Students must register for a minimum of 24 thesis credits. Appropriate graduate level courses taken at another university may be approved for transfer. Coursework completed under an M.S. program can be counted towards the Ph.D. degree. The student is expected to maintain a B average or better in all coursework.

**Language Requirements**—None.

#### **Minor Requirements for Students**

**Majoring in Other Fields**—Requirements are designed to fit the student's needs. A doctoral minor requires 12 credits in areas not closely related to the major; no more than 3 of these credits may be in research or special problems.

## **Anthropology**

**Contact Information**—Department of Anthropology, University of Minnesota, 395 Hubert H. Humphrey Center, 301-19th Ave. S., Minneapolis, MN 55455 (612-625-3400; fax 612-625-3095; [anth@umn.edu](mailto:anth@umn.edu); <<http://cla.umn.edu/anthropology/>>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### **Professor**

Patricia Albers, American Indian Studies, ASM  
 Luther P. Gerlach (emeritus), ASM  
 Guy E. Gibbon, SM  
 Stephen F. Gudeman, SM  
 John M. Ingham, SM  
 Frank C. Miller (emeritus), ASM  
 Riv-Ellen Prell, American Studies, ASM  
 Gloria G. Raheja, SM  
 Peter S. Wells, SM  
 Joseph J. Westermeyer, Psychiatry, AM2

#### **Associate Professor**

Daphne Berdahl, SM  
 Timothy Dunnigan, SM  
 David M. Lipset, SM  
 Mischa Penn, SM  
 Janet D. Spector (emeritus), ASM

#### **Assistant Professor**

Kathleen Barlow, SM  
 Karen Ho, SM  
 Pradeep Jeganathan, SM  
 Gregory Laden, SM  
 Jean Langford, SM  
 Martha Tappen, SM  
 Karen S. Taussig, SM  
 Gilbert B. Tostevin, SM  
 Thomas Wolfe, History, ASM

#### **Fellow**

Sonia E. Patten, Family Practice and Community Health, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The Department of Anthropology offers graduate education in sociocultural anthropology, anthropological archaeology, and biological anthropology. Major areas of faculty research and graduate student training in sociocultural anthropology include the politics and poetics of tradition and memory; gender and feminist anthropology; language and rhetorical practices; the cultural construction of economy; the politics of anthropological knowledge; colonialism and nationalism; transglobal processes; culture and consumption; and psychological anthropology. Regional specialization includes Melanesia, India, Europe, Latin America, and North America.

The program in biological anthropology offers training and research opportunities in paleoanthropology with a focus on faunal analysis and taphonomy, and behavioral biology with a focus on human foragers, evolutionary ecology, and evolutionary theory. Regional specializations include Africa and the Caucasus.

The program in anthropological archaeology offers perspectives on the nature of archaeological knowledge, paleoecology and evolutionary theory, and the use of sociocultural theories and interpretive strategies in the reconstruction of historic and prehistoric pasts. Regional specialization includes Africa, Europe, the Near East, and North America.

**Prerequisites for Admission**—A B.A. degree or equivalent is required for admission.

**Special Application Requirements**—Three letters of recommendation on a form furnished by the department and scores from the General Test of the GRE should be sent to the director of graduate studies. Admission is for fall semester; the deadline for all materials is January 5.

**Courses**—Please refer to Anthropology (Anth) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—4xxx anthropology courses may be included on the degree program form if they are taught by members of the graduate faculty.

### M.A. Degree Requirements

For Plan A and Plan B, 20 semester credits; 14 in anthropology and 6 in minor or related field. Students should consult the department Web site at [www.cla.umn.edu/anthropology](http://www.cla.umn.edu/anthropology) for special requirements for sociocultural anthropology and for archaeology and biological anthropology.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—The minor program is individually designed by the student and the director of graduate studies. Minimally, students must take 6 credits in anthropology (5xxx courses or above).

### Ph.D. Degree Requirements

Requirements include 36 credits of coursework; 24 in anthropology and 12 in a minor or supporting program. Students should consult the department Web site at [www.cla.umn.edu/anthropology](http://www.cla.umn.edu/anthropology) for special requirements for sociocultural anthropology and for archaeology and biological anthropology.

**Language Requirements**—Requirements depend upon student's special area of research.

### Minor Requirements for Students

**Majoring in Other Fields**—The minor program in anthropology is individually designed by the student and the director of graduate studies. A minimum of 12 credits in anthropology (5xxx or 8xxx courses) must be completed for the minor.

## Applied Developmental Psychology

### Postbaccalaureate Certificate

**Contact Information**—Applied Developmental Psychology Certification Program, Institute of Child Development, 51 East River Road, Minneapolis, MN 55455 (612-624-2576; fax 612-624-6373).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

#### Professor

Ann D. Pick, M (emeritus)  
Herbert L. Pick, Jr., M  
Richard Weinberg, M

The certificate in applied developmental psychology allows graduate students who major or minor in child psychology to study and experience applications of developmental science issues, policies, and problems concerning children and child development at the local, state, and national level. Through the combination of theory and field experience, students learn how to help solve pressing real-life problems and to improve the lives of children. The 21-credit program explores such topics as ethical issues in applied developmental psychology, media and children's programming, nutrition and hunger, accidents and safety issues, children in the judicial system, the design and role of children's museums, and the development of children's toys, games, and recreational activities. Professionals in this field need to develop an in-depth understanding of how public policy affects children's lives, how to make pure research comprehensible and practical without losing its complexity, and how to work in interdisciplinary teams.

**Admission**—Admission is open to graduate students enrolled in a doctoral program at the University. Students in child psychology must consult with the training director(s) and complete a department application form before officially registering for the first seminar. Students not in child psychology must have successfully completed a four-year undergraduate degree with a minimum 3.00 GPA and equivalent of 12 quarter or 9 semester course credits in psychology, and one statistics course. Admission is based primarily on the applicant's academic record, GRE scores, and research experience.

**Curriculum**—CPsy 8360 (2 cr, section 7) gives an overview of applied developmental science problems and provides a framework for the second two components of the program. CPsy 8301 (4 cr) and 8302 (4 cr) are the core courses in developmental psychology covering biological, cognitive, and social aspects of development. They are fundamental to understanding the developmental perspective. CPsy 8996 (5 cr) integrates and applies information learned in coursework. The course is individually designed based on each student's prior experience and interests. Students focus on practical and/or public policy applications of developmental research in settings such as

the Search Institute, the Minnesota Children's Museum, the guardian ad litem program in the local courts, the Center for 4-H Youth Development, and the National Institute on Media and the Family. The field experience may be taken in one to three semesters or a summer session, but must be at least 5 credits and total 188 hours. A major paper describing the field experience and integrating relevant basic research literature with practical availability taking place in the field setting is expected. Electives (6 cr) may include 5xxx or 8xxx courses approved by the training directors and chosen to complement the student's area of interest.

## Applied Plant Sciences

**Contact Information**—Director of Graduate Studies, University of Minnesota, 411 Borlaug Hall, 1991 Upper Buford Circle, St. Paul, MN 55108 (612-625-1791; fax 612-625-1268; [aps@umn.edu](mailto:aps@umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

#### Regents Professor

Ronald L. Phillips, SM

#### Professor

Roger L. Becker, SM  
Deborah L. Brown, M2  
Vernon B. Cardwell, SM  
Iris Charvat, SM  
Jerry D. Cohen, SM  
Beverly R. Durgan, SM  
Nancy J. Ehke, SM  
Vincent A. Fritz, SM  
Gary M. Gardner, SM  
Burle G. Gengenbach, SM  
Jeffrey L. Gunsolus, SM  
Leland L. Hardman, SM  
Dale R. Hicks, SM  
Emily E. Hoover, SM  
Robert J. Jones, SM  
Nicholas R. Jordan, SM  
Pen Hsiang Li, SM  
James J. Luby, SM  
Albert H. Markhart III, SM  
Peter J. Olin, M2  
James H. Orf, SM  
David G. Pitt, Landscape Architecture, M2  
Carl J. Rosen, Soil, Water, and Climate, SM  
Ruth G. Shaw, SM  
Craig C. Sheaffer, SM  
Steve R. Simmons, SM  
David A. Somers, SM  
Joseph R. Sowokinos, SM  
Deon D. Stuthman, SM  
Donald B. White, SM  
David K. Wildung, SM  
Donald L. Wyse, SM  
Nevin D. Young, Plant Pathology, SM

#### Adjunct Professor

John W. Gronwald, SM  
Hans-Joachim G. Jung, SM  
Howard W. Rines, SM  
Carroll P. Vance, SM

#### Associate Professor

James A. Anderson, SM  
Rex N. Bernardo, SM  
Gregory J. Cuomo, SM  
John E. Erwin, SM  
Susan M. Galatowitsch, SM  
Gregg A. Johnson, SM  
Mary H. Meyer, SM  
Gary J. Muehlbauer, SM  
Bradley W. Pedersen, M2  
Paul M. Porter, SM

Alan G. Smith, SM  
 Christian A. Thill, SM  
 Cindy B. Tong, SM  
 John V. Wiersma, M2

#### **Adjunct Associate Professor**

Frank Forcella, SM  
 JoAnn F. Lamb, SM

#### **Assistant Professor**

Neil O. Anderson, SM  
 Jeffrey H. Gillman, SM  
 Stan C. Hokanson, SM  
 Brian P. Horgan, SM  
 Seth L. Naeve, SM  
 Paul Peterson, SM  
 Lori K. Scott, SM  
 Kevin P. Smith, SM  
 Jochum J. Wiersma, SM

#### **Adjunct Assistant Professor**

David Francis Garvin, SM  
 Helene Murray, SM

#### **Other**

Raymie A. Porter, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Applied plant sciences is an interdisciplinary program for educating students to become professional scientists well grounded in the applied disciplines of agronomy/agroecology, horticulture, and plant breeding. Graduates of the program are able to provide innovative leadership and contribute to problem solving in their discipline in the public or private sector and within society at large. The program develops the quantitative and qualitative research skills necessary to conduct high quality research and scholarship. Students gain a broad familiarity with all the disciplines within the program and gain in-depth knowledge within their area of expertise. The program's graduate faculty is drawn primarily from the Department of Agronomy and Plant Genetics and the Department of Horticultural Science, but also from the Departments of Plant Pathology; Soil, Water, and Climate; and Landscape Architecture and related departments. Students choose from among four specialization tracks—agronomy/agroecology, applied plant sciences, horticulture, or plant breeding/plant molecular genetics.

#### **Agroecology/Agronomy Specialization**

Students conduct research to increase their knowledge of cropping systems and weed science including alternative approaches and management strategies. Emphasis is on improving production efficiency and profitability in an environmentally sound approach that benefits society. Mechanisms of crop physiology and ecology underlying plant responses to the environment are a particular emphasis of this track.

#### **Applied Plant Sciences Specialization**

Students create an integrated, individualized program combining a breadth of courses from several disciplines or areas including plant biology at the organismal level, genetics and plant breeding, cropping

systems and communities, and courses relating to the production of agronomic and/or horticultural commodities.

**Horticulture Specialization**—Students conduct research related to fruits, vegetables, potatoes, flowers, ornamental trees and shrubs or turf; and on the physiology, production, environmental impact of cropping systems, and use of horticultural crops. Research areas include the effect of horticultural commodities on human health, hormonal, and stress physiology; flower development and flowering physiology; integrated pest management; postharvest physiology; and cropping system strategies. Students get a broad range of experiences in the field, greenhouse, and/or laboratory using genetic, molecular, biochemical, and ecological tools to answer research questions.

**Plant Breeding/Plant Molecular Genetics Specialization**—This track allows students to select from genetic research projects ranging from applied plant breeding projects emphasizing breeding procedures and methodologies to molecular genetic projects doing biotechnology, genetic engineering, and genomic research in agronomic and horticultural crops. These research projects give students the opportunity to integrate the latest developments in the laboratory with applied applications in the field to reach the overarching goal of developing new germplasm that will improve the sustainability of our food and fiber systems.

**Prerequisites for Admission**—Students entering the program should have a foundation in the physical and biological sciences, preferably with some emphasis in plant science. A minimum of 10 credits of math and physics, 12 credits of chemistry and biochemistry, and 15 credits of biological and/or agricultural sciences are recommended for admission. In addition, students should have completed a B.S. or B.A. degree in agriculture, biology, or other related life sciences. Students with a B.S. or B.A. degree outside these areas may be admitted with the requirement that they take the prerequisite courses noted above at the undergraduate level in addition to their graduate coursework.

**Special Application Requirements**—Applicants must submit scores from the General (Aptitude) Test of the GRE, three letters of recommendation from persons familiar with their scholarship and research potential, a complete set of official transcripts, and a clearly written statement of career interests, goals, and objectives. Students may apply at any time; however, submission of all application materials by January 1 is strongly encouraged to ensure priority consideration for fellowships and teaching and research assistantships awarded for the next academic year. Students can be admitted any term.

**Courses**—Please refer to Agronomy and Plant Genetics (Agro), Applied Plant Sciences (APSc), Horticultural Science (Hort) and Sustainable Agricultural Systems (SAgr) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on the degree program form is subject to adviser and director of graduate studies approval.

#### **M.S. Degree Requirements**

The M.S. is offered under Plan A (with thesis) and Plan B (with project). Plan A requires a minimum of 20 course credits and 10 thesis credits; Plan B requires a minimum of 30 course credits. Students are encouraged to complete the courses in the common curriculum and the requirements for their specialization, and to present one graduate seminar. Additional course requirements are flexible and are determined in consultation with the student's adviser(s) and advisory committee.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

#### **Ph.D. Degree Requirements**

Ph.D. students are required to complete the courses in the common curriculum, the requirements for their respective specialization, and present two graduate seminars; 24 thesis credits are also required. Additional course requirements are flexible and are determined in consultation with the student's adviser(s) and advisory committee.

**Language Requirements**—None.

**Minor Requirements for Students Majoring in Other Fields**—A Ph.D. minor requires 12 credits from among 4xxx, 5xxx, and 8xxx courses in the areas of specialization, with only one 4xxx course allowed.

## **Arabic**

*No new students are currently being accepted to this program. Contact the Graduate School for information on the status of the program.*

**Contact Information**—Arabic Program, Department of African American and African Studies, University of Minnesota, 808 Social Sciences Building, 267 19th Avenue S., Minneapolis, MN 55455 (612-624-9847).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### **Professor**

Caesar E. Farah, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—*Note: No new students are currently being accepted to this program. Contact the Graduate School for information on the status of the program.*

The program focuses on the Arabic language and the literature and culture of the Arabic-speaking world.

### **M.A. Plan B Degree Requirements**

The M.A. is offered under Plan B only. The minimum requirement is 33 credits, including 27 course credits and 6 credits for the Plan B research paper. The coursework must include 15 credits in Arabic literature or culture, including Arab 5001 (3 credits) and one 8xxx seminar (3 credits). Students also take 6 credits (2 courses) in related fields outside Arabic, depending on the student's academic goals and subject to the approval of the director of graduate studies.

**Language Requirements**—Students must complete Arab 5102 (Advanced Arabic) or its equivalent, and must demonstrate reading knowledge of a classical or modern language appropriate to the field.

**Final Exam**—The final exam is oral.

### **Minor Requirements for Students**

**Majoring in Other Fields**—A minimum of 12 graduate credits for a master's minor is required. Students must possess an acceptable knowledge of Arabic, but may not apply language-specific courses toward the minor. A program of study must be arranged with the director of graduate studies of Arabic. No written exam is required for the minor.

## **Architecture**

**Contact Information**—Department of Architecture, University of Minnesota, 145 Rapson Hall, 89 Church Street S.E., Minneapolis, MN 55455 (612-624-7866; fax 612-624-5743; [calainfo@umn.edu](mailto:calainfo@umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### **Professor**

Thomas Fisher, M2  
Lance A. LaVine, M2  
Julia Robinson, M2  
Garth C. Rockcastle, M2  
Leon G. Satkowski, M2  
Duane Thorbeck, AM2

### **Adjunct Professor**

Dale M. Mulfinger, AM2

### **Associate Professor**

Lee B. Anderson, M2  
Arthur H. Chen, M2  
Rene Cheng, M2  
William F. Conway, M2  
Gunter Dittmar, M2  
Bruno Franck, M2  
Mary M. Guzowski, M2  
Cynthia Jara, M2  
Andrzej Piotrowski, M2  
Katherine M. Solomonson, M2  
J. Stephen Weeks, M2

### **Adjunct Associate Professor**

Thomas Andrew Meyer, AM2  
Todd J. Rhoades, AM2  
Lee E. Tollefson, AM2  
Craig L. Wilkins, AM2

### **Assistant Professor**

John Charles Carmody, M2

### **Adjunct Assistant Professor**

Mary deLaittre, AM  
Nina Ebbighausen, AM  
Timothy Fuller, AM  
Ali Heshmati, AM  
Douglas Lew, AM  
Robert Mack, AM  
Nancy Miller, M2  
Tim Quigley, AM  
Marcy Schulte, AM  
Mark Searles, AM  
Mark Wentzell, AM

### **Lecturer**

Robert Adams, AM2  
Robert Ferguson, AM2  
Dawn Gilpin, AM2  
Sharon Roe, AM2

### **Adjunct Teaching Instructor**

Lucas Alm, AM  
Doug Bergert, AM  
Jonee K. Brigham, M  
Steve Buetow, AM  
Mike Christenson, AM  
Dan Clark, AM  
Dave Dimond, AM  
Jim Dozier, AM  
Martha McQuade, AM  
Mary Springer, AM  
Suzi Strothman, AM  
Mark Tambornino, AM  
Marcelo Valdes, AM  
Josh Weinstein, AM  
Tom Westbrook, AM

### **Research Fellows**

John C. Carmody, M2  
Virajita Singh, M  
Billy Weber, M

### **Other**

Janet Abrams, M  
William A. Blanski, AM  
Todd P. Hansen, AM  
Thomas G. Whitcomb, AM  
Jennifer A. Yoos, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Architecture encompasses the making and study of the buildings and environment that we inhabit. The concerns of architecture involve a wide variety of areas of study, including the art of representing built projects through drawings and computer graphics; the technology of building structure, building materials, and natural and mechanical systems; the history, theory, and art of making, using, and understanding buildings as cultural artifacts for human use; and the practice of architecture in the context of urban form and business economics.

The M.Arch. program introduces students to the practice and discipline of architecture as a speculative, analytic, and investigative endeavor. It prepares students to enter architecture as both a profession and a field of knowledge. The program is organized around the design studio, incorporating coursework in the diverse areas of architectural knowledge: representation, technology, history, theory, urban design, and architectural practice.

The professional M.Arch. degree program is for those who have an undergraduate degree with a major or concentration in architecture and seek to become licensed architects. Because the admitted student will already have a broad educational background and will have completed fundamental courses, the program focus is on professional and disciplinary coursework, including required and elective lecture, seminar, and design studio courses.

In the United States, most state registration boards require a degree from an accredited professional degree program as a prerequisite for licensure. The National Architectural Accrediting Board (NAAB), which is the sole agency authorized to accredit U.S. professional degree programs in architecture, recognizes two types of degrees: the bachelor of architecture and the master of architecture. A program may be granted a five-year, three-year, or two-year term of accreditation, depending on its degree of conformance with established educational standards.

Master's degree programs may consist of a pre-professional undergraduate degree and a professional graduate degree, which, when earned sequentially, comprise an accredited professional education. However, the pre-professional degree is not, by itself, recognized as an accredited degree.

**Prerequisites for Admission**—Track A applicants to the M.Arch. program must hold a baccalaureate degree and must have completed the equivalent of at least a year of preparatory work, including coursework in calculus, physics, architectural history, drawing, and architectural design. Track A candidates can expect to complete the M.Arch. program in six semesters (three years), including the thesis.

Students are expected to have basic computer skills before beginning the program, including familiarity either with Macintosh or Windows operating systems, word processing, basic drawing or painting programs, and use of e-mail. Intermediate classes in computer methods in architecture (Arch 5371, 5372, 5373) are part of degree requirements during the first year; advanced classes (Arch 5374, 5375) are required during the second year. Typically, students who complete their B.A. or B.S. in architecture, as well as students who have undergraduate degrees in other disciplines, apply to the master's program as Track A candidates.

Track B applicants who have completed at least two years of architectural design studios plus structures and materials courses that would be the equivalent of the first year of this graduate program, and who have a nonprofessional bachelor's degree in architecture, would receive advanced placement in the program sequence. Depending on academic record, previous coursework, and portfolio review, Track B students can complete the M.Arch. degree in as little as two years. Upon acceptance, Track

B applicants will have coursework reviewed by the director of graduate studies to determine their specific course requirements.

Track C applicants, those who hold a bachelor of architecture professional degree (B.Arch.) or a first professional master of architecture (M.Arch.) degree, are admitted to pursue the master of architecture. These students, in conjunction with the director of graduate studies, plan a curriculum around their special interests. Students with a prior professional degree take a minimum of 30 credits in an individually developed program requiring a minimum of three semesters and culminating in a thesis project that reflects their course of study in their chosen specialty.

For more complete information, please see the *College of Architecture and Landscape Architecture Bulletin* and contact the Department of Architecture.

#### Special Application Requirements—

Admission to the M.Arch. program is highly competitive. In addition to meeting Graduate School application requirements, students applying to the program must demonstrate design talent in a portfolio and must submit all of the following: a one-page statement of interest, transcripts of all coursework, three faculty recommendations, a recent paper written in English, and GRE scores. The portfolio should be a notebook no larger than 8.5" x 11" (other portfolio formats will be rejected). International students must submit scores from the TOEFL or the MELAB.

**Courses**—Please refer to Architecture (Arch) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—4xxx courses cannot be included on degree program forms without the permission of the adviser and director of graduate studies.

#### M.Arch. Plan A Degree Requirements

The professional M. Arch. curriculum accredited by the National Architectural Accreditation Board (NAAB) consists of a minimum of 93 credits, including the thesis. The first-year integrated curriculum is followed by two years of less structured coursework culminating in the thesis. Students are required to take intermediate and advanced courses in computer methods in architecture.

**Language Requirements**—None.

**Final Exam**—Oral and visual presentation of the thesis is required.

## Art

**Contact Information**—Department of Art, University of Minnesota, 205 Art Building, 405 21st Avenue S., Minneapolis, MN 55455 (612-625-8096; fax 612-625-7881; [artdept@umn.edu](mailto:artdept@umn.edu); <<http://artdept.umn.edu>>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### Professor

Karl E. Bethke, M2  
Curtis C. Hoard, M2  
M. Diane Katsiaficas, M2  
Clarence E. Morgan, M2  
Mark Pharis, M2  
Wayne E. Potratz, M2  
Thomas A. Rose, M2

#### Associate Professor

Guy A. Baldwin, M2  
Thomas R. Cowette, M2  
David Feinberg, M2  
Lynn A. Gray, M2  
Gary L. Hallman, M2  
James V. Henkel, M2  
Jerald A. Krepps, M2  
Thomas J. Lane, M2  
Susan M. Lucey, M2  
Lynn T. Lukkas, M2  
Joyce Lyon, M2

#### Assistant Professor

Christine A. Baeumler, M2  
Margaret Bohls, M2  
Jan Estep, M2  
Marjorie Franklin, M2  
Erik Geshke, M2  
Alexis Kuhr, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The master of fine arts program places major emphasis on creative studio work of high quality. It promotes not only the conceptual and technical education of the professional artist in the context of the studio environment, encouraging critical inquiry, excellence, and an understanding of the history of art, but also an experimental approach toward each media. The following areas of concentration are available: ceramics, drawing and painting, photography, printmaking, sculpture, and time and interactivity. The M.F.A. is considered the terminal degree in the field of fine arts and is typically the degree required to teach at the college or university level.

**Prerequisites for Admission**—An undergraduate degree is required.

**Special Application Requirements**—Admission is in fall semester only. Ceramics, painting, and sculpture applicants must submit from 10 to 20 color slides of work in a slide carousel completed in their chosen medium. Printmaking applicants must submit a minimum of four original prints in addition to slides. Time and interactivity applicants must submit a portfolio in the medium appropriate to the work being submitted for review. Photography applicants may submit 10 to 20 slides or a minimum of ten finished prints. Three letters of recommendation must be sent directly to the director of graduate studies, as well as a brief statement of purpose that describes the applicant's reasons for pursuing an advanced degree. Completed Graduate School applications (including official transcripts) must reach the Graduate School by January 5. Slides or visual portfolio, letters of recommendation, and the statement of purpose must reach the director

of graduate studies in the Department of Art also by January 5. Incomplete files will not be reviewed.

**Courses**—Please refer to Art (ArtS) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses in the related field (other than art history) on the degree program form is subject to the adviser and director of graduate studies approval.

#### M.F.A. Degree Requirements

The M.F.A. program requires a total of 60 credits. It is typically a three-year program and studio space is provided for a maximum of three consecutive years for the pursuit of appropriate visual research. The program requires that coursework be completed prior to the final year of thesis registration. Candidates must plan programs with their advisers to include the graduate seminars ArtS 8400 (taken in the first term) and ArtS 8410 (taken in the second year) and 27 credits of visual art coursework. The related field requirement of 9 credits includes three courses in the history of art (or two courses in the history of art and one course from another academic department pertinent to the student's program). Candidates must be reviewed annually for progress through the program. At the end of the thesis year, candidates demonstrate their visual research accomplishments through a solo thesis exhibition on campus, a supporting paper, and a final oral exam.

**Language Requirements**—None.

#### Minor Requirements for Students

**Majoring in Other Fields**—A minor in art may be obtained by candidates in a master's program by completing 9 credits of graduate level coursework chosen in consultation with the director of graduate studies in art. Candidates in a Ph.D. program must complete 12 credits. The minor must include ArtS 8400—Theoretical Constructions in Contemporary Art.

## Art Education

See Education, Curriculum, and Instruction.

## Art History

**Contact Information**—Department of Art History, University of Minnesota, 338 Heller Hall, 271 19th Avenue South, Minneapolis, MN 55455 (612-624-4500; fax 612-626-8679; [arthist@umn.edu](mailto:arthist@umn.edu); <[www.arthist.umn.edu](http://www.arthist.umn.edu)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### Professor

Frederick M. Asher, SM  
Frederick A. Cooper, SM  
Karal Ann R. Marling, SM  
Evan M. Maurer, AM  
Sheila J. McNally, SM  
Robert J. Poor, SM  
Leon G. Satkowski, ASM  
Gabriel P. Weisberg, SM

### Associate Professor

W. John Archer, ASM  
Catherine B. Asher, SM  
Jane M. Blocker, SM  
Lyndel I. King, AM  
Robert B. Silberman, SM  
Katherine M. Solomonson, ASM  
John W. Steyeart, SM

### Assistant Professor

Jane M. Blocker, SM  
Michael Gaudio, SM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Areas of specialization are: American art, architecture, and popular culture; early modern art; East Asian art and Bronze Age archaeology; Greek and Roman art and archaeology; Islamic art and architecture; Late Gothic and northern Renaissance art; modern art and theory including film and photography studies as well as nineteenth through twenty-first century art; South Asian art and architecture.

**Prerequisites for Admission**—For the M.A. program, a bachelor's degree is required, preferably in art history or a closely related field. Ability and scholarly promise must be demonstrated by a past record of academic excellence. For the Ph.D. program, an M.A. degree in art history or in a field closely related to the chosen area of specialization is required, as well as coursework or other experience indicating substantial background in art historical methods and knowledge.

**Special Application Requirements**—For the M.A. program, results from the GRE General Test, at least one substantial research paper in art history, and three letters of recommendation from persons well acquainted with the applicant's research and writing skills are required. In addition, M.A. applicants must provide a detailed statement describing previous experience and academic training as related to the projected course of study and academic goals.

For the Ph.D. program, results from the GRE General Test, an M.A. thesis or a minimum of two substantial M.A. papers in art history, and three letters of recommendation from persons well acquainted with the applicant's research and writing skills are required. In addition, Ph.D. applicants must provide a statement describing previous experience and academic training as related to the projected course of study and academic goals. Ph.D. candidates are urged to contact the director of graduate studies before application.

Applications for the Ph.D. program (if not previously enrolled in the department) and M.A. program are reviewed in January for admission in the fall. For both of these, the application form, statement of purpose, official transcripts, and official GRE scores must reach the Graduate School by early January (contact the Department of Art History for the precise date). Duplicates of these materials, as well as three letters of

recommendation and research paper(s), must reach the department by the same deadline. Internal Ph.D. applicants should contact the department for details and deadlines. All applications for financial aid are due on the same date as the applications for admission.

**Art History Visual Resources Center**—The Art History Visual Resources Center (VRC) is located at 460 Heller Hall. The center has holdings of approximately 250,000 slides, and 100,000 photo archives, with content ranging from the prehistoric to the contemporary, in architecture, sculpture, painting, and other media, from all areas of the world. In addition, there is a collection of over 250 films.

**Courses**—Please refer to Art History (ArtH) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx art history courses on the degree program form is subject to adviser and director of graduate studies approval. Students from other majors may include such courses subject to their own program's approval.

### M.A. Plan B Degree Requirements

A minimum of 36 course credits (about 12 courses) is required, including at least two 8xxx seminars in art history. A minimum of 21 credits must be art historical in content and drawn from courses in at least three of the following areas: American, ancient, early modern, East Asian, Islamic, medieval, modern and contemporary, South Asian. Of these, three courses must be in an area of primary concentration, two courses in an area of secondary concentration, and one course in a third area. Students focusing on Asian/Islamic art must take at least one course in western art. Students focusing on western art must take at least one course in Asian/Islamic art. In addition, students must take 6 credits in courses that are not art historical in content. The remaining 9 credits may be either in art history or outside the discipline; this is decided in consultation with the adviser and the director of graduate studies. Two Plan B papers are required, the first of which should be completed by the end of the first year of full-time study.

**Language Requirements**—Students must attain reading proficiency in a second language directly related to their course of study.

**Final Exam**—The final exam is written. See the department's *Graduate Student Handbook* for details.

### Minor Requirements for Students

**Majoring in Other Fields**—For an M.A. degree, a minimum of 11 graduate credits in art history is required for a minor.

### Ph.D. Degree Requirements

A minimum of 54 course credits (about 18 courses) is required. At least 18 credits (about six courses) must be in an area of primary concentration within art history, while a minimum of 9 credits (about three courses) must be in an area of secondary

concentration in art history. In addition, at least 6 credits (about two courses) must be outside the field of art history in the minor or supporting program beyond work done at the M.A. level; a minimum of 12 credits in a minor or supporting field is required.

**Language Requirements**—Students must attain reading proficiency in at least two foreign languages. Contact the director of graduate studies for details.

### Minor Requirements for Students

**Majoring in Other Fields**—A doctoral minor requires a minimum of 12 credits in art history.

## Asian Languages and Literatures

New graduate degree programs in Asian Languages, Cultures, and Media (ALCM) in the department of Asian Languages and Literatures (ALL) are under development. Contact the program for more information.

**Note:** *No new students are being admitted to the Chinese, Japanese, and South Asian Languages graduate programs.*

Graduate students currently enrolled in any of these degree programs are to work with the Graduate School to complete their course requirements. Questions regarding curriculum options can be directed to the director of graduate studies of Asian Languages and Literatures, or to a member of the ALL administrative staff.

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Chinese

#### Professor

Joseph R. Allen, SM  
Richard B. Mather (emeritus), ASM  
Ann B. Waltner, History, SM

#### Assistant Professor

William Schaefer, SM

### Japanese

#### Professor

Joseph R. Allen, SM

#### Associate Professor

Michael S. Molasky, SM  
Polly E. Szatrowski, SM

#### Assistant Professor

Mark Anderson, ASM  
Maki Morinaga, ASM

### South Asian Languages

#### Professor

Frederick M. Asher, Art History, SM  
Iraj Bashiri, SM  
Indira Y. Junghare, SM

#### Associate Professor

William W. Malandra, Classical and Near Eastern Studies, SM

#### Librarian

Donald C. Johnson, Ames Library of South Asia, M2

## Astrophysics

**Contact Information**—Department of Astronomy, University of Minnesota, 356 Tate Laboratory of Physics, 116 Church Street S.E., Minneapolis, MN 55455 (612-624-0211; fax 612-626-2029; [grad-eq@astro.umn.edu](mailto:grad-eq@astro.umn.edu) <<http://astro.umn.edu>>).  
For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Cynthia A. Cattell, Physics, ASM  
Kris D. Davidson, SM  
John M. Dickey, SM  
Robert D. Gehrz, SM  
Roberta M. Humphreys, SM  
Terry J. Jones, SM  
Thomas W. Jones, SM  
Leonard V. Kuhl, SM  
Robert L. Lysak, Physics, ASM  
Keith A. Olive, Physics, ASM  
Robert O. Pepin, Physics, ASM  
Lawrence Rudnick, SM  
Evan D. Skillman, SM  
Paul R. Woodward, SM

### Associate Professor

Shaul Hanany, Physics, ASM  
Yong-zhong Qian, Physics, ASM  
Charles E. Woodward, SM  
John R. Wygant, Physics, ASM

### Assistant Professor

Michael DuVernois, Physics, ASM  
Kim A. Venn, Macalester College, ASM  
Liliya L. Williams, SM

### Senior Research Associate

David H. Porter, SM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Astrophysics is the study of the universe and its constituent parts. The program offers emphases in observational, theoretical, and computational astrophysics and in instrument development. The main research areas include properties and dynamics of normal and active galaxies, quasars, stellar evolution, interaction of stars with their environments, the interstellar medium, astrophysical magnetohydrodynamics, and galactic and cosmological structure. Observational research includes activities that cover X-ray, ultraviolet, optical, infrared, and radio wavelengths. Extensive research programs in space physics and the elementary particle-cosmology interface are also carried out in interdisciplinary connections with the graduate program in physics.

**Prerequisites for Admission**—For major work, an undergraduate degree in astronomy or physics or the equivalent is required. Contact the director of graduate studies for exceptions.

**Special Application Requirements**—A statement of career goals, scores from the GRE General (Aptitude) Test and Subject (Advanced) Test in physics, and three letters of recommendation are required. Applications for financial aid are due January 15. Applications are accepted for entry into fall semester only.

**Facilities**—The Department of Astronomy has purchased a 5 percent share in the Large Binocular Telescope (LBT) on Mt. Graham in southeastern Arizona. The LBT is currently under construction through a consortium of universities and research institutes led by the University of Arizona and has an expected completion date of 2004. This purchase will also allow the department to trade time on the LBT for time on several other telescopes—including the 6.5 meter upgraded Multiple Mirror Telescope, the two 6.5 meter Magellan telescopes in the southern hemisphere, and the 10 meter Heinrich Hertz millimeter radio telescope—as well as other smaller telescopes in Arizona, providing guaranteed access to multi-wavelength capabilities.

The University also operates a 60-inch telescope on Mt. Lemmon, near Tucson, Arizona, which is well equipped for both optical and infrared observations. A 30-inch telescope with a CCD camera and infrared instruments is maintained at the O'Brien Observatory about 40 miles from the Twin Cities campus. Both telescopes are fully computer controlled and can be operated remotely. Excellent shop facilities support our instrument development for the telescopes at O'Brien and Mt. Lemmon and for major national observatories such as the NASA Infrared Telescope Facility (IRTF) in Hawaii and for the LBT.

The Automated Plate Scanner is based in the astronomy department and has been used to digitize the entire Palomar Sky Survey resulting in a massive catalog of star and galaxy positions, magnitudes, and colors. The catalog is freely available on the Web. The associated computer reduction system can analyze 100,000 images per hour.

The astronomy department maintains a large network of linux-based computers used for the reduction and analysis of X-ray, ultraviolet, optical, and radio observations. The department is connected through an ethernet backbone to clusters of supercomputers and super-workstations at the University's Digital Technology Center and the Laboratory for Computational Science and Engineering. These facilities are available to faculty and students for their research.

In addition, members of the department regularly use such national facilities as the Kitt Peak National Observatory; Cerro Tololo Inter-American Observatory in Chile; National Radio Astronomy Observatory's facilities in Green Bank and the VLA; Arecibo Radio Observatory; and the NASA space based facilities such as the Hubble Space Telescope, the Far Ultraviolet Space Explorer, the Space Infrared Telescope Facility, the Chandra X-ray Space Telescope, and the IRTF in Hawaii.

**Courses**—Please refer to Astronomy (Ast) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—A 4xxx astrophysics course may be counted toward the M.S. or Ph.D. degree programs.

### M.S. Degree Requirements

The master's degree requires a minimum of 30 credits, including one semester of classical physics (Phys 5011) and one year of the two year-long sequences in introductory astrophysics (Ast 4011-4021 or Ast 5012-5022). Additional requirements depend on whether the student chooses the thesis (Plan A) or non-thesis (Plan B) option. Plan A requires 20 credits of coursework and 10 thesis credits. Plan B requires 30 credits of coursework. Completion of the degree normally takes two years.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—For the master's minor, 8 credits in astrophysics are required, either the Ast 4011-4021 or Ast 5012-5022 sequence.

### Ph.D. Degree Requirements

The Ph.D. degree requires a minimum of 40 course credits, including a year of classical physics (Phys 5011-5012), the two year-long sequences in introductory astrophysics (Ast 4011-4021 and Ast 5012-5022), and 12 credits in a minor or supporting program; 24 thesis credits are also required. The graduate written examination, offered during the spring, must be passed on the second "real" attempt (first-year students are given a free trial). A second-year project must be defended by the end of the fall semester of the third year. The preliminary oral exam must be passed by the end of the third year.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—For the Ph.D. minor, 12 credits in astrophysics are required, including either the Ast 4011-4021 or the Ast 5012-5022 sequence.

## Biochemistry, Molecular Biology, and Biophysics

**Contact Information**—Department of Biochemistry, Molecular Biology, and Biophysics, University of Minnesota, 6-155 Jackson Hall, 321 Church Street S.E., Minneapolis, MN 55455 (612-625-5179; fax 612-625-2163), [bmbbgp@umn.edu](mailto:bmbbgp@umn.edu) <<http://cbs.umn.edu/gpbmbb/>>.

For information on the master's and doctoral degree programs offered in conjunction with the University of Minnesota Duluth, contact the associate director of graduate studies, Department of Biochemistry and Molecular Biology, 251 School of Medicine, University of Minnesota, 1035 University Drive, Duluth, MN 55812 (218-726-7922).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

John S. Anderson, SM  
Matthew T. Andrews, Biology, Duluth, SM  
Ian M. Armitage, SM  
Leonard J. Banaszak, SM  
George Barany, Chemistry, SM  
Bridgette A. Barry, SM  
David A. Bernlohr, SM  
Victor A. Bloomfield, SM  
Robert J. Brooker, Genetics, Cell Biology, and Development, SM  
Bianca M. Conti-Fine, SM  
Anath Das, SM  
Mary E. Dempsey, SM  
Lester R. Drewes, Biochemistry and Molecular Biology, Duluth, SM  
Michael C. Flickinger, SM  
James A. Fuchs, SM  
Arun Goyal, Plant Biology, SM  
Thomas S. Hays, Genetics, Cell Biology, and Development, SM  
Alan B. Hooper, SM  
David C. LaPorte, SM  
John D. Lipscomb, SM  
Dennis M. Livingston, SM  
Rex E. Lovrien, SM  
Kevin H. Mayo, SM  
Matthew F. Mescher, Laboratory Medicine and Pathology, SM  
Karin Musier-Forsyth, Chemistry, SM  
Gary L. Nelsestuen, SM  
Michael B. O'Connor, Genetics, Cell Biology, and Development, SM  
Douglas H. Ohlendorf, SM  
Harry T. Orr, Laboratory Medicine and Pathology, SM  
Joseph R. Prohaska, Biochemistry and Molecular Biology, Duluth, SM  
Lawrence Que, Chemistry, SM  
Michael J. Sadowsky, Soil, Water, and Climate, SM  
Michel M. Sanders, SM  
Janet L. Schottel, SM  
David H. Sherman, Microbiology, SM  
David D. Thomas, SM  
Howard C. Towle, SM  
Tian Y. Tsong, SM  
Brian G. Van Ness, SM  
Lawrence P. Wackett, SM  
Kendall B. Wallace, Biochemistry and Molecular Biology, Duluth, SM

### Associate Professor

Kenneth W. Adolph, SM  
Vivian J. Bardwell, Genetics, Cell Biology, and Development, SM  
Benjamin L. Clarke, Medical Microbiology and Immunology, Duluth, SM  
Antony Michael Dean, BioTechnology Institute, SM  
Stephen C. Ekker, Genetics, Cell Biology, and Development, SM  
Cecilia Giuliani, Chemistry, Duluth, SM  
Eric A. Hendrickson, SM  
Thomas E. Huntley, Duluth, SM  
Alex J. Lange, SM  
Sharon E. Murphy, SM  
Merry Jo Oursler, Biology, Duluth, SM  
Robert J. Roon, SM  
Ann E. Rougvie, Genetics, Cell Biology and Development, SM  
Paul G. Siliciano, SM  
Jeffrey A. Simon, Genetics, Cell Biology, and Development, SM  
David A. Zarkower, Genetics, Cell Biology, and Development, SM

### Assistant Professor

Anja K. Bielinsky, SM  
Annette L. Boman, Biochemistry and Molecular Biology, Duluth, SM  
Deborah A. Ferrington, Ophthalmology, SM  
Arun Goyal, Biology, Duluth, SM  
Julio E. Herrera, SM  
Arkady B. Khodursky, SM  
Hiroshi Matsuo, SM  
Laura J. Mauro, Animal Science, SM  
Lincoln R. Potter, SM  
Claudia Schmidt-Dannert, SM

Robert J. Sheaff, SM  
Gianluigi Veglia, Chemistry, SM  
Kylie J. Walters, SM  
Jennifer J. Westendorf, Cancer Center, SM  
Carrie M. Wilmot, SM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The biochemistry, molecular biology, and biophysics program focuses on an explanation at the molecular level of the structures and processes that occur in living organisms. In the broadest sense, the program encompasses the chemistry, physics, and biology of living systems. Included is the study of the structure and function of biomolecules (proteins, nucleic acids, lipids, and carbohydrates), enzyme catalysis, metabolic pathways, bioenergetics, and the biochemical nature of genetic information storage and transmission, as well as the control, regulation, and integration of these processes. The program has four areas of emphasis: regulatory biochemistry, molecular biology, microbial biotechnology, and molecular biophysics. All students are expected to demonstrate a minimum level of competence in these areas but emphasize that area most related to their thesis project. The program involves faculty from the Department of Biochemistry, Molecular Biology, and Biophysics, as well as many faculty members from several other departments in the College of Biological Sciences, Medical School, Institute of Technology, and College of Veterinary Medicine.

**Prerequisites for Admission**—The program is flexible enough to accommodate students with a wide variety of educational backgrounds. Applications from students with undergraduate or master's degrees in the biological, chemical, or physical sciences are encouraged. Recommended academic preparation includes one year each of calculus, organic chemistry, and basic biology, including biochemistry and genetics. For students of demonstrated ability, background deficiencies can be made up during the first year of graduate study.

**Special Application Requirements**—Applicants must submit three letters of recommendation from persons familiar with their academic and research capabilities. A statement of interests and goals, a complete set of transcripts, and official scores from the General Test of the GRE are required. The GRE Subject Test in biochemistry, cell and molecular biology, biology, or chemistry is strongly recommended, but not required. The recommended date for receipt of completed applications is December 1. Completed files are reviewed between December and February. Graduate studies typically begin fall semester. Information about an early start program involving participation in laboratory research beginning on July 1 may be obtained from the director of graduate studies.

**Courses**—Please refer to Biochemistry (BioC) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses toward degree requirements is permitted with written approval from a director of graduate studies.

### M.S. Plan A Degree Requirements

Requirements for the M.S. degree include core coursework and laboratory experiences taken by all students, followed by one or more courses in one of the areas of specialization. In addition, all students are expected to participate in the seminar involving student reports on current literature and research. A thesis based on original laboratory research is required.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor requires 6 credits of general graduate level coursework which may be selected (with approval by the director of graduate studies) from the 5xxx and 8xxx courses offered by the program. BioC 4331 and 4332 may also be considered if approved by the directors of graduate studies of both the major and minor programs.

### Ph.D. Degree Requirements

Requirements for the doctoral degree include core coursework and laboratory experiences taken by all students, followed by one or more courses in one of the areas of specialization. In addition, all students are expected to participate in two continuing series of seminars: one involving student reports on current literature and research and the other involving prominent national and international scientists.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—A doctoral minor requires BioC 8002 (4 credits) plus additional courses (8 credits), approved by the director of graduate studies, to meet the minimum requirement of 12 total credits. In extenuating cases, students may petition the director of graduate studies for substitution of a required course.

## Bioethics

### Minor Only

**Contact Information**—Graduate Minor in Bioethics, Center for Bioethics, University of Minnesota, N504 Boynton, 410 Church St. SE, Minneapolis MN 55455-0346 (612-624-9440; fax 612-624-9108; [bioethx@umn.edu](mailto:bioethx@umn.edu); [www.bioethics.umn.edu](http://www.bioethics.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Muriel Bebeau, Preventive Sciences, M  
Dan Burk, Law, M  
Norman Dahl, Philosophy, M  
John Eyler, History of Medicine, M  
Jasper Hopkins, Philosophy, M

Jeffrey Kahn, Medicine, M  
 Rosalie Kane, Public Health, M  
 David Mayo, Philosophy, Duluth, M  
 Steven Miles, Medicine, M  
 Naomi Scheman, Philosophy, M  
 Susan M. Wolf, Law School, M

#### Associate Professor

John Dolan, Philosophy, M  
 Carl Elliott, Pediatrics, M  
 Joan Liaschenko, Nursing, M  
 Gregory Plotnikoff, Medicine, M  
 Michael Root, Philosophy, M

#### Assistant Professor

Debra DeBruin, Medicine, M  
 Edward Ratner, Medicine, M  
 John Song, Medicine, M  
 Karen-Sue Taussig, Medicine, M  
 Beth Virmig, Health Services Research and Policy, M

#### Senior Research Fellow

Jonathan Kahn, Law, M

#### Other

Dianne Bartels, Center for Bioethics, M  
 Ronald Cranford, Neurology, M

**Curriculum**—The Center for Bioethics, in close cooperation with the Department of Philosophy, offers a minor in bioethics for master's (M.A. and M.S.) and doctoral students with approval of the director of graduate studies in bioethics. The minor provides a structured program of study as well as formal recognition for academic accomplishments in the field.

While recognizing that philosophy is the focal discipline for the study of bioethics, the minor offers numerous opportunities for multidisciplinary study, including in history and philosophy of medicine, health law and public policy, health-care economics, professional ethics, clinical ethics, medical humanities, and moral development.

**Prerequisites for Admission**—Admission is contingent upon prior admission to a master's or doctoral degree-granting program within the Graduate School. Students are encouraged to have some previous exposure to philosophy or biomedicine or both. Graduate students in philosophy are expected to have successfully completed at least one graduate course in ethical theory.

**Special Application Requirements**—Contact the director of graduate studies in bioethics for an *Intent to Enroll* form, which should be submitted by the middle of the spring semester the year before initiating coursework in the minor. Enrollment is contingent upon approval by the director of graduate studies for bioethics.

**Courses**—Please contact the minor program office for information on relevant coursework.

**Use of 4xxx Courses**—Some 4xxx courses are allowed as indicated in the guidelines for the bioethics minor, available from the director of graduate studies.

#### Minor Only Requirements

**Students Majoring in Philosophy**—Master's students (M.A. and M.S.) must complete a minimum of 8 graduate credits in bioethics consisting of 6 credits of required courses and 2 credits of electives outside the Department of Philosophy.

Doctoral students must complete a minimum of 14 graduate credits in bioethics consisting of 8 credits of required courses and 6 credits of electives outside the Department of Philosophy.

**Students Majoring in a Field Other Than Philosophy**—Master's students (M.A. and M.S.) must complete a minimum of 8 graduate credits in bioethics outside the student's major. Master's students are not required to take electives in bioethics and cognate areas, but are encouraged to do so.

Doctoral students must complete a minimum of 14 graduate credits in bioethics outside the student's major consisting of 8 credits of required courses and 6 credits of electives.

## Bioinformatics

### Minor Only

**Contact Information**—Graduate Minor Program in Bioinformatics, Department of Laboratory Medicine and Pathology, University of Minnesota, MMC 511, 420 Delaware Street S.E., Minneapolis, MN 55455 (612-625-8440; fax 612-625-7166; [bioinfo@umn.edu](mailto:bioinfo@umn.edu); <[www.binf.umn.edu](http://www.binf.umn.edu)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### Professor

Daniel Boley, Computer Science, M  
 Lynda B. M. Ellis, Laboratory Medicine and Pathology, M  
 Alexander Grosberg, Physics, M  
 Vivek Kapur, Microbiology, M  
 Claudia Neuhauser, Ecology, Evolution, and Behavior, M  
 Hans Othmer, Mathematics, M  
 Lawrence P. Wackett, Biochemistry, Molecular Biology, and Biophysics, M  
 Nevin Dale Young, Plant Pathology, M

#### Associate Professor

Colin Campbell, Pharmacology, M  
 John Carlis, Computer Science, M  
 Scott Fahrenkrug, Animal Science, M  
 Georgiana May, Ecology, Evolution, and Behavior, M  
 Wei Pan, Biostatistics, M

#### Assistant Professor

Yang Da, Animal Science, M  
 George Karypis, Computer Science, M  
 Yiannis Kaznessis, Chemical Engineering and Materials Science, M  
 Arkady Khodursky, Biochemistry, Molecular Biology, and Biophysics, M  
 Cavan Reilly, Biostatistics, M

**Curriculum**—The bioinformatics minor is available to master's (M.A. and M.S.) and doctoral students. The minor includes core coursework in computer and biological sciences and opportunities to interact with others interested in bioinformatics. The curriculum encourages interdisciplinary interaction, communication, and synthesis. The minor is intended to provide graduate-level biological or computer science students with basic training in bioinformatics as a complement to their major science background and broaden their professional abilities. The program of study is tailored by advance consultation between the student and the director of graduate studies for the bioinformatics minor. All courses taken to fulfill minor requirements must be graded A-F.

**Prerequisites for Admission**—Admission to a master's or doctoral degree-granting program within the Graduate School and preparation of a minor program of coursework approved by the director of graduate studies in bioinformatics is required. Potential programs must be discussed with the director of graduate studies.

**Courses**—Courses are taken from a designated course list available online at <[www.binf.umn.edu/courses.html](http://www.binf.umn.edu/courses.html)>.

**Use of 4xxx Courses**—Biol 4003—Genetics is the only 4xxx course that may be included on degree program forms.

#### Minor Only Requirements

The master's and doctoral minors are developed in consultation with, and must be approved in advance by, the director of graduate studies for bioinformatics. The master's minor requires at least 9 credits, including CSci 5481—Computational Techniques for Genomics, one of several genomics or sequence analysis courses, and a third designated course. Other courses may be substituted upon the recommendation of the director of graduate studies.

The doctoral minor requires at least 15 credits, including the master's courses, one of several courses in statistical genomics, and an elective. Other courses may be substituted upon the recommendation of the director of graduate studies.

## Biological Science

**Contact Information**—Master of Biological Science, Professional Program, College of Biological Sciences, 123 Snyder Hall, 1475 Gortner Avenue, St. Paul, MN 55108 (612-625-3133; fax 612-624-2785; [biolink@cbs.umn.edu](mailto:biolink@cbs.umn.edu); <[www.cbs.umn.edu/biolink/mbs2.html](http://www.cbs.umn.edu/biolink/mbs2.html)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### Professor

John S. Anderson, Biochemistry, Molecular Biology, and Biophysics, M2  
 Jay Bell, Soil, Water, and Climate, AM2  
 Judith G. Berman, Molecular, Cellular, Developmental Biology and Genetics, M2  
 David A. Bernlohr, Biochemistry, Molecular Biology, and Biophysics, M2  
 Linda J. Brady, Food Science and Nutrition, AM2  
 Robert M. Brambl, Plant Biology, M2  
 Paul P. Cleary, Microbiology, AM2  
 Gary M. Dunny, Microbiology, AM2  
 Leonard C. Ferrington, Entomology, AM2  
 James A. Fuchs, Biochemistry, Molecular Biology, and Biophysics, M2  
 Daniel D. Gallaher, Food Science and Nutrition, AM  
 Ralph W. Holzenthal, Entomology, AM2  
 Ross G. Johnson, Molecular, Cellular, Developmental Biology and Genetics, AM2  
 John H. Kersey, Laboratory Medicine and Pathology, AM2  
 Youngki Kim, Pediatrics, AM2  
 Richard King, Pediatrics, AM2  
 Mindy S. Kurzer, Food Science and Nutrition, AM2  
 Paul T. Magee, Microbiology, M2  
 Sheldon M. Mauer, Pediatrics, M2  
 Gary L. Nelsestuen, Biochemistry, Molecular Biology, and Biophysics, AM2

Harry T. Orr, Laboratory Medicine and Pathology, M2  
Gary A. Reineccius, Food Science and Nutrition, AM2  
Michael J. Sadowsky, Soil, Water, and Climate, AM2  
Patrick M. Schlievert, Microbiology, AM2  
Michael J. Simmons, Molecular, Cellular,  
Developmental Biology and Genetics, M2  
Donald B. Siniff, Ecology, Evolution, and Behavior,  
M2  
Joanne L. Slavin, Food Science and Nutrition, AM2  
D. Peter Snustad, Plant Biology, M2  
George R. Spangler, Fisheries, Wildlife, and  
Conservation Biology, AM2  
Howard Towle, Biochemistry, Molecular Biology, and  
Biophysics, M2  
Daniel A. Vallera, Therapeutic Radiology, AM2  
Brian G. Van Ness, Laboratory Medicine and  
Pathology, M2  
Lawrence P. Wackett, BioTechnology Institute, M2  
Clifford M. Wetmore, Plant Biology, M2  
Chester B. Whitley, Pediatrics, AM2

### **Ajunct Professor**

Bruce Vondracek, Fisheries, Wildlife, and  
Conservation Biology, AM2

### **Associate Professor**

Gregory Jose Beilman, Surgery, AM2  
Wei Chen, Pediatrics, AM2  
Joellen Feirtag, Food Science and Nutrition, AM2  
Susan M. Galatowitsch, Horticultural Science, AM2  
Craig A. Hassel, Food Science and Nutrition, AM2  
Stephen Jameson, Laboratory Medicine and  
Pathology, AM2  
Ronald R. Jemerson, Microbiology, AM2  
David A. Largaespada, Genetics, Cell Biology, and  
Development, AM2  
Susan E. Marino, Pharmacy, AM2  
Christopher A. Pennell, Laboratory Medicine and  
Pathology, AM2

### **Assistant Professor**

Cheryl A. Gale, Pediatrics, AM2  
David C. Fulton, Fisheries, Wildlife, and Conservation  
Biology, AM2  
Anna Petryk, Pediatrics, AM2

### **Research Associate**

Nicole Kirchof, Surgery, AM2  
Laura J. Suggs, Biomedical Engineering, AM2  
Robert C. Venette, Entomology, AM2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—A professional master of biological science (M.B.S.) degree is offered with concentrations in areas such as biochemistry, basic biology (animal, plant, cell, applied, and general), biotechnology, biophysics, ecology, environment, evolution, food science and nutrition, genetics, microbiology, molecular biology, and neuroscience. It is a multicollege, cooperative degree program among the Colleges of Biological Sciences, Veterinary Medicine, and Agricultural, Food and Environmental Sciences. The program is administered by the College of Biological Sciences and the degree is conferred by the Graduate School.

The M.B.S. is a highly flexible graduate-level practitioner-based program offered to meet the needs of a substantial portion of the working community who wish or need to increase their knowledge in areas related to modern biology. The program provides educational opportunities beyond those that aim at maintaining and improving productivity within the professions. It fills a

gap in the present educational system for those who have neither the time nor the flexibility to earn a graduate degree through more traditional channels. It also provides this population with the most current information and advanced skills in their areas of professional interest, and gives them acknowledgment for their achievement. The degree enables recipients to learn new job skills, change professional emphasis, or provide added value to their present job.

**Courses**—Please contact the program office for information on relevant coursework.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### **M.B.S. Coursework Only Degree Requirements**

The program includes coursework, seminars, independent study, workshops, and a capstone project. With guidance from faculty advisers, students complete 30 credits.

M.B.S. candidates may transfer up to 8 credits into the program. Core credits may be waived or substituted if the student can show proficiency in the subject area, pending advisory committee approval. If a core credit is waived, the credits must still be earned in an elective course. Coursework is taken from the regular curriculum in the participating colleges, as well as from other approved credit-bearing courses (e.g., intensive short courses and Internet courses). The overall GPA of a candidate must be a minimum of 3.00 for the degree to be awarded. A student with 8 or more credits of incomplete (I) coursework will not be allowed to register for additional courses until the I's are completed.

**Language Requirements**—None.

**Final Exam**—A capstone project is required.

## **Biomedical Engineering**

**Contact Information**—Department of Biomedical Engineering, University of Minnesota, 7-105 BS&BE, 312 Church Street S.E., Minneapolis, MN 55455 (612-624-8396; fax 612-624-1120; [bmengp@umn.edu](mailto:bmengp@umn.edu); <[www1.umn.edu/bme](http://www1.umn.edu/bme)>). Program office is located in room 187 Shepherd Labs, 100 Union Street S.E., Minneapolis campus.

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### **Professor**

Robert J. Bache, Medicine, SM  
David G. Benditt, Medicine, SM  
John C. Bischof, Mechanical Engineering, SM  
Frank B. Cerra, Surgery, SM  
Wei Chen, Radiology, SM  
Jay N. Cohn, Medicine, SM  
Max Donath, Mechanical Engineering, SM  
William K. Durfee, Mechanical Engineering, SM  
Timothy J. Ebner, Neuroscience, SM  
Arthur G. Erdman, Mechanical Engineering, SM  
Stanley M. Finkelstein, Laboratory Medicine and Pathology, SM  
Martha Flanders, Neuroscience, SM  
John E. Foker, Surgery, SM  
Lorraine F. Francis, Chemical Engineering and Materials Science, SM

Leo T. Furcht, Laboratory Medicine and Pathology, SM  
James R. Gage, Orthopaedic Surgery, M2  
Michael G. Garwood, Radiology, M2  
Robert P. Hebbel, Medicine, SM  
Wei-Shou Hu, Chemical Engineering and Materials Science, SM  
Xiaoping Hu, Radiology, SM  
Paul A. Iaizzo, Anesthesiology, SM  
Kenneth H. Keller, Public Affairs, SM  
Tarald O. Kvalseth, Mechanical Engineering, SM  
Paul C. Letourneau, Cell Biology and Neuroanatomy, SM  
David G. Levitt, Physiology, SM  
Jack L. Lewis, Orthopaedic Surgery, SM  
Rex E. Lovrien, Biochemistry, SM  
James B. McCarthy, Laboratory Medicine and Pathology, SM  
Robert P. Patterson, Physical Medicine and Rehabilitation, SM  
Dennis L. Polla, SM  
Richard E. Poppele, Neuroscience, SM  
Gundu H. R. Rao, Laboratory Medicine and Pathology, SM  
William P. Robbins, Electrical and Computer Engineering, M2  
Ronald A. Siegel, Pharmaceutics, SM  
Ephraim M. Sparrow, Mechanical Engineering, SM  
Stephen C. Strother, Radiology, SM  
Ahmed H. Tewfik, Electrical Engineering, SM  
Robert T. Tranquillo, Biomedical Engineering, SM  
Charles L. Truwit, Neurology, M2  
Neal F. Viemeister, Psychology, SM  
Robert F. Wilson, Medicine, M2

### **Associate Professor**

Jerome H. Abrams, Surgery, SM  
Alan J. Bank, Medicine, M2  
Gladwin S. Das, Medicine, SM  
Emad S. Ebbini, Electrical and Computer Engineering, SM  
William B. Gleason, Laboratory Medicine and Pathology, SM  
Bruce E. Hammer, Radiology, SM  
Ramesh Harjani, Electrical and Computer Engineering, M2  
James E. Holte, Electrical and Computer Engineering, SM  
Allison Hubel, Laboratory Medicine and Pathology, SM  
Keith G. Lurie, Medicine, M2  
Ronald C. McGlennen, Laboratory Medicine and Pathology, M2  
David J. Odde, SM  
Clark M. Smith II, Pediatrics, SM  
Joseph J. Tahlghader, Electrical and Computer Engineering, M2  
J. Thomas Vaughan, Radiology, SM  
Timothy S. Wiedmann, Pharmaceutics, SM  
Jay Zhang, Medicine, SM

### **Assistant Professor**

Edgar A. Arriaga, Chemistry, SM  
Victor H. Barocas, Biomedical Engineering, SM  
Joan E. Bechtold, Orthopaedic Surgery, M2  
Linda K. Hansen, Laboratory Medicine and Pathology, SM  
Haiying Liu, Radiology, M2  
Mark A. Nicosia, Biomedical Engineering, M2  
A. David Redish, Neuroscience, M2  
Kenneth P. Roberts, Urologic Surgery, SM  
Michael H. Schwartz, Orthopaedic Surgery, SM  
Carl S. Smith, Urologic Surgery, M2  
Peter N. Steinmetz, Biomedical Engineering, M2  
Babak Ziaie, Electrical and Computer Engineering, M2

### **Research Associate**

Laura J. Suggs, Biomedical Engineering, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Biomedical engineering is the application of engineering principles and methods to problems in biology and medicine. The discipline includes the study of fundamental processes in biology and physiology, the study of the diagnosis and treatment of disease and injury, and the design and development of medical devices and techniques. Students take courses in mathematics, biology, biomedical engineering, and areas of science and engineering that are relevant for the degree objectives.

**Prerequisites for Admission**—A baccalaureate degree in engineering or in a physical or biological science is required. Successful applicants without an engineering degree are required to complete appropriate coursework (including linear algebra and differential equations) before being admitted as a candidate for the degree. In most cases, this coursework is not considered part of the degree program.

**Special Application Requirements**—Three letters of recommendation and GRE scores are required of all applicants. For international students, the TOEFL with a minimum score of 575 is required.

**Courses**—Please refer to Biomedical Engineering (BME) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—No more than 3 credits of 4xxx courses may be included. These courses require approval of the adviser and director of graduate studies.

### M.S. Degree Requirements

The M.S. is offered under two plans: Plan A (with thesis) and Plan B (with project). Each program requires courses in mathematics, biology, biomedical engineering, and relevant areas of science and engineering, and a minor or related field. Plan A requires completion of 25 course credits. Plan B requires completion of 35 course credits, including the research project. Coursework in a minor or supporting field must include a minimum of 6 credits for both Plan A and Plan B.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—The master's minor requires at least 6 course credits, including one BME core course (5001, 5101, 5201, 5311, or 5351) and one other BME course at 5xxx or higher.

### Ph.D. Degree Requirements

The Ph.D. program requires coursework in mathematics, biology, biomedical engineering, and relevant areas of science and engineering (typically 40 credits, including those satisfying a minor field or supporting program), a written preliminary exam, an oral preliminary exam, a dissertation, and a final oral exam.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—The doctoral minor requires at least 12 credits, including two BME core courses (5001, 5101, 5201, 5311, or 5351), one course with a biological sciences emphasis (may be BME 5501), and one course with an engineering emphasis. All courses must be at 5xxx or higher.

## Biomedical Science

**Contact Information**—Assistant Director, Combined M.D./Ph.D. Training Program, University of Minnesota, MMC 293, 420 Delaware St. S.E., B690 Mayo, Minneapolis, MN 55455 (612-625-3680, 612-625-7402; <<http://mdphd.med.umn.edu>>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Regents Professor

Ashley T. Haase, Microbiology, SM  
James G. White, Laboratory Medicine and Pathology, SM

### Professor

Robert J. Bache, Medicine, SM.  
Leonard J. Banaszak, Biochemistry, SM  
Timothy Behrens, Medicine, SM  
Judith Berman, Genetics, Cell Biology, and Development, SM  
David Bernlohr, Biochemistry, Molecular Biology, and Biophysics, SM  
Susan Berry, Pediatrics, SM  
John Bischof, Mechanical Engineering, SM  
Peter Bitterman, Medicine, SM  
Bruce R. Blazar, Pediatrics, SM  
David Brown, Pathobiology, SM  
Paul P. Cleary, Microbiology, SM  
Denis Clohisey, Orthopaedic Surgery, SM  
Bianca M. Conti-Fine, Biochemistry, SM  
David N. Cornfield, Pediatrics, SM  
Gary Dunny, Microbiology, SM  
Timothy J. Ebner, Neuroscience, SM  
Robert P. Elde, Biological Sciences, SM  
David P. Fan, Genetics, Cell Biology, and Development, SM  
Stanley M. Finkelstein, Laboratory Medicine and Pathology, SM  
Martha Flanders, Neuroscience, SM  
Aaron Folsom, Epidemiology, SM  
James Fuchs, Biochemistry, Molecular Biology, and Biophysics, SM  
Apostolos P. Georgopoulos, Neuroscience, SM  
Glenn J. Giesler, Jr., Neuroscience, SM  
Christopher M. Gomez, Neurology, SM  
Dale Gregerson, Ophthalmology, SM  
Robert Hebbel, Medicine, SM  
Stephen S. Hecht, Cancer Center, SM  
Jordan L. Holtzman, Medicine, SM  
Karen Hsiao-Ashe, Neurology, SM  
Wei-Shou Hu, Chemical Engineering and Materials Science, SM  
David H. Ingbar, Medicine, SM  
Marc Jenkins, Microbiology, SM  
Jeffrey Kahn, Medicine, SM  
Richard King, Medicine, SM  
Ryoko Kuriyama, Genetics, Cell Biology, and Development, SM  
Alice A. Larson, Veterinary Pathobiology, SM  
Ping-Yee Law, Pharmacology, SM  
Tucker W. LeBien, Laboratory Medicine and Pathology, SM  
Hon Cheung Lee, Pharmacology, SM  
Paul C. Letourneau, Neuroscience, SM  
Jack L. Lewis, Orthopaedic Surgery, SM  
Richard W. Linck, Genetics, Cell Biology, and Development, SM  
John D. Lipscomb, Biochemistry, Molecular Biology, and Biophysics, SM  
Dennis Livingston, Biochemistry, Molecular Biology, and Biophysics, SM

Horace H. Loh, Pharmacology, SM  
Walter C. Low, Neurosurgery, SM  
Kevin Mayo, Biochemistry, Molecular Biology, and Biophysics, SM  
James B. McCarthy, Laboratory Medicine and Pathology, SM  
R. Scott McIvor, Genetics, Cell Biology, and Development, SM  
Steven C. McLoon, Neuroscience, SM  
Matthew F. Mescher, Laboratory Medicine and Pathology, SM  
Jeffrey S. Miller, Medicine, SM  
Robert Miller, Neuroscience, SM  
Daniel Mueller, Medicine, SM  
Charles Nelson, Child Health and Human Development, SM  
Eric Newman, Neuroscience, SM  
Douglas Ohlendorf, Biochemistry, Molecular Biology, and Biophysics, SM  
Harry T. Orr, Laboratory Medicine and Pathology, SM  
Richard Poppele, Neuroscience, SM  
Sundaram Ramakrishnan, Pharmacology, SM  
Laura Ranum, Genetics, Cell Biology, and Development, SM  
Michel M. Sanders, Biochemistry, SM  
Patrick Schlievert, Microbiology, SM  
Virginia S. Seybold, Neuroscience, SM  
Eyal Shahar, Epidemiology, SM  
Yoji Shimizu, Laboratory Medicine and Pathology, SM  
John F. Soechting, Neuroscience, SM  
Chang W. Song, Therapeutic Radiology, SM  
Sheldon B. Sparber, Pharmacology, SM  
Stanley A. Thayer, Pharmacology, SM  
David D. Thomas, Biochemistry, SM  
Howard C. Towle, Biochemistry, SM  
Robert Tranquillo, Biomedical Engineering, SM  
Kamil Ugurbil, Radiology, SM  
Daniel A. Vallera, Therapeutic Radiology, SM  
Brian G. Van Ness, Genetics, Cell Biology, and Development, SM  
Catherine Verfaillie, Medicine, SM  
Li-Na Wei, Pharmacology, SM  
Carol L. Wells, Laboratory Medicine and Pathology, SM  
George Wilcox, Neuroscience, SM  
Douglas Yee, Medicine, SM

### Associate Professor

James Ashe, Neuroscience, SM  
Vivian J. Bardwell, Genetics, Cell Biology, and Development, SM  
John C. Bischof, Mechanical Engineering, SM  
Kathleen F. Conklin, Microbiology, SM  
Stephen Ekker, Genetics, Cell Biology, and Development, SM  
Kristin A. Hogquist, Laboratory Medicine and Pathology, SM  
Christopher Honda, Neuroscience, SM  
Allison Hubel, Mechanical Engineering, SM  
Victoria Iwanji, Genetics, Cell Biology, and Development, SM  
Stephen C. Jameson, Laboratory Medicine and Pathology, SM  
David A. Largaespada, Genetics, Cell Biology, and Development, SM  
Linda McLoon, Ophthalmology, SM  
Jose V. Pardo, Psychiatry, SM  
Christopher Pennell, Laboratory Medicine and Pathology, SM  
Lisa A. Peterson, Environmental and Occupational Health, SM  
Mary E. Porter, Genetics, Cell Biology, and Development, SM  
Leslie Schiff, Microbiology, SM  
Paul G. Siliciano, Biochemistry, Molecular Biology, and Biophysics, SM  
Donald Simone, Oral Sciences, SM  
Amy P. N. Skubit, Laboratory Medicine and Pathology, SM  
Peter J. Southern, Microbiology, SM  
R. Carston Wagner, Pharmacy, SM

### Assistant Professor

Edgar Arriaga, Chemistry, SM  
Victor Barocas, Biomedical Engineering, SM  
Joan Bechtold, Orthopaedic Surgery, SM  
Paul Bohjanen, Microbiology, SM  
Linda M. Boland, Neuroscience, SM  
Michael Bowser, Chemistry, SM  
Michael Farrar, Laboratory Medicine and Pathology, SM  
Dan Kaufman, Medicine, SM  
Carol A. Lange, Medicine, SM  
Paul Mermelstein, Neuroscience, SM  
Lincoln Potter, Biochemistry, Molecular Biology, and Biophysics, SM  
Kathryn Schmitz, Epidemiology, SM  
Peter Steinmetz, Biomedical Engineering, SM  
Gianluigi Veglia, Chemistry, SM  
Jennifer Westendorf, Orthopaedic Surgery, SM  
Kevin Wickman, Pharmacology, SM

### Senior Research Associate

William Engeland, Surgery, SM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—In consultation with their faculty advisers and the Committee on Graduate Studies, students custom design interdisciplinary programs at the interfaces of biology, medicine, engineering, and physical sciences.

**Prerequisites for Admission**—Admission is limited to students who have been accepted by the Medical School's combined M.D./Ph.D. training program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### Ph.D. Degree Requirements

This interdisciplinary program enables M.D./Ph.D. students to custom design their Ph.D. program. The goal is to train scientists who will be at the interface of research in several disciplines and to provide an alternative when a traditional graduate program will not satisfy the student's needs or intentions. Despite the interdisciplinary quality of biomedical science, each student's program will contain a coherent and cohesive core of individualized course material.

**Language Requirements**—None.

## Biophysical Sciences and Medical Physics

**Contact Information**—Biophysical Sciences and Medical Physics Program, Department of Radiology, University of Minnesota, MMC 292, Room B230 Mayo Building, 420 Delaware Street S.E., Minneapolis, MN 55455 (612-626-6638; [hanse032@umn.edu](mailto:hanse032@umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Dwight L. Anderson, Oral Sciences, SM  
Victor A. Bloomfield, Biochemistry, SM  
Bianca M. Conti-Fine, Biochemistry, SM  
Ralph DeLong, Oral Sciences, M2

William H. Douglas, Oral Sciences, SM  
Stanley M. Finkelstein, Laboratory Medicine and Pathology, SM  
John E. Foker, Surgery, SM  
Michael G. Garwood, Radiology, SM  
Rolf Gruetter, Radiology, SM  
Russell K. Hobbie (emeritus), Physics and Astronomy, ASM  
Xiaoping Hu, Radiology, ASM  
Faiz M. Khan (emeritus), Therapeutic Radiology, ASM  
Merle K. Loken (emeritus), Radiology, ASM  
Rex E. Lovrien, Biochemistry, SM  
Robert H. Margolis, Otolaryngology, SM  
Scott M. O'Grady, Animal Science, SM  
Robert P. Patterson, Physical Medicine and Rehabilitation, SM  
Richard E. Poppele, Physiology, SM  
E. Russell Ritenour, Radiology, SM  
Chang W. Song, Therapeutic Radiology, SM  
Stephen C. Strother, Radiology, M2  
David D. Thomas, Biochemistry, SM  
Kamil Ugurbil, Radiology, SM  
Warren J. Warwick, Pediatrics, SM

### Associate Professor

Alan J. Bank, Medicine, M2  
Richard A. Geise, Radiology, ASM  
Bruce J. Gerbi, Therapeutic Radiology, SM  
Bruce E. Hammer, Radiology, SM  
Patrick Higgins, Therapeutic Radiology, M2  
James E. Holte, Electrical Engineering, SM  
Michael Jerosch-Herold, Radiology, M2

### Assistant Professor

Vincent A. Barnett, Physiology, M2  
Mark J. Conroy, Radiology, M2  
Bruce E. Hasselquist, Radiology, AM2  
Haiying Liu, Radiology, M2  
Kelly Rehm, Radiology, AM2

### Senior Research Associate

Ching-Change Ko, Oral Science, M2  
David H. Live, Biochemistry, Molecular Biology, and Biophysics, M2

### Other

Firmin C. Deibel, M2  
Christopher C. Kuni, M2  
Kevin G. Waddick, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—This interdisciplinary program includes faculty members who have primary appointments in fields such as radiobiology, physics, engineering, computer science, physiology, dentistry, genetics, and biochemistry. Students concentrate in research areas such as molecular biophysics, medical imaging, magnetic resonance imaging and spectroscopy, radiobiology, radiation therapy physics, and mathematical biophysics and computation. A limited number of students prepare for employment as hospital-based medical physicists through a program that includes opportunities for coursework, laboratory work, and directed study to provide experience in areas such as purchase specification, acceptance testing, quality assurance, and radiation safety.

**Prerequisites for Admission**—All students should have some familiarity with physical chemistry, intermediate physics, intermediate mathematics, biostatistics, computer programming, biology, physiology, and biochemistry. This may be demonstrated by coursework completed at the undergraduate level or as part of the graduate program; by reading or practical experience; or by informal competency examinations.

**Special Application Requirements**—Three letters of recommendation and scores from the General Test of the GRE are required. Applicants are considered for admission in both semesters.

**Courses**—Please refer to Biophysical Sciences (BPhy) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### M.S. Degree Requirements

The M.S. is offered under two plans: Plan A, (with thesis), and Plan B, (with project). Plan A is considered suitable for students with full-time employment whose thesis can be related to their work assignments. Plan B is more suitable for students planning to work in government or hospital settings where technical knowledge is more germane than research experience. Plan B students complete a project under the direction of a faculty member and present the work to their faculty committee in an oral exam. A total of 30 credits is required, including 14 in the major and 6 in a related field or minor.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—Programs are arranged on an individual basis and must consist of courses that represent a subfield of the discipline, e.g., radiobiology or medical physics. At least 6 credits of BPhy courses are required.

### Ph.D. Degree Requirements

Ph.D. students take preliminary written exams at the end of the first year of study or as soon as possible after completing the core course sequence in topics in physics for medicine and biology. An oral preliminary exam focuses on the plan for thesis research and the student's grasp of related information and is taken by the fall of the third year of full-time registration or its equivalent. At least 12 credits are required in a minor or supporting program. Additionally, 24 thesis credits are required.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—Programs are arranged on an individual basis and must consist of courses that represent a subfield of the discipline, e.g., radiobiology or medical physics.

## Biostatistics

**Contact Information**—Student Services Center, School of Public Health, University of Minnesota, MMC 819, 420 Delaware Street S.E., Minneapolis, MN 55455 (612-626-3500 or 1-800-774-8636; fax 612-626-6931; [sph-ssc@umn.edu](mailto:sph-ssc@umn.edu); [www.sph.umn.edu](http://www.sph.umn.edu) or [www.biostat.umn.edu](http://www.biostat.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Mark P. Becker, SM  
Bradley P. Carlin, SM  
John E. Connett, SM  
Anne I. Goldman, SM  
Chap T. Le, SM  
James D. Neaton, SM

### Associate Professor

Patricia M. Grambsch, SM  
Birgit Grund, ASM  
Wei Pan, M2  
William Thomas, M2

### Assistant Professor

Sudipto Banerjee, M2  
Susan Duval, AM2  
Lynn E. Eberly, M2  
Chiung-Yu Huang, M2  
Cavan S. Reilly, M2  
Melanie M. Wall, SM

### Senior Research Associate

James S. Hodges, SM

### Research Associate

Judith Bebhuk, M2  
Li Chen, M2  
Katherine Huppler Hullsiek, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Biostatistics combines statistics, biomedical science, and computing to advance health research. Biostatisticians design, direct, and analyze clinical trials; develop new statistical methods; and analyze data from observational studies, laboratory experiments, and health surveys. This is an ideal field for students who have strong mathematical backgrounds and who enjoy working with computers, collaborating with investigators, and participating in health research. Students take courses in biostatistical methods, theory of statistics, clinical trials, statistical computing, categorical data, survival analysis, and health sciences.

**Prerequisites for Admission**—For the M.S., multivariable calculus and linear algebra, an introductory course in applied statistics, and programming in C, Fortran, or other high-level programming language are required. For the Ph.D., an M.S. in statistics, biostatistics, or mathematics, with coursework in applied and theoretical statistics, and graduate level real analysis is required.

Three letters of recommendation and the GRE are required. Applicants should have an overall GPA of at least 3.10. Applicants to the M.S. program should have a GPA of

3.40 in quantitative courses, 450 on the verbal GRE, and 550 on the quantitative and analytical GRE. Applicants to the Ph.D. program should have a GPA of 3.70 in quantitative courses, 550 on the verbal GRE, and 650 on the quantitative and analytical GRE. Applicants to either program who are not native speakers of English should have a TOEFL score of at least 600 (paper version) or 250 (computer version) or a score of at least 7.0 on IELTS.

### Special Application Requirements

Students should apply for admission during fall semester only. New students generally are not admitted in spring semester.

**Courses**—Please refer to Public Health (PubH), where most biostatistics courses are numbered 54xx or 84xx.

**Use of 4xxx Courses**—No 4xxx courses may be used to satisfy any graduate degree program requirements in biostatistics.

### M.S. Degree Requirements

For the M.S. Plan B degree, students must complete 12 courses with a GPA of 3.00, pass a written exam, complete the Plan B project, and pass a final oral exam. Most students need two years of full-time study to finish the degree. The required credits are divided among three areas: 1) eight required courses in statistical theory and biostatistics methods; 2) one elective course in health science; 3) three elective courses in biostatistics. Details of the program are in the *Student Handbook* at [www.biostat.umn.edu](http://www.biostat.umn.edu). The M.S. Plan A thesis degree is for those who have completed advanced work, such as a Ph.D. in a mathematical science and who want to begin dissertation research in biostatistics methodology after only one year of coursework. Students complete at least 20 credits, (14 in biostatistics and 6 in related fields), pass a written exam, complete the Plan A thesis, and a final oral exam.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—The master's minor in biostatistics requires two courses from the following list: PubH 5462, 5470, 5482, 5483, 8420.

### Ph.D. Degree Requirements

The Ph.D. program requires five core courses (including mathematical statistics, linear models, probability models, and Bayesian methodology) and three elective courses in biostatistical theory and methods, a preliminary written examination on the material from some of the required courses, a preliminary oral examination, a written dissertation, and dissertation defense in a final oral examination. This usually requires three years of full-time study after the M.S. degree.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—A doctoral minor for students majoring in statistics consists of two required courses: PubH 5462, 8420, and a choice of two courses from the following: PubH 8430, 8431, 8433, 8434, 8436.

A doctoral minor for students in programs other than statistics consists of two required courses: PubH 5465, 5466, and two courses from the following: PubH 5462, 5467, 5470, 5482, 5483, 8420.

## Biosystems and Agricultural Engineering

**Contact Information**—Director of Graduate Studies, Department of Biosystems and Agricultural Engineering, University of Minnesota, 1390 Eckles Avenue, St. Paul, MN 55108-6005 (612-625-7733; fax 612-624-3005; [bae@umn.edu](mailto:bae@umn.edu); [www.bae.umn.edu](http://www.bae.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Mrinal Bhattacharya, SM  
Charles J. Clanton, SM  
Forrest T. Izuno, SM  
Larry D. Jacobson, SM  
Kevin A. Janni, SM  
Theodore P. Labuza, Food Science and Nutrition, SM  
R. Vance Morey, SM  
John L. Nieber, SM  
Rongsheng R. Ruan, SM  
John M. Shutske, SM  
William F. Wilcke, SM  
Bruce N. Wilson, SM

### Associate Professor

James J. Boedicker, M2  
Jonathan Chaplin, SM  
Philip R. Goodrich, SM

### Assistant Professor

Gary R. Sands, M2  
Jun Zhu, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Areas of emphasis include bioprocessing, food engineering, water quality, surface and subsurface flow, contaminant transport, animal environment and air quality, waste and manure management, resource utilization, machine systems, safety, and grain quality. Programs usually include study in at least one other engineering discipline as well as study or research in a biological or agricultural discipline.

The program offers the following degrees: M.B.A.E., M.S.B.A.E. Plan A or Plan B, and Ph.D.

The master of biosystems and agricultural engineering (M.B.A.E.) is primarily a design-oriented professional degree intended for students who are already employed in engineering design positions, but the degree is also open to students who are not currently

employed and students may select a coursework only option. The M.B.A.E. is normally considered to be a terminal degree; students who think they might pursue a Ph.D. would usually take the M.S., Plan A.

Graduate education in biosystems and agricultural engineering develops a strong foundation in engineering principles that are applied to problems involving biological and agricultural systems. The master of science in biosystems and agricultural engineering (M.S.B.A.E.) degree is for students with a bachelor's degree in a biological, biosystems, agricultural, or related engineering field. Emphases are outlined above. Programs usually include study in at least one other engineering discipline as well as study or research in a biological or agricultural discipline. Students can select a Plan A, or thesis program, or Plan B without a thesis.

The Ph.D. degree is for students with exceptional research and problem-solving capabilities. It should build upon a strong undergraduate program in engineering, biology, and agricultural systems, and progress in rigor to prepare the student to research advanced biosystems and agricultural engineering problems. Emphases are outlined above. Programs usually include study in at least one other engineering discipline as well as study or research in a biological or agricultural discipline.

**Prerequisites for Admission**—A B.S. degree in biological, agricultural, or related field of engineering, or equivalent coursework in mathematics, physics, engineering science, and engineering design is required. A strong academic record is also required.

**Special Application Requirements**—The GRE is not required, but GRE scores are highly recommended for students who do not have engineering degrees, have degrees from institutions outside the U.S., or have a low GPA. Students are admitted each semester.

**Courses**—Please refer to Biosystems and Agricultural Engineering (BAE) and Agricultural Engineering Technology (AgET) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Degree programs are expected to include mostly 5xxx and 8xxx courses. If the program contains more than three 4xxx courses in the M.S. program, or more than two 4xxx courses beyond the courses taken for the master's degree in the doctoral program, students and their advisers are asked to include a letter of explanation when the degree program is submitted for approval.

### M.B.A.E Degree Requirements

Students are required to complete a minimum of 14 course credits in the major field, 6 course credits in a related field or a minor, and a design project of a minimum of 10 credits. The design project is expected to be of professional caliber. As an alternative, students may opt for a coursework (30 credits) only program. The coursework

program must be approved by the biosystems and agricultural engineering director of graduate studies and the chair of the graduate program committee.

**Language Requirements**—None.

**Final Exam**—Students must present a seminar and pass a final oral exam. Students must also meet all Graduate School requirements regarding the final exam.

### Minor Requirements for Students

**Majoring in Other Fields**—A minor consists of at least 6 credits of BAE courses numbered 4xxx or higher.

### M.S.B.A.E. Degree Requirements

The M.S.B.A.E. may be completed as either a Plan A (thesis) or Plan B (project). Plan A students must complete a minimum of 14 course credits in the major field, 6 course credits in a related field or a minor, and 10 thesis credits. Plan B students must complete a minimum of 14 course credits in the major field, 6 course credits in a related field or a minor, 10 other credits, and at least one Plan B project. All coursework programs must be approved by the biosystems and agricultural engineering director of graduate studies and the chair of the graduate program committee.

**Language Requirements**—None.

**Final Exam**—Students must present a seminar and pass a final oral exam. Students must also meet all Graduate School requirements regarding the final exam.

### Minor Requirements for Students

**Majoring in Other Fields**—A minor consists of at least 6 credits of BAE courses numbered 4xxx or higher.

### Ph.D. Degree Requirements

This degree is intended to move students to the cutting edge of research in their subject matter area. Students develop skills that enable them to define problems or research questions, plan research, conduct research and/or lead research efforts, analyze data, and communicate research results to a variety of audiences. All Ph.D. degree programs must include a minimum of 45 graduate course credits beyond the B.S. and a minimum of 24 doctoral thesis credits (BAE 8888). A minimum of 12 course credits must be in a minor field or in a supporting program. Ph.D. degree programs should contain a minimum of 9 course credits in a concentrated area of scientific or mathematical theoretical development that is related to the student's research.

**Language Requirements**—None.

**Final Exam**—Students must pass preliminary written and oral exams, write a dissertation, and pass a final oral exam. Students must also meet all Graduate School requirements regarding the final exam.

### Minor Requirements for Students

**Majoring in Other Fields**—A minor consists of at least 12 credits of BAE courses numbered 4xxx or higher.

## Business Administration

**Contact Information**—Ph.D. Program in Business Administration, Carlson School of Management, Room 4-201, 321 19th Avenue S., University of Minnesota, Minneapolis, MN 55455 (612-624-0875 or 612-624-5065; fax 612-624-8221; [ebronson@csom.umn.edu](mailto:ebronson@csom.umn.edu); [www.carlsonschool.umn.edu/Page798.aspx](http://www.carlsonschool.umn.edu/Page798.aspx)).

Master of Business Administration—Graduate School students who wish to take M.B.A. courses must contact the Carlson School of Management MBA Office, 2-210 Carlson School of Management, Minneapolis, MN 55455 (612-625-5555; fax 612-626-7785).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Carl R. Adams, Information and Decision Sciences, SM  
Dennis A. Ahlburg, Human Resources and Industrial Relations, AM2  
Gordon J. Alexander, Finance, SM  
Amin H. Amershi, Accounting, SM  
John C. Anderson, Operations and Management Science, SM  
Richard D. Arvey, Human Resources and Industrial Relations, ASM  
Frederick J. Beier, Marketing and Logistics Management, SM  
Lawrence M. Benveniste, Finance, SM  
Mark E. Bergen, Marketing and Logistics Management, SM  
Robert G. Berryman (emeritus), Accounting, ASM  
Norman E. Bowie, Strategic Management and Organization, SM  
John H. Boyd, Finance, SM  
Philip Bromiley, Strategic Management and Organization, SM  
John M. Bryson, Public Affairs, Strategic Management and Organization, AM2  
Norman L. Chervany, Information and Decision Sciences, SM  
Terry L. Childers (emeritus), Marketing and Logistics Management, ASM  
Shawn P. Curley, Information and Decision Sciences, SM  
Gordon B. Davis, Information and Decision Sciences, SM  
John W. Dickhaut, Accounting, SM  
W. Bruce Erickson, Strategic Management and Organization, SM  
Arthur V. Hill, Operations and Management Science, SM  
Thomas R. Hoffman (emeritus), Information and Decision Sciences, SM  
Michael J. Houston, Marketing and Logistics Management, SM  
Deborah R. John, Marketing and Logistics Management, SM  
George John, Marketing and Logistics Management, SM  
Paul E. Johnson, Information and Decision Sciences, SM  
Edward J. Joyce, Accounting, SM  
Chandra S. Kanodia, Accounting, SM  
John H. Kareken (emeritus), Finance, ASM  
Robert J. Kauffman, Information and Decision Sciences, SM  
Stefanie A. Lenway, Strategic Management and Organization, SM  
Ross Levine, Finance, SM  
Barbara J. Loken, Marketing and Logistics Management, SM  
Ian H. Maitland, Strategic Management and Organization, SM  
Alfred A. Marcus, Strategic Management and Organization, SM

Joan Meyers-Levy, Marketing and Logistics Management, SM  
 Christopher J. Nachtsheim, Operations and Management Science, SM  
 Timothy J. Nantell, Finance, SM  
 Mary L. Nichols, Strategic Management and Organization, SM  
 Akshay R. Rao, Marketing and Logistics Management, SM  
 Judy Rayburn, Accounting, SM  
 Kenneth J. Roering, Marketing and Logistics Management, SM  
 Robert W. Ruekert, Marketing and Logistics Management, SM  
 Harry R. Sapienza, Strategic Management and Organization, SM  
 Roger G. Schroeder, Operations and Management Science, SM  
 Kingshuk K. Sinha, Operations and Management Science, SM  
 Andrew H. Van de Ven, Strategic Management and Organization, SM  
 Jan Werner, Economics, Finance, ASM  
 Andrew F. Whitman, Human Resources and Industrial Relations, ASM  
 Andrew Winton, Finance, SM  
 Akbar Zaheer, Strategic Management and Organization, SM  
 Srilata Zaheer, Strategic Management and Organization, SM  
 Mahmood A. Zaidi, Human Resources and Industrial Relations, ASM

#### Associate Professor

Stuart Albert, Strategic Management and Organization, SM  
 Chun Chang, Finance, SM  
 Gordon L. Duke, Accounting, SM  
 Gordon C. Everest, Information and Decision Sciences, SM  
 Frank Barry Gigler, Accounting, SM  
 Alok Gupta, Information and Decision Sciences, SM  
 Robert A. Hansen, Marketing and Logistics Management, SM  
 William Li, Operations and Management Science, SM  
 Erzo Luttmmer, Economics, Finance, ASM  
 John J. Mauriel, Strategic Management and Organization, SM  
 Thomas P. Murtha, Strategic Management and Organization, SM  
 J. David Naumann, Information and Decision Sciences, SM  
 Paul J. Seguin, Finance, SM  
 Priti P. Shah, Strategic Management and Organization, SM  
 Myles Shaver, Strategic Management and Organization, SM

#### Assistant Professor

Gediminas Adomavicius, Information and Decision Sciences, M2  
 Regina M. Anctil, Accounting, M2  
 Luca Benzoni, Finance, M2  
 Rajesh Chandy, Marketing and Logistics Management, M2  
 Alvaro Cuervo-Cazurra, Strategic Management and Organization, M2  
 Yan Dong, Marketing and Logistics Management, M2  
 Karen L. Donohue, Operations and Management Science, M2  
 Jane E. Ebert, Marketing and Logistics Management, M2  
 Daniel Forbes, Strategic Management and Organization, M2  
 Susan Meyer Goldstein, Operations and Management Science, M2  
 Ioulia Ioffe, Finance, M2  
 Loraine Lau-Gesk, Marketing and Logistics Management, M2  
 Kevin Linderman, Operations and Management Science, M2  
 Debasish Mallick, Operations and Management Science, M2  
 Om Narasimhan, Marketing and Logistics Management, M2  
 Jinsoo Park, Information and Decision Sciences, M2  
 Valery Polkovnichenko, Finance, M2

Paul Povel, Finance, M2  
 Frederick J. Riggins, Information and Decision Sciences, M2  
 Karen A. Schnatterly, Strategic Management and Organization, M2  
 Rachna Shah, Operations and Management Science, M2  
 Brian P. Shapiro, Accounting, M2  
 Pervin Shroff, Accounting, M2  
 Rajdeep Singh, Finance, M2  
 Andrew Spero, Accounting, M2  
 Mani R. Subramani, Information and Decision Sciences, M2  
 Ramgopal Venkataraman, Accounting, M2  
 Weidong Xia, Information and Decision Sciences, M2  
 Mary E. Zellmer-Bruhn, Strategic Management and Organization, M2

#### Coordinator

Frederick R. Jacobs, AM2

#### Lecturer

Maria Carkovic, AM2  
 Gary W. Carter, AM2  
 James M. Gahlon, AM2  
 Thomas D. Legg, AM2  
 Terry Tranter, AM2  
 Lester A. Wanninger, AM2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—This program offers full-time advanced graduate education for students seeking academic placement at leading universities or research-oriented positions in business or government. The program is for individuals who have the intellectual capacity for advanced study, enjoy independent research and analytical thinking, and who wish to master a discipline within business administration.

Students choose to concentrate in one of six areas of specialization: accounting; finance; information and decision sciences (including the management information systems and decision science subfields); marketing and logistics management; operations and management science; and strategic management and organization (covering the subfields of strategy, organization behavior, entrepreneurship and business-government-society, all of which include an international focus).

**Prerequisites for Admission**—Applicants must have completed an undergraduate degree, in any field, and have successfully completed college courses in microeconomics and finite mathematics or calculus. Scores from the GMAT or GRE test taken no more than five years prior to admission must be submitted.

**Special Application Requirements**—Applicants must submit a copy of the Graduate School application, GMAT or GRE scores, TOEFL scores (international applicants), three letters of recommendation, complete official transcripts from each college or university attended, and a clearly written statement of purpose. These materials are to be sent directly to the program office to ensure proper processing. Graduate study begins in fall semester only.

**Courses**—Please refer to Accounting (Acct); Business Administration (BA); Business Law (BLaw); Entrepreneurship (Entr); Finance (Fina); Information and Decision Sciences (IDSc); Insurance (Ins); Logistics Management (LM); Management (Mgmt); Marketing (Mktg); and Operations and Management Science (OMS) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to the approval of the adviser and director of graduate studies.

#### Ph.D. Degree Requirements

Degree requirements vary by area of concentration. Each student's degree coursework is determined in consultation with an adviser, but in general it includes courses in the field of specialization, in research methodology, and in a minor or supporting program.

**Accounting**—This area of concentration requires a minimum of 12 credits from accounting Ph.D. seminars. In addition, students take a minimum of 16 credits in a minor area outside the Carlson School of Management, or at least 16 credits in supporting programs taken across relevant fields (minimum of two courses from any one area). Students are expected to supplement these required credits with coursework in fields related to their research interests, e.g., finance, economics, statistics, or psychology, but there is no minimum requirement.

**Finance**—Students must take all three finance classes (Fina 8801, 8811, 8821), for 12 credits, plus the microeconomics sequence (Econ 8101, 8102, 8103, 8104) for 8 credits. The 8-credit macroeconomics and applied econometrics courses are also highly recommended. Students should take a minimum of 8 additional elective credits in economics, statistics, accounting, etc.

**Information and Decision Sciences**—Students are required to take 12 courses over a two-year period (a minimum of 40 credits total). Courses must include IDSc 8511 and 8521, and two experimental design and regression analysis courses (OMS 8653 is recommended as one of the two). An additional eight courses can be taken as electives and supporting program courses, with at least two of these being methodology courses.

**Marketing and Logistics Management**—The department requires students to take its five seminars (20 credits total) plus a minimum of 12 credits of research methodology courses outside the department. Minor or supporting program coursework is determined by the student and adviser, and must total at least 16 credits.

**Operations and Management Science**—Students are required to take a minimum of ten courses (approximately 40 credits), including eight OMS Ph.D. courses, Mgmt 8101, and one graduate-level course in linear programming (either OMS 8661 or Math

5711). Students should supplement this with at least 16 credits from outside the department for a minor or supporting program.

**Strategic Management and Organization**—Students are required to take at least five of seven core Ph.D. courses (20 credits), which must include one course from each of three areas (strategy, organization behavior, business-government-society), plus two in the student's area of specialization. The student should take at least five additional classes outside the department (approximately 20 credits) in supporting fields.

**Language Requirements**—None.

**Minor Requirements for Students**

**Majoring in Other Fields**—For a doctoral minor, students must complete a cohesive program of at least 16 credits (at least four courses) of graduate work in one of the six areas of concentration. This program of study is developed in consultation with an adviser who is a full member of the graduate faculty in business administration.

## Business Taxation

**Contact Information**—Master of Business Taxation Degree Program, Department of Accounting, University of Minnesota, 3-108 Carlson School of Management, Minneapolis, MN 55455 (612-624-7511; fax 612-626-7795; [mbt@tc.umn.edu](mailto:mbt@tc.umn.edu); <[www.mbt.carlsonschool.umn.edu](http://www.mbt.carlsonschool.umn.edu)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

R. Glen Berryman (emeritus), Accounting, Business Law, M2

W. Bruce Erickson, Strategic Management and Organization, M2

### Lecturer

Charles Caliendo, M2

Gary W. Carter, M2

Paul G. Gutterman, M2

Frederick R. Jacobs, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—This program helps students acquire a conceptual understanding of taxation and develop technical competence in the practical application of the rules of taxation in business and personal decision making.

Offered only in the evenings, the program accommodates both part-time and full-time students. Historically, more than 80 percent of students are employed in the business community and take courses on a part-time basis. Graduates of the program possess a common body of knowledge in traditional business areas such as accounting, finance, and marketing. In addition, courses in business, government, and economic tax policy provide breadth to complement the technical tax courses that make up the majority of credits. Students enrolled part-

time can expect to complete the program in approximately two to three years. Students enrolled full-time can complete the program in a shorter period.

**Special Application Requirements**—

Results of the GMAT or the Law School Admission Test (LSAT) are required.

Applicants are considered for admission for fall, spring, and summer terms.

**Courses**—Please refer to Accounting (Acct); Business Law (BLaw); Finance (Fina); Information and Decision Sciences (IDSc); Insurance (Ins); Logistics Management (LM); Management (Mgmt); Marketing (Mktg); Master of Business Taxation (MBT); and Operations and Management Science (OMS) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

**M.B.T. Plan B Degree Requirements**

The M.B.T. requires 30 credits, including 6 credits in specified courses dealing with accounting and business and economic tax policy, 10 credits in specified tax courses, and 14 credits of elective tax courses. All students must have completed coursework in finance, marketing, accounting, economics, statistics, management, business law, operations management, information and decision sciences, and strategic management. It is expected that students with business degrees will have few, if any, deficiencies in these areas. Students with deficiencies must make them up before being awarded the degree and may do so while enrolled in program courses.

**Final Exam**—None.

**Language Requirements**—None.

## Cell and Developmental Biology

See Molecular, Cellular, Developmental Biology and Genetics.

## Cellular and Integrative Physiology

**Contact Information**—Cellular and Integrative Physiology Program, Department of Physiology, University of Minnesota, 6-125 Jackson Hall, 321 Church Street S.E., Minneapolis, MN 55455 (612-625-9178; fax 612-625-5149; [physio@umn.edu](mailto:physio@umn.edu) <[http://physiology.med.umn.edu/grad/gc\\_iidx.htm](http://physiology.med.umn.edu/grad/gc_iidx.htm)>).

Additional information concerning the Duluth campus (master's program) is available by contacting the Associate Director of Graduate Studies, Department of Medical and Molecular Physiology, School of Medicine, University of Minnesota, 1035 University Drive, Duluth, MN 55812 (218-726-7934; [phsl@d.umn.edu](mailto:phsl@d.umn.edu) <[www.d.umn.edu/medweb/phsl/physiology/](http://www.d.umn.edu/medweb/phsl/physiology/)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Peter B. Bitterman, Medicine, ASM

Frank B. Cerra, Surgery, ASM

Joseph DiSalvo, Physiology, SM

William C. Engeland, Surgery, ASM

John E. Foker, Surgery, ASM

Robert P. Hebbel, Medicine, ASM

Lois J. Heller, School of Medicine, Duluth, SM

Paul A. Iaizzo, Surgery, SM

David H. Ingbar, Medicine, SM

Hon Cheung Lee, Pharmacology, ASM

Arthur S. Leon, Kinesiology, ASM

David G. Levitt, Physiology, SM

Walter C. Low, Neurosurgery, SM

Scott M. O'Grady, Animal Science, SM

John W. Osborn, Physiology, SM

O. Douglas Wangenstein, Physiology, SM

### Associate Professor

Mustafa N. Al'Absi, School of Medicine, Duluth, AM2

W. Dale Branton, Neuroscience, ASM

Janet L. Fitzakerley, School of Medicine, Duluth, M2

Jurgen F. Fohlmeister, Physiology, SM

Edwin W. Haller (emeritus), School of Medicine, Duluth, AM2

Stephen A. Katz, Physiology, SM

David E. Mohrman, School of Medicine, Duluth, M2

Edward K. Stauffer, School of Medicine, Duluth, M2

LaDora V. Thompson, Physical Medicine and Rehabilitation, SM

Lorentz E. Wittmers, Jr., School of Medicine, Duluth, SM

### Assistant Professor

Vincent A. Barnett, Physiology, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Physiology may be defined as the application of mathematics, physics, and chemistry to the study of structure and function in living systems. As such, physiology is a "hybrid" field in which expertise from many other disciplines is ordinarily required and combined.

The program emphasizes a quantitative approach to understanding the functions of cells, organs, and systems in living animals. Ph.D. students take a core concentration that provides a broad background in the physiology of membranes, cells, transport, and organ systems. Individualized programs are structured to build on the student's strengths and to fill in gaps that would otherwise be an impediment to specific problem solving. Teaching experience is also available to all students.

Areas of specialization include cardiovascular, respiratory, membrane and transport processes, cell physiology, and to a limited extent, exercise and gastrointestinal physiology, and endocrinology.

Students enter the M.S. program from one of two sites. On the *Duluth campus*, students can enroll in coursework and participate in research in several basic areas. Students may pursue studies in muscle, cardiovascular, respiratory, and endocrine physiology, as well as in membrane transport, temperature regulation, and several areas of neuroscience.

## Chemical Engineering and Materials Science and Engineering

**Contact Information**—Department of Chemical Engineering and Materials Science, University of Minnesota, 151 Amundson Hall, 421 Washington Avenue S.E., Minneapolis, MN 55455 (612-625-0382; fax 612-626-7246; cemsgrad@umn.edu; <www.cems.umn.edu/>).

For up-to-date graduate faculty listings, see <www.grad.umn.edu/faculty\_rosters/step1.asp>.

### Regents Professor

H. Ted Davis, SM  
Lanny D. Schmidt, SM  
L. E. Scriven, SM

### Professor

Frank S. Bates, SM  
Raul Caretta, SM  
Robert W. Carr, Jr., SM  
C. Barry Carter, SM  
James R. Chelikowsky, SM  
Philip I. Cohen, Electrical and Computer Engineering, ASM  
Robert F. Cook, SM  
Edward L. Cussler, SM  
Prodromos Daoutidis, SM  
Jeffrey J. Derby, SM  
Michael C. Flickinger, BioTechnology Institute, ASM  
Lorraine F. Francis, SM  
Christie J. Geankoplis, SM  
William W. Gerberich, SM  
Steven L. Girshick, Mechanical Engineering, ASM  
Wayne L. Gladfelter, Chemistry, ASM  
J. Woods Halley, Physics and Astronomy, ASM  
Wei-Shou Hu, SM  
Kenneth H. Keller, SM  
David L. Kohlstedt, Geology and Geophysics, ASM  
Timothy P. Lodge, SM  
John S. Lowengrub, Mathematics, ASM  
Christopher W. Macosko, SM  
Alon V. McCormick, SM  
Hans G. Othmer, Mathematics, ASM  
Christopher J. Palmstrom, SM  
David A. Shores, SM  
Ronald A. Siegel, Pharmacy, ASM  
J. Ilja Siepmann, Chemistry, ASM  
William H. Smyrl, SM  
Friedrich Srien, SM  
Robert T. Tranquillo, SM  
Michael Tsapatsis, SM  
Michael D. Ward, SM  
Kewen Yin, Wood and Paper Science, ASM  
Michael R. Zachariah, Mechanical Engineering, ASM

### Associate Professor

Alfonso Franciosi, Chemical Engineering, ASM  
Materials Science, SM  
C. Daniel Frisbie, SM  
Marc A. Hillmyer, Chemistry, ASM  
David C. Morse, SM  
David J. Norris, SM  
David J. Odde, Biomedical Engineering, ASM  
Beth Stadler, Electrical and Computer Engineering, ASM  
Renata M. Wentzcovitch, SM

### Assistant Professor

Victor H. Barocas, Biomedical Engineering, ASM  
Yiannis Kaznessis, SM  
Efrsini Kokoli, SM  
Satish Kumar, SM  
Christopher Leighton, SM  
Jennifer Maynard, SM  
Richard B. McClurg, SM

### Research Associate

Daniel M. Kroll, Pharmacy, AM  
Greg D. Haugstad, Characterization Facility, AM

### M.S. Degree Requirements

*Duluth campus:* All course requirements for the M.S. degree can be completed on the Duluth campus. Students are expected to fulfill all degree requirements over a period of two to three calendar years. The program includes at least 20 credits in physiology and 6 credits in a minor or related field of study. Incoming students are encouraged to undertake at least two laboratory rotations in faculty research laboratories of their choice. Fulfillment of degree requirements also includes the presentation and defense of a thesis (Plan A). The final written examination and oral defense of the thesis takes place with participation of faculty from both campuses.

*Twin Cities campus:* A degree for individuals involved in research and employed at local companies requires 14 credits in physiology and 6 credits outside of physiology. The degree is based on laboratory research off or on campus, and requires a written thesis or written project and an oral presentation of the work for the final exam. The M.S. degree is Plan A, unless there are special circumstances requiring a Plan B. For Plan B, the final exam is oral.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—A minimum of 6 graduate credits in cellular and integrative physiology is required.

### Ph.D. Degree Requirements

The Ph.D. program requires courses in medical physiology and human neuroscience. No other specific courses are required, although some graduate level courses in cellular or molecular biology must be completed. The coursework is tailored to the student's interests with input from the director of graduate studies or the adviser. During the first year, students rotate through three laboratories, pick an adviser, and begin a research project. A preliminary written exam in physiology and neuroscience is taken before the preliminary oral exam. The preliminary oral exam is given to test the student's ability to apply principles of both physiology and the minor or supporting program to a proposed research based thesis. A minimum of 12 credits must be completed in the minor field or supporting program.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—Ph.D. students are expected to take Phsl 6101 or the equivalent.

In addition, the *Twin Cities campus* has a special masters program that focuses on training people in local private industries who are engaged in relevant physiological projects. People working in various biotechnology, biomedical, and bioengineering companies in the Twin Cities area and doing work in physiology may benefit from formal training. The curriculum can be blended into a part-time graduate program, allowing continued employment while working for the M.S. degree.

Students enter the Ph.D. program only from the Twin Cities campus, although a Ph.D. may be pursued on the Duluth campus in some circumstances. The Twin Cities Ph.D. program focuses on educating people with previous medical training who are already at the University of Minnesota or are considering the University of Minnesota Medical School for residency or fellowship training. A surgical resident, a renal or cardiology fellow, or other comparable student may be interested in bundling their required or optional research into a Ph.D. program. Also, people already affiliated with University graduate faculty such as appropriate undergraduate students, lab techs, or others already working in a graduate faculty laboratory are encouraged to apply for admission. An additional route of admission is application with the aid of a graduate faculty sponsor.

Entering Ph.D. students are expected to take a series of laboratory rotations to familiarize themselves with areas of research active within the degree program. The program offers faculty and corresponding research laboratories from the Department of Physiology and from other departments (or divisions), including medicine, psychology, surgery, neuroscience, neurosurgery, veterinary biology, neurology, anesthesiology, kinesiology, and animal science.

**Prerequisites for Admission**—For the major, an undergraduate degree with at least one year (three quarters or two semesters) of calculus, one year of physics, one year of biology, and two years of chemistry is required. For the minor, a background in mathematics, physics, chemistry, and biology acceptable to the graduate faculty, is required.

**Special Application Requirements**—For the M.S. and Ph.D., applicants must take either the General Test of the GRE or the Medical College Admission Test. In addition, all applicants need three letters of recommendation. Admission can be in either fall or spring semester.

**Courses**—Please refer to Physiology (Phsl) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to both adviser and director of graduate studies approval. Students from other majors may include such courses subject to their own program's approval.

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Research activities are broadly organized in the areas of theory and computation; reaction engineering and chemical process synthesis; biotechnology and bioengineering; polymers; ceramics and metals; electronic and magnetic materials; and coating processes and interfacial engineering.

The graduate courses offered cover core areas of chemical engineering (fluid mechanics, applied mathematics: linear and nonlinear analysis, transport, chemical thermodynamics, statistical thermodynamics and kinetics, and analysis of chemical reactors) and core areas of materials science (structure and symmetry of materials, thermodynamics and kinetics, electronic properties of materials, and mechanical properties of materials). In addition, several specialized topics are offered, including biochemical engineering, biological transport processes, food processing technology, colloids, principles of mass transfer in engineering and biological engineering, rheology, coating process fundamentals, process control, finite elements methods of computer-aided analysis, ceramics, polymers, materials design and performance, materials processing, corrosion, introduction to polymer chemistry, polymer laboratory, contact and fracture properties of materials, electron microscopy, thin films and interfaces, composites, electrochemical engineering, physical chemistry of polymers, solid state reaction kinetics, electronic structure of materials, electronic properties and applications of organic materials, electronic ceramics, dislocations and interfaces, epitaxial thin film growth, and science of porous media.

**Prerequisites for Admission**—A bachelor's degree in chemical engineering, materials science, metallurgy, ceramics, polymer engineering, chemistry, physics, mechanical engineering, or electrical engineering is required. Applicants may be accepted without this prerequisite, but may be required to complete additional preparatory studies prescribed by their adviser or the director of graduate studies after admission.

**Special Application Requirements**—Applicants must submit scores from the General Test of the GRE, three letters of recommendation from persons familiar with their scholarship and research potential, a complete set of official transcripts, and a clearly written statement of career interests, goals, and objectives. International students are required to provide scores of at least 560 on the paper-based or 220 on the computer-based TOEFL. Students may apply at any time; submission of all application materials by January 1 is strongly encouraged to ensure priority consideration for fellowships and assistantships; late applications are considered if space is available.

**Research Centers and Facilities, Professional Courses, and Major Collaborating Programs**—A number of outstanding interdisciplinary centers supplement the department, including the National Science Foundation Materials Research Science and Engineering Center, the Corrosion Research Center, the Industrial Partnership for Research in Interfacial and Materials Engineering, the Army High Performance Computing Research Center, the BioTechnology Institute, the Institute for Theoretical Physics, the Minnesota Supercomputer Institute, the Institute for Mathematics and its Applications, and the Regional Instrumentation Facility for Surface Analysis. Department faculty and students participate in all of these centers, creating powerful facilities and many opportunities to explore interdisciplinary research interests.

**Courses**—Please refer to Chemical Engineering (ChEn) and Materials Science (MatS) in the course section of this catalog for courses pertaining to these programs.

**Use of 4xxx Courses**—Chemical engineering allows MatS 4214 to be taken for graduate credit. Materials science allows MatS 4212, 4214, 4221, 4301, and 4511 to be taken for graduate credit. All other ChEn or MatS 4xxx courses must have adviser and director of graduate studies approval.

### M.Ch.E or M.Mat.S.E. Design Project Degree Requirements

This professional master's in engineering degree is designed for employees of local industries who wish to pursue their studies on a part-time basis. It is intended to provide a fifth year of professional work and is offered under the design project track. No financial support is available from the program. The M.Ch.E. and M.Mat.S.E. are terminal degrees. Only under exceptional circumstances is a student allowed to transfer to an M.S. program.

Both degrees require a minimum of 14 course credits in the major field and a minimum of 6 credits in the minor or related fields. The work-related design project consists of an in-depth study of an engineering design. It need not represent a publishable research project. While the amount of work should be the same as for an M.S. thesis, the project can contain elements that the thesis would not, such as economic considerations, design consultation, and social relevance.

**Language Requirements**—None.

**Final Exam**—A final oral exam focused on the design project is required.

**Minor Requirements for Students Majoring in Other Fields**—Approval of the chemical engineering or materials science director of graduate studies is required for a master's minor.

### M.S.Ch.E. and M.S.Mat.S.E. Plan A Degree Requirements

The M.S.Ch.E. and M.S.Mat.S.E. are offered only under Plan A (with thesis). The degrees

require a minimum of 14 course credits in the major and a minimum of 6 credits in a minor or in one or more related fields. The program normally is completed in about 18 months. Students interested in a degree without a thesis should consider the professional master's in chemical engineering or materials science degree outlined above.

Many students entering these programs change to the Ph.D. program before or after completing the M.S. degree. Application for a change of status is done in consultation with the adviser and the director of graduate studies.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—Approval of the chemical engineering or materials science director of graduate studies is required for a master's minor.

### Ph.D. Degree Requirements

The Ph.D. is primarily a research degree and performance that leads to a research thesis is emphasized. Supporting coursework is planned in consultation with the adviser. The Ph.D. requires a minimum of 21 course credits within the major, and 12 course credits in a minor or supporting program.

**Language Requirements**—None.

**Minor Requirements for Students Majoring in Other Fields**—For a minor in chemical engineering or materials science, students must successfully complete at least four of the core graduate courses in the minor program and obtain approval by the director of graduate studies.

## Chemical Physics

**Contact Information**—Chemical Physics Program, Department of Chemistry, University of Minnesota, 137 Smith Hall, 207 Pleasant Street S.E., Minneapolis, MN 55455 (612-626-7444; fax 612-626-7541; [inquiry@chem.umn.edu](mailto:inquiry@chem.umn.edu); [www.chem.umn.edu/chemphys](http://www.chem.umn.edu/chemphys)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Regents Professor

H. Ted Davis, Chemical Engineering and Materials Science, SM  
Lanny D. Schmidt, Chemical Engineering and Materials Science, SM

### Professor

Charles E. Campbell, Physics, SM  
Barry C. Carter, Chemical Engineering and Materials Science, SM  
James R. Chelikowsky, Chemical Engineering and Materials Science, SM  
Christopher J. Cramer, Chemistry, SM  
Jiali Gao, Chemistry, SM  
William R. Gentry, Chemistry, SM  
Allen M. Goldman, Physics, SM  
J. Woods Halley, Physics, SM  
Cheng-Cher Huang, Physics, SM  
Kenneth R. Leopold, Chemistry, SM  
Sanford Lipsky, Chemistry, SM  
Wilmer G. Miller, Chemistry, SM  
Karin Musier-Forsyth, Chemistry, SM  
Jeffrey T. Roberts, Chemistry, SM

J. Ilja Siepmann, Chemistry, SM  
David D. Thomas, Biochemistry, SM  
Donald G. Truhlar, Chemistry, SM  
Xiaoyang Zhu, Chemistry, SM

#### **Associate Professor**

David M. Ferguson, Medicinal Chemistry,  
Pharmacognosy, SM  
Doreen G. Leopold, Chemistry, SM  
David C. Morse, Chemical Engineering and Materials  
Science, SM  
Renata M. Wentzcovitch, Chemical Engineering and  
Materials Science, SM

#### **Assistant Professor**

David A. Blank, Chemistry, SM  
Richard M. McClurg, Chemical Engineering and  
Materials Science, SM  
Darrin M. York, Chemistry, SM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Chemical physics focuses on areas where the techniques of chemistry and physics are brought together for the study of atoms and molecules; their interactions in gases, liquids, and solids; and the detailed structure and dynamics of material changes. Areas of research and specialization include spectroscopy, optical properties, laser applications, molecular collisions, chemical dynamics, quantum mechanics, computational chemistry, statistical mechanics, thermodynamics, low-temperature behavior, polymers and macromolecules, surface science, biochemistry, and biochemical and heterogeneous catalysis.

**Prerequisites for Admission**—Applicants should have adequate preparation in mathematics, physics, and chemistry. For financial support, applicants should apply either to the Department of Chemistry or the Department of Physics. Applicants not requiring financial support have their academic qualifications reviewed by the director of graduate studies in chemical physics.

**Special Application Requirements**—Three letters of recommendation are required.

**Courses**—Please refer to Chemistry (Chem), Physics (Phys), Chemical Engineering (ChEn), Materials Science (MatS), Mathematics (Math), Chemical Physics (ChPh) and Scientific Computation (SciC) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of any 4xxx courses on degree program forms is subject to approval by the director of graduate studies.

#### **M.S. Plan A Degree Requirements**

The M.S. degree is offered Plan A (with thesis) and requires at least 20 course credits and 10 or more thesis credits. The course credits must include at least 6 credits each in chemistry, physics, and quantum mechanics, and at least 3 credits in thermodynamics, statistical mechanics, or statistical physics. There is no minor or related field requirement.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

#### **Ph.D. Degree Requirements**

A proficiency exam in physical chemistry is required. The Ph.D. program ordinarily consists of at least 24 course credits that include coursework in chemistry and/or physics with options for coursework in quantum mechanics, thermodynamics, statistical physics, and chemical dynamics. There is no minor or supporting program requirement. Students must also complete 24 thesis credits.

**Language Requirements**—None.

#### **Minor Requirements for Students**

**Majoring in Other Fields**—Ph.D. minor requirements are determined by the director of graduate studies, the student, and the adviser.

## **Chemistry**

**Contact Information**—Assistant to the Director of Graduate Studies, Department of Chemistry, University of Minnesota, 137 Smith Hall, 207 Pleasant Street S.E., Minneapolis, MN 55455 (612-626-7444 or 1-800-777-2431; fax 612-626-7541; [inquiry@chem.umn.edu](mailto:inquiry@chem.umn.edu); [www.chem.umn.edu](http://www.chem.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

#### **Regents Professor**

H. Ted Davis, SM

#### **Professor**

George Barany, SM  
Bridgette A. Barry, Biochemistry, ASM  
Frank S. Bates, Chemical Engineering and Materials  
Science, ASM  
Victor A. Bloomfield, Biochemistry, ASM  
Peter W. Carr, SM  
Christopher J. Cramer, SM  
John E. Ellis, SM  
Jiali Gao, SM  
W. Roland Gentry, SM  
Wayne L. Gladfelter, SM  
Gary Roland Gray, SM  
Thomas R. Hoye, SM  
Steven R. Kass, SM  
Kenneth R. Leopold, SM  
John D. Lipscomb, Biochemistry, ASM  
Sanford Lipsky, SM  
Timothy P. Lodge, SM  
Kent R. Mann, SM  
Karin Musier-Forsyth, SM  
Wayland E. Noland, SM  
Louis H. Pignolet, SM  
Lawrence Que, Jr., SM  
Jeffrey T. Roberts, SM  
J. Ilja Siepmann, SM  
Marian Stankovich, SM  
Andreas Stein, SM  
William B. Tolman, SM  
Donald G. Truhlar, SM  
Michael D. Ward, Chemical Engineering and  
Materials Science, ASM  
Michael R. Zachariah, Mechanical Engineering, ASM  
Xiaoyang Zhu, SM

#### **Associate Professor**

Mark D. Distefano, SM  
Craig J. Forsyth, SM  
C. Daniel Frisbie, ASM  
William B. Gleason, Laboratory Medicine and  
Pathology, ASM  
Marc A. Hillmyer, SM

Richard Hsung, SM  
Doreen G. Leopold, SM  
Carston R. Wagner, Pharmacy, ASM

#### **Assistant Professor**

Edgar A. Arriaga, SM  
David A. Blank, SM  
Michael T. Bowser, SM  
Philippe Bühlmann, SM  
Kristopher McNeill, SM  
George A. O'Doherty, SM  
R. Lee Penn, SM  
T. Andrew Taton, SM  
Gianluigi Veglia, SM  
Darrin M. York, SM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Graduate work in the Department of Chemistry is organized into six specialty areas: analytical chemistry, chemical biology, inorganic chemistry, materials chemistry, organic chemistry, and physical chemistry. Interdisciplinary work is also an option.

**Prerequisites for Admission**—Applicants must offer the substantial equivalent of the courses in analytical, inorganic, organic, and physical chemistry required of undergraduate majors in the University of Minnesota chemistry curriculum. They must also have at least one year of college physics plus college mathematics through calculus.

**Special Application Requirements**—Three letters of recommendation are required for all applications. Scores from General (Aptitude) and Subject (Advanced) Tests of the GRE are required for fellowship consideration and are strongly recommended for all other applicants. International applicants are expected to provide scores of at least 580 on the TOEFL, as well as GRE scores.

**Proficiency Examinations**—Student in the Ph.D. program are expected to pass four of five proficiency examinations during their first year in residence. The exams, which are at the level of an advanced undergraduate course, are in analytical chemistry, biochemistry, inorganic chemistry, organic chemistry, and physical chemistry. The exams are given during the chemistry first-year orientation program in August. In the event that a student does not pass the first exam, they are offered two more times during the academic year.

**Courses**—Please refer to Chemistry (Chem) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—One of the following courses may be allowed: Chem 4150 or 4701.

#### **M.S. Degree Requirements**

M.S. students are expected to pass the proficiency exam in their specialty area in their first academic year in residence. Plan A requires 20 course credits and 10 thesis credits; Plan B requires 30 course credits (and one or two Plan B papers).

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—Six course credits from graduate-level chemistry courses are required for a master's minor.

### Ph.D. Degree Requirements

The Ph.D. program requires 24 course credits and 24 thesis credits. Students are also required to pass four out of five proficiency exams (see above) by the end of their first academic year in residence.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—Twelve course credits from graduate-level chemistry courses are required for a Ph.D. minor.

## Child Psychology

**Contact Information**—Child Psychology Program, University of Minnesota, 204 Child Development Building, 51 East River Road, Minneapolis, MN 55455 (612-624-4127; fax 612-624-6373; <<http://education.umn.edu/icd>>).

See the *College of Education and Human Development Professional Studies Catalog* for information on the master of education (M.Ed.) program in early childhood education.

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Dale A. Blyth, 4H Youth Development Center, AM2  
Patricia J. Bauer, SM  
Sandra L. Christenson, Educational Psychology, AM2  
W. Andrew Collins, SM  
Nicki R. Crick, SM  
Byron Egeland, SM  
Michael K. Georgieff, Pediatrics, SM  
Harold D. Grotevant, Family Social Science, AM2  
Megan R. Gunnar, SM  
Susan C. Hupp, Educational Psychology, AM2  
William G. Iacono, Psychology, ASM  
Gloria R. Leon, Psychology, ASM  
Michael P. Maratsos, SM  
Ann S. Masten, SM  
Scott R. McConnell, Educational Psychology, AM2  
Charles A. Nelson, SM  
Anne D. Pick (emeritus), ASM  
Herbert L. Pick, Jr., SM  
Maria D. Sera, SM  
Elsa G. Shapiro, Pediatrics, AM2  
L. Alan Sroufe, SM  
Paulus W. van den Broek, Educational Psychology, AM2  
Richard A. Weinberg, SM  
Albert Yonas, SM  
Steven R. Yussen, SM

### Associate Professor

Carrie M. Borchardt, Psychiatry, AM2  
Martha Erickson, Children, Youth, and Family Consortium, AM2  
Monica Luciana, Psychology, ASM

### Assistant Professor

Canan Karatekin, SM  
Kathleen Thomas, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The Ph.D. in child psychology focuses primarily on training for research in normal human development, and most students take positions in academic or research settings. The goal of the program is to train all students for careers in research and college teaching in child psychology, and to prepare students in the collaborative program options for careers in applied areas of child psychology as well. General program students may choose to specialize in an area such as cognitive neuroscience, language, learning, personality, memory, perception, psychobiology, or social development. Students interested in applied areas may specialize in developmental psychopathology and clinical science or school psychology.

The developmental psychopathology and clinical science (DPCS) program is a cooperative effort between the Institute of Child Development and the Department of Psychology to train leaders in research and teaching. Training draws on the unique strengths of each program. Students are admitted to the Ph.D. program in child psychology through the Institute of Child Development and to this training program by the agreement of program faculty in both departments.

The APA-approved school psychology program is a cooperative program of the Institute of Child Development, the Department of Psychology, and the Department of Educational Psychology. Students are admitted jointly to one of the cooperating departments and to the school psychology program. Students must meet the standards and requirements of both the admitting department and the school psychology program.

**Prerequisites for Admission**—The equivalent of three semester (or four quarter) courses in psychology and one course in statistics are required.

**Special Application Requirements**—New students are normally admitted in fall semester. Application deadline is in December of the preceding year. Applicants must submit the departmental applications for graduate work, scores from the General Test of the GRE that are less than five years old, three letters of recommendation from persons familiar with their scholarship and research potential, a complete set of official transcripts, and a clearly written statement of career interests, goals, and objectives. The three letters of recommendation also must be received by the deadline. The TOEFL should be submitted when applicable.

**Courses**—Please refer to Child Psychology (CPsy) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Child psychology Ph.D. students may include 4xxx courses as part of their supporting program coursework with director of graduate studies' approval and if the course is taught by a member of the graduate faculty in the supporting program. Students from other majors may include 4xxx CPsy courses subject to their own program's approval.

### M.A. Degree Requirements

The Institute of Child Development does not offer *admission* for a master's degree. Students may choose to complete a master's degree (typically Plan B) during their progress toward the Ph.D. Requirements for the M.A. are met through either Plan A or Plan B. Both require a full academic year of coursework.

Plan A requires a minimum of 20 course credits (a minimum of 14 in the major and 6 in the minor/related field) and 10 thesis credits.

Plan B requires 30 course credits, of which 14 credits must be in child psychology and 6 credits in one or more related fields. A project equivalent to 120 hours of work is also required.

**Language Requirements**—None.

**Final Exam**—The final exam for Plan A is oral; typically, the final exam for Plan B is written.

### Ph.D. Degree Requirements

The Ph.D. degree usually requires four years of graduate work. Major program components include coursework, research activities, and teaching experience. Coursework requirements are specialization specific, but all students are required to take 44 credits in the major, 14 credits in a supporting program, and 24 thesis credits. Each student specializes in an area such as social and personality development, learning, cognitive development, cognitive neuroscience, language development, psychobiology or perceptual development. Required courses include CPsy 8301, 8302, 8304, 8311, 8321, 8360, 8888, 8994, and statistics through EPsy 8263 or equivalent.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—A Ph.D. minor requires 12 credits in child psychology, to include CPsy 8301 (4 cr), 8302 (4 cr), and 8996 (1-6 cr). Remaining credits can be taken from 4xxx (subject to their own program's approval) or 8xxx courses.

## Chinese

See Asian Languages and Literatures.

## Civil Engineering

**Contact Information**—Department of Civil Engineering, University of Minnesota, 122 Civil Engineering Building, 500 Pillsbury Drive S.E., Minneapolis, MN 55455 (612-625-5522; fax 612-626-7750; [gradsec@ce.umn.edu](mailto:gradsec@ce.umn.edu); <[www.ce.umn.edu](http://www.ce.umn.edu)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Roger E. A. Arndt, SM  
Patrick L. Brezonik, SM  
Steven L. Crouch, SM  
Emmanuel M. Detournay, SM  
Andrew Drescher, SM  
Efi Foufoula-Georgiou, SM

Catherine E. French, SM  
 John S. Gulliver, SM  
 Joseph F. Labuz, SM  
 Panos Michalopoulos, SM  
 John L. Nieber, Biosystems and Agricultural  
 Engineering, ASM  
 Gary Parker, SM  
 Michael J. Semmens, SM  
 Heinz G. Stefan, SM  
 Henryk K. Stolarski, SM  
 Otto D. L. Strack, SM  
 Vaughan R. Voller, SM

#### **Adjunct Professor**

Peter A. Cundall, ASM

#### **Associate Professor**

Randal J. Barnes, SM  
 Gary A. Davis, SM  
 Robert J. Dexter, SM  
 Bojan B. Guzina, SM  
 Jerome F. Hajjar, SM  
 Miki Hondzo, SM  
 Raymond M. Hozalski, SM  
 Gerald W. Johnson, M2  
 Paige J. Novak, SM  
 Arturo E. Schultz, SM  
 Carol K. Shield, SM  
 Karl A. Smith, SM

#### **Associate Adjunct Professor**

Paul D. Capel, AM2

#### **Assistant Professor**

William A. Arnold, SM  
 Kevin J. Krizek, Urban and Regional Planning, AM2  
 Timothy M. LaPara, SM  
 David M. Levinson, SM  
 Mihai O. Marasteanu, SM  
 Fernando Porté-Agel, SM

#### **Assistant Adjunct Professor**

Eil Kwon, AM2

#### **Senior Research Associate**

Sofia G. Mogilevskaya, ASM  
 Eugene L. Skok, Jr., AM2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Emphases are available in environmental engineering (e.g., pollutant fate and transport, process modeling, soil and groundwater remediation, water and wastewater treatment), geomechanics engineering (e.g., fracture and localization, groundwater flow, stability and liquefaction, wave and shock propagation), structural engineering (e.g., computational and structural mechanics, earthquake engineering, infrastructure performance and durability, new systems and materials), transportation engineering (e.g., intelligent transportation systems, pavement design and materials, transportation economics, traffic safety), and water resources engineering (e.g., earthscape processes, environmental and biological systems, hydrologic and climate dynamics, hydrodynamics, and turbulence).

**Prerequisites for Admission**—A bachelor's degree in an engineering, basic science, or mathematics program is preferred. Admission depends primarily on the applicant's academic record and letters of recommendation. Applicants who lack civil engineering training are often required to complete one or more appropriate courses

from the undergraduate civil engineering program. Graduate credit is not awarded for such preparatory work. For the M.C.E. program, an ABET-accredited bachelor's degree in engineering is required.

#### **Special Application Requirements**—

Applicants are required to submit results of the GRE in support of their applications. A minimum score of 550 on the paper-based or 213 on the computer-based TOEFL is required of foreign applicants from non-English-speaking countries. Admission requirements also include three letters of recommendation and a statement of purpose that outlines the prospective student's research interests, reasons for pursuing graduate studies, and career plans after graduation. Students are admitted each semester, but applicants are strongly encouraged to submit their applications by December 31 in order to begin the following fall semester.

**Courses**—Please refer to Civil Engineering (CE) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx department courses is subject to adviser and director of graduate studies approval. Students from other majors may include such courses subject to their own program's approval.

#### **M.C.E. Coursework Only and Design Project Degree Requirements**

The master of civil engineering (M.C.E.) degree is designed for the practicing engineer who would like to obtain an advanced degree on a part-time or full-time basis. Students who intend to proceed to the Ph.D. program or think they may later wish to be admitted to the Ph.D. program should apply for the master of science program.

Students are expected to follow a coherent program of coursework in one of the following subareas of civil engineering: environmental, geomechanics, structural, transportation, or water resources engineering. The program is selected with the help of a faculty adviser and approved by the director of graduate studies. In addition to completing graduate level courses, students must demonstrate professional competence either by carrying out and defending a design project or by taking a coursework-related final oral exam (without a project). The degree typically takes 12 to 18 months to complete on a full-time basis.

The M.C.E. degree requires 30 credits and is offered under two plans. One requires a minimum of 20 course credits and preparation of a design project (10 credits); the design project must be carried out by the student in consultation with a faculty adviser. The other plan is a coursework-only degree program and requires 30 course credits. At least 6 of the course credits must be taken outside the department for either plan.

**Language Requirements**—None.

**Final Exam**—A final oral exam is required of all M.C.E. candidates.

#### **Minor Requirements for Students**

**Majoring in Other Fields**—For a master's minor, two or more 5xxx or 8xxx courses from the same subarea of civil engineering are required, for a total of 6 or more credits.

#### **M.S. Degree Requirements**

The master of science (M.S.) degree balances education in engineering fundamentals and design with research and development. The M.S. degree provides preparation for students wishing to pursue a career in industry or to continue studies toward a Ph.D. degree. Students are expected to follow a coherent program of coursework and research in one of the following subareas: environmental, geomechanics, structural, transportation, or water resources engineering. The program is selected with the help of a faculty adviser and approved by the director of graduate studies and typically takes 18 to 24 months to complete.

The M.S. degree requires 30 credits and is offered under two plans. Plan A emphasizes research and preparation of a thesis and Plan B emphasizes coursework. The thesis must be written on a research project carried out in consultation with a faculty adviser and should result in a scientific or technical contribution to the field. Under Plan B, the student must demonstrate the ability to work independently and present the results of such work effectively by completing one to three Plan B papers as determined by the faculty adviser. A wide variety of studies have been submitted as Plan B papers, including computer programs, annotated bibliographies, field or laboratory investigations, and the analysis/design of special engineering problems. Plan A requires 20 course credits and 10 thesis credits. Plan B requires 30 course credits. At least 6 of the course credits must be taken outside the department for either Plan A or Plan B.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

#### **Minor Requirements for Students**

**Majoring in Other Fields**—For a master's minor, two or more 5xxx or 8xxx courses from the same sub-area of civil engineering are required, for a total of 6 or more credits.

#### **Ph.D. Degree Requirements**

The Ph.D. degree couples independent research with coursework in a comprehensive program for those wishing to attain mastery of their field. The Ph.D. degree demands the ability and desire to pursue independent and original studies and can be earned with emphasis in environmental, geomechanics, structural, transportation, or water resources engineering. Research performance, as judged by preparation of a dissertation on an independently pursued research topic, is the primary requirement for the Ph.D. degree. Students enter the Ph.D. program normally after completing the M.S. degree. The Ph.D. program is typically completed in five to six years following the bachelor's degree.

Each program of study is designed in consultation with a faculty adviser to meet the special needs of the student, although programs must be approved by the director of graduate studies. A typical program consists of 45 credits of coursework beyond the bachelor's degree, plus 24 thesis credits. A supporting program or minor consisting of at least 12 credits taken outside the department must be included. Credits earned in a M.S. program may be presented in partial fulfillment of the Ph.D. requirements. Rigid requirements for the number of 8xxx courses appropriate for Ph.D. programs have not been set, nonetheless, the Ph.D. represents the highest level of scholarly achievement and coursework should be selected accordingly.

**Language Requirements**—None.

**Minor Requirements for Students**

**Majoring in Other Fields**—For a Ph.D. minor, four or more 5xxx to 8xxx courses from one or two subareas of civil engineering are required for a total of 12 or more credits.

## Classical and Near Eastern Studies

**Contact Information**—Department of Classical and Near Eastern Studies, University of Minnesota, 305 Folwell Hall, 9 Pleasant St. S.E., Minneapolis, MN 55455-0125 (612-625-5353; fax 612-624-4894; [cnes@umn.edu](mailto:cnes@umn.edu); <<http://cnes.cla.umn.edu/>>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Regents Professor

Thomas Clayton, English, ASM

### Professor

Elizabeth Belfiore, SM  
Frederick Cooper, SM  
Sheila McNally, SM  
S. Douglas Olson, SM  
Sandra Peterson, Philosophy, ASM  
Robert P. Sonkowsky, SM  
Theofanis G. Stavrou, History, ASM  
Peter Wells, Anthropology, ASM

### Associate Professor

Andrea Berlin, SM  
Nita Krevans, SM  
Bernard Levinson, SM  
William Malandra, SM  
Oliver Nicholson, SM  
Jonathan Paradise, SM  
Philip Sellew, SM  
George Sheets, SM  
John Steyaert, Art History, ASM

### Assistant Professor

Christopher Nappa, M2  
Eva Von Dassow, M2  
Amanda Wilcox, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Classical and Near Eastern Studies (CNES) is an interdisciplinary department that brings together faculty and graduate students who might in other settings be dispersed among a wide range of programs. CNES is dedicated to rigorous

philological and literary training and to the conviction that the ancient Mediterranean world is best studied as a diverse but richly integrated cultural whole. The various M.A. and Ph.D. tracks allow students to concentrate in the area and period that most appeals to them, but students are strongly encouraged to take courses across the entire range of the department's offerings and to develop a broad, multidisciplinary approach to research and teaching. Students entering the Ph.D. program with an M.A. can usually receive credit for some earlier coursework, subject to the approval of the graduate faculty and graduate school requirements. Related special facilities include the Center for Medieval Studies and the Center for Modern Greek Studies.

**Prerequisites for Admission**—For the major track in ancient and medieval art and archaeology, a background in archaeology, art history, and history sufficient to begin graduate level studies in the discipline, and evidence of language-acquisition ability. For the major track in classics, sufficient knowledge to begin graduate reading courses in either Greek or Latin and at least intermediate ability in the other language. For the major tracks in Greek or Latin, sufficient knowledge to begin graduate reading courses in the language of the track. For the major in religions in antiquity, an undergraduate background in the field and sufficient knowledge to begin graduate reading courses in classical Hebrew, Greek, or Latin. Some course prerequisites can be made up on provisional admission.

Applications are welcome from students with undergraduate majors in fields such as ancient Near Eastern studies, art history, biblical studies, classical archaeology, classics, history, Jewish studies, linguistics, and religious studies.

### Special Application Requirements

Applicants must send the following directly to the Department of Classical and Near Eastern Studies: copy of all transcripts; copy of the GRE; three letters of recommendation from persons well acquainted with the student's academic work and professional experience; and a statement describing the student's intended course of study and professional goals. For non-native speakers of English, a copy of the TOEFL is required. Students may be admitted in any academic term, but financial assistance is normally available only to applicants admitted for fall semester (deadline: February 10).

**Courses**—Please refer to Akkadian (Akka), Ancient Near Eastern (ANE), Aramaic (Arm), Classics (Clas), Greek (Grk), Hebrew (Hebr), Latin (Lat), Religions in Antiquity (RelA), and Sumerian (Sum) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to prior approval by the adviser and the director of graduate studies.

## Ancient and Medieval Art and Archaeology Track

### M.A. Degree Requirements

The degree allows concentrations ranging broadly over the ancient and medieval periods, with an emphasis on art historical and archaeological approaches. Work in an appropriate ancient language is encouraged. The minimum requirement for Plan A is 38 credits (including 10 thesis credits), and for Plan B, 32 credits (including directed study registrations for the Plan B papers).

**Language Requirements**—Reading knowledge of one modern foreign language appropriate to the student's program is required (normally German or French).

**Final Exam**—The final exams are written and oral.

### Minor Requirements for Students

**Majoring in Other Fields**—Students must complete Clas 5794, as well as 9 credits in graduate art/archaeology courses with a Clas designator.

### Ph.D. Degree Requirements

The degree allows concentrations ranging broadly over the ancient and medieval periods, with an emphasis on art historical and archaeological approaches. Graduate-level ability in an appropriate ancient language is required for graduation.

Students who continue from the M.A. program may apply those credits toward the Ph.D., with the exception of Plan A thesis credits or Plan B paper credits. A typical Ph.D. program is at least 71 credits, including at least 21 credits in the major, 12 in a supporting program, and 24 thesis credits.

**Language Requirements**—Reading proficiency in German and in a second modern research language as appropriate (usually French), and research knowledge of an ancient language are required.

### Minor Requirements for Students

**Majoring in Other Fields**—Students must complete Clas 5794, as well as 12 credits in graduate art/archaeology courses with a Clas designator.

## Classics Track

### M.A. Degree Requirements

This program provides a broad training in the literature of ancient Greece and Rome in its cultural context. Work in Greek and Latin is supplemented by courses in a related field or area of interest.

The program requires nearly equal emphasis on courses and seminars in Greek and in Latin, as well as supporting work in a related field or area of interest. The minimum requirement for Plan A is 47 credits (including 10 thesis credits), and for Plan B, 41 credits (including directed study registrations for the Plan B papers).

**Language Requirements**—One modern research language as appropriate (normally French or German) and proficiency in reading both Greek and Latin as certified by a department exam on previously unseen passages is required.

**Final Exam**—The final exams are written (Greek and Latin reading proficiency) and oral (general).

#### Minor Requirements for Students

**Majoring in Other Fields**—Students must complete Clas 5794, as well as 6 credits in graduate-level Latin courses (excluding Lat 8120) and 6 credits in graduate-level Greek courses (excluding Grk 8120).

#### Ph.D. Degree Requirements

This program requires extensive advanced work in both Latin and Greek, together with some study in a related field or area of interest.

The program requires nearly equal emphasis on courses and seminars in Greek and in Latin. Students must take at least three seminars in the major, a graduate level course in archaeology, and a two-semester sequence in ancient history, in addition to fulfilling all course requirements specified for the M.A. Students who continue from the M.A. program may apply those credits toward the degree, with the exception of Plan A thesis credits or Plan B paper credits. A typical Ph.D. program is 77 credits, including at least 35 credits in the major, 12 in the supporting program, and 24 thesis credits.

**Language Requirements**—German, plus another modern language, preferably French, and proficiency in reading Greek and Latin as demonstrated by a department exam on previously unseen passages is required.

#### Minor Requirements for Students

**Majoring in Other Fields**—Students must complete Clas 5794, as well as 9 graduate credits of Greek (excluding Grk 8120) and 9 graduate credits of Latin (excluding Lat 8120).

#### Greek Track

##### M.A. Degree Requirements

A core of advanced work in Greek is supplemented by a minor or supporting program in a related field or area of interest. The minimum requirement for Plan A is 47 credits (including 10 thesis credits), and for Plan B, 41 credits (including directed study registration for Plan B papers).

**Language Requirements**—One modern research language as appropriate, preferably French or German, is required.

**Final Exam**—The final exams are written (Greek reading proficiency) and oral (general).

#### Minor Requirements for Students

**Majoring in Other Fields**—Students must complete Clas 5794, as well as 9 graduate credits of Greek (excluding Grk 8120).

#### Ph.D. Degree Requirements

A core of advanced work in Greek is supplemented by a minor or a supporting program in a related field or area of interest. Students must take at least three seminars in the major, a graduate level course in archaeology, and a two-semester sequence of ancient history in addition to completing all M.A. course requirements. Students who continue from the M.A. program may apply those credits toward the degree, with the exception of Plan A thesis or Plan B paper credits. A typical Ph.D. program is 77 credits, including at least 15 credits in Greek, 15 credits in the supporting program, and 24 thesis credits.

**Language Requirements**—German and a second modern language, preferably French, and reading proficiency in ancient Greek as demonstrated by a department exam on previously unseen passages is required.

#### Minor Requirements for Students

**Majoring in Other Fields**—Students must complete Clas 5794, as well as 15 graduate credits in Greek (excluding Grk 8120).

#### Latin Track

##### M.A. Degree Requirements

A core of advanced work in Latin is supplemented by a minor or supporting program in a related field or area of interest. The minimum requirement for Plan A is 47 credits (including 10 thesis credits), and for Plan B, 41 credits (including directed study registration for Plan B papers).

**Language Requirements**—One modern research language as appropriate, preferably German or French, and reading proficiency in Latin as demonstrated by a department exam on previously unseen passages is required.

**Final Exam**—The final exams are written (Latin reading proficiency) and oral (general).

#### Minor Requirements for Students

**Majoring in Other Fields**—Students must complete Clas 5794, as well as 9 graduate credits of Latin (excluding Lat 8120).

#### Ph.D. Degree Requirements

A core of advanced work in Latin is supplemented by a minor or supporting program in a related field or area of interest. Students must take at least three seminars in the major, a graduate level course in archaeology, and a two-semester sequence in ancient history, in addition to completing all M.A. course requirements. Students who continue from the M.A. program may apply those credits towards the degree, with the exception of Plan A thesis credits or Plan B paper credits. A typical Ph.D. program is 77 credits, including at least 15 credits in Latin, 15 credits in the supporting program, and 24 thesis credits.

**Language Requirements**—German and a second modern research language, normally French, and reading proficiency in Latin as demonstrated by a department exam on previously unseen passages is required.

#### Minor Requirements for Students

**Majoring in Other Fields**—Students must complete Clas 5794 and 15 graduate credits of Latin (excluding Lat 8120).

#### Religions in Antiquity Track

##### M.A. Degree Requirements

The religions in antiquity track is comparative in both method and content. Although students may focus on a particular religious tradition, they will nonetheless study several ancient religions. The Plan A requires 22 credits in the major, 9 credits in a related field, plus 10 thesis credits. The Plan B requires 26 credits in the major plus 9 credits in a related field.

**Language Requirements**—Proficiency in one modern language (normally German) and M.A.-level proficiency in classical Hebrew, Greek, or Latin as demonstrated by a department exam on previously unseen passages is required.

**Final Exam**—The final exams are written (ancient language reading proficiency) and oral (general).

## Classics

See Classical and Near Eastern Studies.

## Clinical Laboratory Science

**Contact Information**—Clinical Laboratory Science Program, Department of Laboratory Medicine and Pathology, University of Minnesota Medical School, MMC 609, 420 Delaware Street S.E., Minneapolis, MN 55455 (612-625-8952; fax 612-625-5901; [cls@umn.edu](mailto:cls@umn.edu); <[http://pathology.umn.edu/ClinicalLab/MS\\_CLS.html](http://pathology.umn.edu/ClinicalLab/MS_CLS.html)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### Professor

Fred S. Apple, Laboratory Medicine and Pathology, M2  
 Henry H. Balfour, Jr., Laboratory Medicine and Pathology, M2  
 Paul P. Cleary, Microbiology, M2  
 Agustin P. Dalmasso, Laboratory Medicine and Pathology, M2  
 Gary M. Dunny, Microbiology, M2  
 John H. Eckfeldt, Laboratory Medicine and Pathology, M2  
 Stanley L. Erlandsen, Cell Biology and Neuroanatomy, M2  
 Patricia Ferrieri, Laboratory Medicine and Pathology, M2  
 Robert P. Hebbel, Medicine, M2  
 Stephen S. Hecht, Laboratory Medicine and Pathology, M2  
 Marc K. Jenkins, Microbiology, M2  
 Russell C. Johnson, Microbiology, M2  
 Vivek Kapur, Veterinary Pathobiology, M2  
 John H. Kersey, Laboratory Medicine and Pathology, M2  
 Nigel Key, Medicine, M2  
 Tucker W. LeBien, Laboratory Medicine and Pathology, M2  
 J. Jeffrey McCullough, Laboratory Medicine and Pathology, M2  
 R. Scott McIvor, Laboratory Medicine and Pathology, M2

Gary L. Nelsestuen, Biochemistry, M2  
Harry T. Orr, Laboratory Medicine and Pathology, M2  
Gundu H. R. Rao, Laboratory Medicine and Pathology, M2  
Michael Y. Tsai, Laboratory Medicine and Pathology, M2  
Daniel A. Vallera, Therapeutic Radiology, M2  
Catherine M. Verfaillie, Medicine, M2  
Carol L. Wells, Laboratory Medicine and Pathology, M2  
Michael J. Wilson, Laboratory Medicine and Pathology, M2

### Associate Professor

Ronald R. W. Jemmerson, Microbiology, M2  
Ronald C. McGlennen, Laboratory Medicine and Pathology, M2  
Phuong L. Nguyen, Laboratory Medicine and Pathology, M2  
Timothy W. Olsen, Ophthalmology, M2  
Miriam Segall, Laboratory Medicine and Pathology, M2  
Amy P. Skubitz, Laboratory Medicine and Pathology, M2  
William R. Swaim, Laboratory Medicine and Pathology, M2

### Assistant Professor

Elizabeth G. Ingulli, Pediatrics, M2  
Angela Panoskaltis-Mortari, Pediatrics, M2  
Kim-Sue Tudor, Laboratory Medicine and Pathology, M2

### Research Associate

Connie J. Gebhart, Research Animal Resources, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—This program offers students with basic science or medical technology backgrounds the opportunity to gain competence in a specialized area of laboratory medicine. It provides training in the research, supervisory, and teaching aspects of the field. Students pursue investigative work in one of five specialty areas: chemistry, genetics, hematology, immunology, and microbiology.

**Prerequisites for Admission**—A bachelor's degree in a basic science or in medical technology, including standard college courses in organic/inorganic chemistry, biochemistry, quantitative analysis, physics, and mathematics, is required. Previous laboratory experience is desirable.

### Special Application Requirements

Applicants must forward to the Department of Laboratory Medicine and Pathology three letters of recommendation, an autobiographical outline that includes a statement of career goals, and scores from the General Test of the GRE. A minimum TOEFL score of 213 computer-based and 550 paper test is required for applicants whose native language is not English.

**Courses**—Please see Clinical Laboratory Science (CLS) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—The program accepts MedT 4xxx courses when cross-listed with CLS 5xxx courses and approved by the adviser and/or director of graduate studies, (e.g., MedT 4104 and 4105—Principles of Diagnostic Microbiology: Lecture and Lab,

MedT 4251—Hematology I: Basic Techniques, MedT 4310 and 4311—Clinical Chemistry I and II: Lecture and Lab). However, credit will not be granted if the CLS equivalent of these MedT courses was taken as part of an undergraduate degree.

### M.S. Plan A Degree Requirements

The M.S. is a multidisciplinary program that prepares the medical technologist or basic science undergraduate for a career in research, teaching, or industry within a specialized area of laboratory medicine. Students pursue investigative work in one of five specialty areas: clinical chemistry, genetics/molecular genetics, hematology, immunology, or microbiology. Each area has required courses, but flexibility is maintained to allow students to choose some coursework that meets individual requirements and research interests.

Requirements include at least 17 credits in the specialty area, at least 6 credits in a minor or in related fields outside the specialty area, 10 thesis credits, and 2 student seminar credits.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

## Clinical Research

**Contact Information**—Student Services Center, School of Public Health, University of Minnesota, MMC 819, 420 Delaware Street S.E., Minneapolis, MN 55455 (612-626-3500; fax 612-626-6931; [sph-ssc@umn.edu](mailto:sph-ssc@umn.edu); <[www.epi.umn.edu/epi\\_pages/academic/ms\\_cr.html](http://www.epi.umn.edu/epi_pages/academic/ms_cr.html)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Linda H. Bearinger, Nursing, M2  
Carole J. Bland, Family Practice and Community Health, M2  
David M. Brown, Laboratory Medicine and Pathology, M2  
James C. Cloyd III, Pharmacy Practice, M2  
Allan J. Collins, Medicine, M2  
Kristine E. Ensrud, Medicine, M2  
G. Scott Giebink, Pediatrics, M2  
Stephen P. Glasser, Epidemiology, M2  
Richard H. Grimm, Medicine, M2  
Joseph T. Hanlon, Health Services Research and Policy, M2  
Dorothy Hatsukami, Psychiatry, M2  
Robert P. Heibel, Medicine, M2  
Jeffrey P. Kahn, Health Services Research and Policy, M2  
Robert L. Kane, Health Services Research and Policy, M2  
Bertram L. Kasiske, Medicine, M2  
Nigel S. Key, Medicine, M2  
Russell V. Luepker, Epidemiology, M2  
Jeffrey McCullough, Laboratory Medicine and Pathology, M2  
Jim D. Neaton, Biostatistics, M2  
Thomas E. Nevins, Pediatrics, M2  
Mark S. Paller, Medicine, M2  
Bruce A. Peterson, Medicine, M2  
Bruce L. Pihlstrom, Preventive Sciences, M2  
Norma K. Ramsay, Pediatrics, M2  
Leslie L. Robison, Pediatrics, M2  
Hanna B. Rubins, Medicine, M2  
Elizabeth R. Seaquist, Medicine, M2  
Daniel J. Weisdorf, Medicine, M2  
Douglas Yee, Medicine, M2

### Associate Professor

Gregory J. Beilman, Surgery, M2  
Donna Z. Bliss, Nursing, M2  
Linda J. Burns, Medicine, M2  
Patricia Fontaine, Family Practice and Community Health, M2  
James G. Gurney, Pediatrics, M2  
Timothy D. Henry, Medicine, M2  
Alan T. Hirsch, Medicine, M2  
Ann C. Mertens, Pediatrics, M2  
Antoinette Moran, Pediatrics, M2  
Pamela J. Schreiner, Epidemiology, M2  
John William Thomas, Biostatistics, M2

### Assistant Professor

Moise Desvarieux, Epidemiology, M2  
Edward W. Greeno, Medicine, M2  
Hassan N. Ibrahim, Medicine, M2  
Karen L. Margolis, Medicine, M2  
Timothy W. Schacker, Medicine, M2  
M. Kathryn Schmitz, Epidemiology, M2  
Mark W. Yeazel, Family Practice and Community Health, M2

### Senior Research Associate

James S. Hodges, Biostatistics, M2  
John O. Look, Diagnostic and Surgical Science, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—This interdisciplinary program trains health professionals to design, implement, and manage research in clinical populations. Because the field is fast becoming more complex, sophisticated, and regulated, there is an emerging recognition of, and demand for, formalized training. This program focuses primarily on patient-oriented health research including mechanisms of human disease, therapeutic interventions, clinical trials, and development of new techniques. It focuses less on epidemiologic and behavioral studies, or on outcomes research and health services research; students interested in these areas might better be served by seeking a master of public health (M.P.H.) degree.

**Prerequisites for Admission**—The program is designed for individuals interested in a research career in academia, industry, research institutes, health agencies, or regulatory agencies. Applicants must have an advanced health professional degree such as M.D., D.D.S., D.V.M., Pharm.D., Ph.D., or advanced doctoral degree in a clinical biomedical field; or advanced nursing degree (e.g., M.S. in nursing, M.S.N., or nurse practitioner). Students must have completed or be at an advanced stage of their clinical practice training and be affiliated with someone at the University of Minnesota who can provide advising and access to a clinical project. The admissions committee considers exceptions on an individual basis.

**Special Application Requirements**—In addition to the School of Public Health requirements listed in their catalog, the M.S. has specific application requirements including a health science professional degree, and training sufficient to be eligible for a license to practice as supported in the form of an official transcript. An official

TOEFL score of at least 600 (written) or 250 (computer) is required of international students who have earned all of their degrees from non-native English speaking countries. There are three exceptions: 1) students who have taken and successfully passed the ECFMG or USMLE exams do not need to submit a TOEFL score; 2) University of Minnesota Medical Fellows or Medical Fellow Specialists who have taken at least 24 credits as part of their University fellowship are exempt from providing an official TOEFL score if they provide a transcript of these credits; 3) the MELAB has been taken as an alternative exam to the TOEFL. The GRE is not required. One of the three required recommendation letters and a completed *School of Public Health Recommendation* form should be from the clinical director of training supporting the applicant's potential as a clinical researcher. **Note:** faculty members at the University of Minnesota above the rank of instructor have additional administrative procedures required by the Graduate School. Contact the Graduate School Admissions Office early in the process.

**Courses**—Please refer to the clinical research curriculum sheet available on the School of Public Health Web site at <[http://www.epi.umn.edu/academic/ms\\_cr.shtm](http://www.epi.umn.edu/academic/ms_cr.shtm)> for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of any 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### M.S. Plan A Requirements

The M.S. requires 38 credits, including 3 elective credits and 10 thesis credits. Coursework in biostatistics, epidemiology, clinical trials, data collection, grant writing, and ethics is provided. Elective courses are chosen in consultation with an adviser. The thesis may take the form of any approved clinical research project in which the student is involved in the design, implementation, and analysis.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students**

**Majoring in Other Fields**—The master's minor requires at least 6 credits. Contact the major coordinator for more information at [gradstudies@epi.umn.edu](mailto:gradstudies@epi.umn.edu).

## Cognitive Science

### Minor Only

**Contact Information**—Center for Cognitive Sciences, University of Minnesota, 205 Elliott Hall, 75 East River Road, Minneapolis, MN 55455 (612-625-9367; fax 612-626-7253; [ccs@cogsci.umn.edu](mailto:ccs@cogsci.umn.edu); <<http://cogsci.umn.edu/>>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Patricia J. Bauer, Child Development, M  
Maria Gini, Computer Science, M  
Jeanette K. Gundel, Linguistics, ESL, and Slavic Languages and Literatures, M  
Keith Gunderson, Philosophy, M  
Paul E. Johnson, Information and Decision Sciences, M

Michael B. Kac, Philosophy, M  
Daniel J. Kersten, Psychology, M  
Gordon E. Legge, Psychology, M  
Charles A. Nelson, Child Development, M  
J. Bruce Overmier, Psychology, M  
Herbert L. Pick, Jr., Child Development, M  
C. Wade Savage, Philosophy, M  
Maria D. Sera, Child Development, M  
Paulus W. van den Broek, M  
Albert Yonas, Child Development, M

### Associate Professor

Charles R. Fletcher, Psychology, M  
Chad J. Marsolek, Psychology, M

### Clinical Associate Professor

Mary Jo Nissen, Psychology, M

**Curriculum**—Cognitive science is a field of inquiry at the interface of cognitive psychology, computer science, linguistics, neuroscience, and philosophy. Cognitive science is concerned with the acquisition, representation, and use of knowledge by humans and machines. The curriculum provides students with a broad foundation in psychological, philosophical, and computational approaches to the study of cognition.

**Prerequisites for Admissions**—Admission is contingent upon prior admission to a master's or doctoral degree-granting program within the Graduate School. Admission is limited and only by permission of the director of graduate studies in cognitive science.

### Special Application Requirements

Contact the director of graduate studies in cognitive science for an *Intent to Enroll* form that students are encouraged to submit by the end of fall semester the year before initiating coursework. Later submissions are considered as space permits.

**Courses**—Please refer to the minor program office for coursework pertaining to the program.

**Use of 4xxx Courses**—4xxx courses may not be included on degree program forms for the cognitive science minor.

### Minor Only Requirements

The minor in cognitive science is available to master's (M.A. and M.S.) and doctoral students. Both a master's and doctoral minor require the following core courses outside the student's major department: CgSc 8000—Philosophy of Cognitive Science, CSci 5511—Artificial Intelligence I, and Psy 5015—Cognition, Computation, and Brain. Substitutions for these courses are permitted only with prior permission from the director of graduate studies for cognitive science. In addition, CgSc 8001—Proseminar in Cognitive Science is required for the doctoral minor. The master's minor requires a minimum of 8 graduate credits; the doctoral minor requires 14 graduate credits. Additional courses beyond those required

must be taught by faculty in the minor program or approved in advance by the cognitive science director of graduate studies. Courses in the student's major department do not count toward the minor.

## Communication Disorders

**Contact Information**—Department of Communication Disorders, University of Minnesota, 115 Shevlin Hall, 164 Pillsbury Drive S.E., Minneapolis, MN 55455 (612-624-322; fax 612-624-756; [dis@umn.edu](mailto:dis@umn.edu); <[www.cdsumn.edu/](http://www.cdsumn.edu/)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Arlene E. Carney, SM  
Karlind T. Moller, SM  
David A. Nelson, ASM  
Joe E. Reichle, SM  
Charles E. Speaks, SM  
Jennifer A. Windsor, SM

### Adjunct Professor

Dianne Van Tasell, ASM

### Associate Professor

Robert S. Schlauch, SM

### Adjunct Associate Professor

David A. Fabry, AM

### Assistant Professor

Mary R. T. Kennedy, M2  
Kathryn Kohnert, M2  
Benjamin Munson, M2  
Peggy B. Nelson, M2

### Adjunct Assistant Professor

Timothy D. Trine, AM

### Clinical Specialist

Leslie E. Glaze, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Emphases in the master's program are speech-language pathology and audiology. Emphases in the doctoral program are speech-language pathology, speech science, language science, audiology, and hearing science.

**Prerequisites for Admission**—Prospective students must have completed an undergraduate degree. Individuals from both communication disorders and other academic areas are welcome. Students entering the M.A. program with minimal background in communication disorders should expect their program to extend beyond the usual two years.

**Special Application Requirements**—Three letters of recommendation evaluating the applicant's scholarship (two from professorial-rank faculty are recommended), a complete set of transcripts (in addition to that required by the Graduate School), and GRE scores are required. Deadline for application to the master's program is January 15; late applications are considered only if space is available. Master's students

ordinarily begin graduate study during fall term. Review of applicants to the doctoral program is continuous.

**Courses**—Please refer to Communications Disorders (CDIs) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### M.A. Degree Requirements

Emphases in the master's program are speech-language pathology and audiology, which are accredited by the American Speech-Language-Hearing Association's Council on Academic Accreditation. Students who complete the M.A. are eligible for clinical certification by the Association.

Students may select between two M.A. options. Plan A requires coursework and a thesis that is experimental in nature. Plan B requires coursework, a comprehensive written examination, and an oral examination.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A minimum of 12 credits, approved by the director of graduate studies, is required for a master's minor.

### Ph.D. Degree Requirements

Emphases in the doctoral program are speech-language pathology, audiology, speech science, language science, or hearing science. The program prepares students for careers in research, teaching, and advanced clinical applications. Most students entering the program have a master's degree in speech-language pathology, audiology, or a related area. The Ph.D. degree usually requires three years of work beyond the master's degree. In general, a student's program is designed by the student in consultation with the adviser to satisfy the particular objectives of the student, but there are also some department and Graduate School requirements that must be satisfied. These include coursework, research activities, teaching experience, and preliminary and final exams.

A minimum of 12 course credits in a minor or supporting program and registration for 24 thesis credits are required. Also required is a statistics sequence, for which students typically register during their first two years. The written and oral preliminary exams are taken at the end of the second year.

Each student completes a seminar (CDIs 8420) and a minimum of 4 credits of teaching experience that provide an opportunity for the student to develop and teach sections of department courses. Students also complete a seminar (CDIs 8410) and a minimum of 4 credits of research under the direction of one or more faculty members in the department other than the adviser.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—A minimum of 15 credits, approved by the director of graduate studies, is required for a doctoral minor.

## Communication Studies

**Contact Information**—Department of Communication Studies, University of Minnesota, 225 Ford Hall, 224 Church Street S.E., Minneapolis, MN 55455 (612-624-5800; <[www.commun.mn.edu](http://www.commun.mn.edu)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Donald R. Browne, SM  
Karlyn K. Campbell, SM  
W. Andrew Collins, ASM  
Alan G. Gross, ASM  
Dean E. Hewes, SM  
Mary M. Lay, ASM  
Edward Schiappa, SM  
Robert L. Scott (emeritus), ASM  
Amy L. Sheldon, SM  
Michael Sunnafrank, Communication, Duluth, AM2  
Arthur E. Walzer, ASM

### Associate Professor

Rosita D. Albert, SM  
Laura J. Gurak, ASM  
David L. Rarick, SM  
Mary D. Vavrus, M2  
Kirt H. Wilson, M2

### Assistant Professor

Ronald W. Greene, M2  
Terry A. Kinney, M2  
Ascan F. Koerner, M2

### Lecturer

Patricia Kovel-Jarboe, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Communication studies focuses on the study of communicative dimensions of human experience using humanistic and social scientific methods. This program prepares students to become researchers and teachers, offering two concentrations: communication theory and rhetorical studies.

Coursework in communication theory has a social scientific orientation. Most students focus on a subarea such as small group, organizational, intercultural, electronic media, interpersonal communication, or problems (e.g., decision making, conflict resolution, information diffusion). Coursework outside the department is usually concentrated in one or more of the behavioral sciences. Students are expected to develop a command of research techniques and a thorough knowledge of statistics. Interdisciplinary programs are encouraged.

Coursework in rhetoric and public address emphasizes humanistic methods and includes argumentation and persuasion, media studies, ethics, rhetorical theory and criticism, and American public address. Students may also

pursue special interests in rhetorical philosophies, movements and campaigns, popular culture, or historical and contemporary political speaking. The program should be supplemented by coursework outside the department. An understanding of history, political science, sociology, or other social sciences is recommended.

**Prerequisites for Admission**—All applicants must have completed at least 15 undergraduate credits in speech or communication courses related to their proposed area of emphasis in the department. A brochure detailing prerequisite requirements is available from the department. All prerequisites must be completed before admission.

### Special Application Requirements

Applicants must submit scores from the GRE General Test, transcripts of all postsecondary academic work, and a written statement of academic and occupational objectives. Three letters of recommendation are required of all applicants for assistantships or fellowships. A deadline of January 15 is recommended for students applying for teaching assistantships or University fellowships for the following academic year.

**Courses**—Please refer to Communication Studies (Comm) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval. Such courses must be taught by graduate faculty and usually no more than two 4xxx courses are allowed on a degree program form.

### M.A. Degree Requirements

The degree is offered under Plan A (thesis) and Plan B (without thesis). Both plans require a minimum of 15 course credits in communication studies, including Comm 5421 and 5615, and a minimum of 6 course credits in a minor or related fields. Plan A also requires 10 thesis credits, and Plan B requires a paper and 6 additional course credits in communication studies.

**Language Requirements**—None.

### Ph.D. Degree Requirements

The program requires no set number of course credits, but students are urged to submit programs consisting of at least 60 course credits (which may include 30 credits from the M.A. and an additional 30 credits of doctoral coursework; Comm 5615 and 5421 or equivalents must be included); 24 thesis credits are required.

The program should include 12 credits in research methods relevant for completing the degree and continuing a scholarly career. Under certain circumstances, foreign language courses may be used to satisfy this requirement.

**Language Requirements**—None.

## Comparative Literature

**Contact Information**—Department of Cultural Studies and Comparative Literature, University of Minnesota, 350 Folwell Hall, 9 Pleasant Street S.E., Minneapolis, MN 55455 (612-625-5358; fax 612-626-0228; [complit@umn.edu](mailto:complit@umn.edu); <http://complit.cla.umn.edu>).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Timothy A. Brennan, SM  
John W. Mowitz, SM  
Harvey B. Sarles, SM  
Jochen Schulte-Sasse, German, Scandinavian, and Dutch, SM  
Nicholas Spadaccini, Spanish and Portuguese Studies, AM2  
Arlene Teraoka, German, Scandinavian, and Dutch, ASM  
Hernan Vidal, ASM  
Jack D. Zipes, German, Scandinavian, and Dutch, ASM

### Associate Professor

Maria M. Brewer, French and Italian, ASM  
Robert Brown, SM  
Cesare Casarino, SM  
Keya Ganguly, SM  
Catherine Liu, SM  
Leslie Morris, German, Scandinavian, and Dutch, ASM  
Thomas A. Pepper, SM

### Assistant Professor

Elizabeth Kotz, Cultural Studies and Comparative Literature, SM  
Haidee Wasson, Cultural Studies and Comparative Literature, SM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Comparative literature is the oldest field of literary criticism, dating back to the eighteenth century. Among the wide range of studies currently conducted in comparative literature nationally and internationally, the University focuses on theories of literary criticism and its explanatory bases; indeed the program is seen as one of the principal initiators of such fields of study. This program is likewise engaged in pushing the bounds of critical inquiry in related domains of literary inquiry, directing much of its energies toward women's writing and emergent literatures, within both First- and Third-World cultures, as well as toward related problems ranging from narrative to postcolonial studies.

A major portion of coursework for degrees in comparative literature is cross-listed with the literature and language departments. Approval may also be given to take graduate courses in such areas as anthropology, art, architecture, history, music, philosophy, and sociology. In all cases, students should consult with an adviser concerning course selections.

**Prerequisites for Admission**—Although most students in the program have undergraduate majors in language or literature, applicants with other undergraduate backgrounds are considered.

**Special Application Requirements**—Applicants must submit scores from the GRE. The deadline for applying for admission and for financial aid is January 15. Admission is only for fall semester.

**Courses**—Please refer to Comparative Literature (CLit) in the course section of this catalog, the current *Class Schedule*, and flyers available in the department office for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses may be permitted in majors or minors for the M.A. or Ph.D. degree with the approval of the adviser and director of graduate studies.

### M.A. Plan B Degree Requirements

Students normally are not admitted to work toward the M.A. degree, but in certain circumstances where earning the M.A. degree is desirable, students already in the Ph.D. program may apply through the director of graduate studies to pursue this degree. Thirty credits including 8 credits of research seminar (8001-2), 12 additional CLit credits, 6 credits in courses in related fields outside comparative literature or in a formal minor in another program, and 4 credits either in CLit courses or in the related minor field are required. One substantial Plan B paper is required.

**Language Requirements**—In addition to English, high competence in one language and reading knowledge of another language are required. The choice of languages is made with respect to the student's area of specialization and in consultation with, and approval of, the adviser.

**Final Exam**—The final exams are written and oral.

**Minor Requirements for Students Majoring in Other Fields**—A minimum of 12 credits are required for a master's minor, which must include CLit 8001 and 8002.

### Ph.D. Degree Requirements

The Ph.D. requires 51 semester credits, as follows: 8 credits of basic seminar (CLit 8001-8002), 3 credits in Pedagogy of Cultural Studies and Comparative Literature (CLit 8901), 28 credits in CLit courses (with approval of the adviser and the director of graduate studies, up to 4 credits of the 28-credit requirement may be taken in the field of the minor or supporting program), and 12 credits in coursework that constitutes a supporting program. A supporting program may be a formal Graduate School minor, or it may be a program designed by students in consultation with their adviser. Overall, the degree should include 16 credits of 8xxx courses (exclusive of CLit 8001-8002 and 8901). 24 thesis credits are also required. A paper of publishable quality must be submitted to, and approved by, the student's doctoral committee before proceeding with the preliminary examinations.

**Language Requirements**—In addition to English, the following language competencies are required: high proficiency in one language, proficiency in a second

language, and a good reading knowledge of a third language. The choice of languages is made with respect to the student's area of specialization and in consultation with, and with the approval of, the adviser. For example, a student specializing in theory could have a high proficiency in French and proficiency in German (or vice versa) and reading knowledge of a classical language such as Latin. Language requirements must be completed before taking the preliminary examination.

**Minor Requirements for Students Majoring in Other Fields**—A minimum of 16 credits is required for the doctoral minor and must include CLit 8001 and 8002.

## Comparative Studies in Discourse and Society

**Contact Information**—Comparative Studies in Discourse and Society Program, University of Minnesota, 350 Folwell Hall, 9 Pleasant Street S.E., Minneapolis, MN 55455 (612-625-5358; fax 612-626-0228; [csds@umn.edu](mailto:csds@umn.edu); <http://csds.cla.umn.edu>).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Timothy Brennan, Cultural Studies and Comparative Literature, SM  
Richard D. Leppert, Cultural Studies and Comparative Literature, SM  
Ellen Messer-Davidow, English, ASM  
John W. Mowitz, Cultural Studies and Comparative Literature, SM  
Paula Rabinowitz, English, ASM  
Harvey Sarles, Cultural Studies and Comparative Literature, SM  
Jochen Schulte-Sasse, German, Scandinavian, and Dutch, SM  
Arlene Teraoka, German, Scandinavian, and Dutch, ASM  
Hernan Vidal, Spanish and Portuguese Studies, ASM  
Jack D. Zipes, German, Scandinavian, and Dutch, ASM

### Associate Professor

W. John Archer, Cultural Studies and Comparative Literature, SM  
Robert L. Brown, Jr., Cultural Studies and Comparative Literature, SM  
Cesare Casarino, Cultural Studies and Comparative Literature, SM  
Maria Damon, English, ASM  
Keya Ganguly, Cultural Studies and Comparative Literature, SM  
Catherine Liu, Cultural Studies and Comparative Literature, SM  
Roger P. Miller, Geography, ASM  
Leslie Morris, German, Scandinavian, and Dutch, ASM  
Thomas Pepper, Cultural Studies and Comparative Literature, SM  
Katherine M. Solomonson, Architecture, ASM  
Gary C. Thomas, Cultural Studies and Comparative Literature, SM  
Jacquelyn N. Zita, Women's Studies, ASM

### Assistant Professor

Elizabeth Kotz, Cultural Studies and Comparative Literature, SM  
Haidee Wasson, Cultural Studies and Comparative Literature, SM

### Other

Jason J. Lahr, ASM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—While most traditional humanistic disciplines tend to focus either on a given mode of discourse (e.g., art history, musicology) or a specific cultural context (e.g., American studies, European languages and literatures), this program engages a broader problematic—how discourse and cultural production both shape and are shaped by life in time, space, matter, and society. Drawing on a variety of theoretical positions, close attention is paid to various types of discourse, such as music, film, myth, ritual, architecture, landscape and urban design, painting, sculpture, and literature in elite, popular, folk, and mass culture, understanding these as both a site and an instrument of contestation and negotiation among social forces. More generally, the program seeks to reassociate intellectual and cultural history with social and political history, to set discourse of various sorts within a social context, and to consider specific social formations within the ongoing historical process. In all this, the program encourages work that is interdisciplinary (at times, even anti-disciplinary) as well as cross-cultural.

The curriculum emphasizes small seminars and directed research. The core requirement is a two-semester research seminar, a practicum that develops critical and analytic skills and introduces current theoretical perspectives with the study of historic problems. The majority of courses are nonrecurring and closely relate to current faculty research. In all cases, students should consult their advisers and the director of graduate studies concerning course selections. Each entering graduate student enrolls in CSDS 8901—Pedagogy, which focuses on developing skills and experience in teaching, fellowship application, placement, and other professional concerns.

**Prerequisites for Admission**—Applicants are required to have a B.A. in a humanities or social science discipline or other relevant field with clear evidence of comparative work. Because the program involves broad, often interdisciplinary, courses of study and a variety of emphases, the graduate admissions committee carefully reviews each applicant's background in terms of analytical skills, knowledge of subject matter, experience, language preparation, and especially, congruity with faculty interests and expertise.

**Special Application Requirements**—Scores from the General (Aptitude) Test of the GRE are required. The deadline for financial aid application is January 15 before the academic year for which aid is sought. Applications for admission are considered only at the January 15 deadline, except in certain cases for students already enrolled in a graduate degree program at the University of Minnesota. Consult the director of graduate studies for application requirements.

**Courses**—Please refer to Comparative Studies in Discourse and Society (CSDS) in the course section of this catalog, the current *Class Schedule*, and fliers available in the department office for courses pertaining to the program.

**Use of 4xxx Courses**—4xxx courses may be included in majors or minors for the M.A. or Ph.D. degree with the approval of the adviser and director of graduate studies.

### M.A. Plan B Degree Requirements

Students normally are not admitted to work toward the M.A. degree, but in certain circumstances where earning the M.A. degree is desirable, students already in the Ph.D. program may apply through the director of graduate studies to pursue this degree. Thirty credits including 8 credits of research seminar (8001-2), 12 additional CSDS credits, 6 credits in courses in related fields outside comparative literature or in a formal minor in another program, and 4 credits either in CSDS courses or in the related minor field are required. One substantial Plan B paper is required.

**Language Requirements**—Reading knowledge of one foreign language appropriate to the student's program is required.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—A minimum of 12 credits is required for a master's minor, which must include CSDS 8001 and 8002.

### Ph.D. Degree Requirements

The Ph.D. requires 51 graduate credits, as follows: 8 credits of basic seminar (CSDS 8001-8002), 3 credits in CSDS 8901—Pedagogy of Cultural Studies and Comparative Literature, 28 credits in CSDS courses (with approval of the adviser and the director of graduate studies up to 4 credits of the 28-credit requirement may be taken in the field of the minor or supporting program), and 12 credits (or more, as necessary) to complete a formal minor in another Graduate School program, excluding comparative literature. If a minor is not pursued in another program, the student must complete 15 credits in coursework outside of CSDS, CSCL, or CLit courses, in a coherent and complementary program to be approved by the adviser and the director of graduate studies. Overall, the degree should include 16 credits of 8xxx courses (exclusive of CSDS 8001-8002 and 8901). 24 thesis credits are also required. A paper of publishable quality must be submitted to, and approved by, the student's doctoral committee before proceeding with the preliminary examinations.

**Language Requirements**—Reading knowledge of two foreign languages appropriate to the student's program is required. Language requirement must be completed before taking the preliminary examination.

### Minor Requirements for Students

**Majoring in Other Fields**—A minimum of 16 credits is required for a Ph.D. minor and must include CSDS 8001 and 8002.

## Complementary Therapies and Healing Practices

### Minor Only

**Contact Information**—Center for Spirituality and Healing, MMC 505, 420 Delaware St. S.E., Minneapolis, MN 55455 (612-624-5166; fax 612-626-5280; <[www.csh.umn.edu](http://www.csh.umn.edu)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Linda J. Brady, M  
Francis F. Busta (emeritus), AM  
Barbara Leonard, M  
Robert P. Patterson, M  
Mariah Snyder (emeritus), AM  
Marilyn Speedie, M  
Mark S. Umbreit, M

### Associate Professor

Laura Duckett, M  
V. Lois Erickson, M  
Craig A. Hassel, M  
Richard Kingston, M  
Ruth A. Lindquist, M  
Gregory Plotnikoff, M  
Janice Post-White, M  
Carla Tabourne, M

### Assistant Professor

Linda L. Chlan, M  
Linda Halcon, M  
Kate M. Hathaway, AM  
Donald R. Houge (emeritus), AM  
Mary Jo Kreitzer, M  
Karen Lawson, M

### Lecturer

Miriam Cameron, M  
Pat Culliton, M  
Dennis McKenna, M  
Sue M. Towey, M

### Other

Lynne Mason, M

**Curriculum**—The graduate minor in complementary therapies and healing practices is an interdisciplinary program designed to expose students to the global range of complementary, cross-cultural, and spiritual healing practices. It enhances the preparation of graduate students in health sciences and other disciplines by developing knowledge and skills in the emerging field of complementary and alternative healthcare. Specifically, the minor provides students with a theoretical basis for applying complementary therapies and healing practices; prepares students to research complementary therapies and healing practices; and prepares students to work collaboratively with other health professionals and patients in a multicultural, pluralistic healthcare system. The minor includes a set of core courses that provide the theoretical foundation for the program. Students may elect to take additional courses offered by the Center for Spirituality and

Healing in clinical applications, spirituality, or cross-cultural health and healing. A number of other University courses also satisfy the course requirements of the minor; contact the minor program office for more information.

**Prerequisites for Admission**—This graduate minor is available to master's and doctoral students. To have the minor formally designated on a transcript students must be enrolled in a major in the Graduate School and have completed—or concurrently be enrolled in—a graduate research course upon beginning the first course in the minor. Note that the research course is in addition to the specified credits required for the minor. Students should work out their program of study with the director of graduate studies for the minor early in their graduate study.

**Courses**—Please refer to Center for Spirituality and Healing (CSPH) in the course section of this catalog. Contact the minor program office for the most current information on relevant coursework pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses in the degree program is permitted based on approval of the graduate faculty and the director of graduate studies.

### Minor Only Requirements

Master's and doctoral students take CSPH 5101 (3 cr) and 8101 (1 cr). Master's students must take an additional 4 credits for a total of 8 credits: doctoral students must take an additional 1 credit 8xxx CSPH elective course and an additional 7 credits for a total of 12 credits. Note that students cannot use course credits to satisfy requirements for both a major and the minor.

## Composition, Literacy, and Rhetorical Studies

See Literacy and Rhetorical Studies.

## Computer and Information Sciences

**Contact Information**—Department of Computer Science and Engineering, University of Minnesota, 4-192 Electrical Engineering/Computer Science, 200 Union Street S.E., Minneapolis, MN 55455 (612-625-4002; fax 612-625-0572; [dgs@cs.umn.edu](mailto:dgs@cs.umn.edu); <[www.cs.umn.edu](http://www.cs.umn.edu)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Daniel L. Boley, SM  
Vladimir Cherkassky, ASM  
David H. Du, SM  
Ding-Zhu Du, SM  
Maria Gini, SM  
Ravi Janardan, SM  
Paul E. Johnson, Information and Decision Sciences, AM2  
Daniel J. Kersten, Psychology, ASM  
Larry L. Kinney, AM2  
Vipin Kumar, SM

E. Bruce Lee, ASM  
David J. Lilja, ASM  
Arthur L. Norberg, SM  
Nikolaos P. Papanikolopoulos, SM  
Haesun Park, SM  
Yousef Saad, SM  
Shashi Shekhar, SM  
Eugene B. Shragowitz, SM  
Jaideep Srivastava, SM  
Anand R. Tripathi, SM  
Pen-Chung Yew, SM

### Associate Professor

John V. Carlis, SM  
Mats P. E. Heimdahl, SM  
Wei-Chung Hsu, SM  
Joseph A. Konstan, SM  
Gary Meyer, SM  
Gopalan Nadathur, SM  
John T. Riedl, SM  
Loren Terveen, SM  
Jon Weissman, SM  
Zhi-Li Zhang, SM

### Assistant Professor

Baoquan Chen, SM  
Victoria Interrante, SM  
George Karypis, SM  
Yongdae Kim, M2  
Donglin Liang, M2  
Stergios Roumeliotis, M2  
Paul Schrater, M2  
Erik Van Wyk, M2  
Richard M. Voyles, SM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The faculty of the graduate program in computer and information sciences conducts research in a broad spectrum of theoretical and applied computer sciences. Graduate students may pursue research and study with faculty on topics such as theory of computation and algorithms, numerical algorithms, parallel and distributed computing, languages and compilers, operating systems, databases, data mining, graphics and visualization, human-computer interaction, artificial intelligence, vision and robotics, computer architecture and networks, computer-aided design, software engineering, distributed systems, information science, and computer security. In addition, students may choose a course of study that combines a portion of one of these major areas with an entirely different field.

The computer and information sciences degrees include a Ph.D., an M.S. (either Plan A with thesis or Plan B with project), and an M.C.I.S. The M.C.I.S. is a coursework-only degree and is intended to be a terminal degree.

The Department of Computer Science and Engineering also supports a master of science in software engineering (M.S.S.E.) degree. This department and the Department of Electrical and Computer Engineering jointly offer a masters of science in computer engineering, and many faculty from computer science and engineering also participate in the graduate program in scientific computation.

**Prerequisites for Admission**—A degree in any major with a substantial background in computer science is required; a computer science major is preferred. Applicants with an inadequate background must resolve any deficiencies before applying to the program.

**Special Application Requirements**—Three letters of recommendation are required. Scores from the General (Aptitude) Test of the GRE are required for M.S. and Ph.D. program applicants. The Subject Test is optional, although highly recommended, especially for those seeking financial assistance. If taken, it should be in the undergraduate major field or, if it is not offered in that field, in computer science, mathematics, or engineering. Master's and Ph.D. students are accepted for fall admission only. The application deadline is April 1. Students seeking financial aid must apply by December 15.

**Research Facilities**—Graduate students have access to today's most powerful supercomputers through the Minnesota Supercomputer Institute and Army High Performance Computing Research Center. The Department of Computer Science and Engineering also provides computing facilities through its various laboratories, such as the Graduate Research Laboratory, the Software Engineering Laboratory, the Artificial Intelligence/Robotics/Vision Laboratory, High Performance Computing Laboratory, Distributed Systems Laboratory, Collaborative Systems Laboratory, Database Laboratory, Scientific Computing Laboratory and Distributed Multimedia Laboratory.

**Courses**—Please refer to Computer Science (CSci) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of CSci 4xxx courses on degree program forms is not permitted. Credits from 4xxx courses from an outside department may be used for related field course requirements if the course grants graduate credit.

### M.C.I.S. Coursework Only Degree Requirements

The M.C.I.S. is a coursework-only degree. It requires 31 credits of graduate work, including the following: at least 18 credits from CSci classes; a breadth requirement of four courses in three different areas—theory, systems, and applications; at least 6 credits from outside the department; at least 6 credits from 8xxx courses; and 1 credit of CSci colloquium, which cannot be counted toward any of the other requirements. Students must maintain a GPA above 3.00 after completing 8 credits.

**Language Requirements**—None.

**Final Exam**—There is no final exam.

### M.S. Degree Requirements

The M.S. requires a minimum of 31 credits, with at least 14 of these from CSci courses (at least 3 of which must be 8xxx courses) and 6 from outside the department. Students must complete a breadth requirement of four

courses in three different areas—theory, systems, and applications. For Plan A, at least 10 thesis credits are required; for Plan B, three Plan B project credits are required. Students must also complete 1 credit of CSci colloquium, which cannot be counted toward the other requirements. Students are expected to maintain a GPA of at least 3.25 for all courses listed on their degree program.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students**

**Majoring in Other Fields**—Contact the department.

### Ph.D. Degree Requirements

The Ph.D. requires at least 43 course credits of which 13 must be in CSci courses and at least 12 in a minor or supporting program. Additionally, at least 24 thesis credits are required. Students are expected to complete all courses in their degree program with a GPA of at least 3.45.

**Language Requirements**—None.

**Minor Requirements for Students**

**Majoring in Other Fields**—Contact the department.

## Computer Engineering

**Contact Information**—Graduate Program in Computer Engineering, University of Minnesota, 4-178 Electrical Engineering/Computer Science, 200 Union Street S.E., Minneapolis, MN 55455 (612-625-3300; fax 612-625-4583; [gradinfo@compengr.umn.edu](mailto:gradinfo@compengr.umn.edu); [www.compengr.umn.edu/](http://www.compengr.umn.edu/)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Vladimir Cherkassky, M2  
David H. Du, M2  
Larry L. Kinney, M2  
Vipin Kumar, M2  
David J. Lilja, M2  
Nikolaos Papanikolopoulos, M2  
Sachin Sapatnekar, M2  
Guillermo Sapiro, M2  
Shashi Shekhar, M2  
Eugene B. Shragowitz, M2  
Jaideep Srivastava, M2  
Ahmed H. Tewfik, M2  
Anand Tripathi, M2  
Pen-Chung Yew, M2

### Associate Professor

Mats P. E. Heimdahl, M2  
Wei-Chung Hsu, M2  
John Riedl, M2  
Jaijeet Roychowdhury, M2  
Gerald E. Sobelman, M2  
Zhi-Li Zhang, M2

### Assistant Professor

Kiarash Bazargan, M2  
George Karypis, M2  
Richard M. Voyles, M2

### Other

Farnaz Mounes-Toussi, AM2  
Matthew T. O'Keefe, AM2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Computer engineering is an interdisciplinary graduate program offered jointly by the Department of Electrical and Computer Engineering and the Department of Computer Science and Engineering. Students in this program develop a broad understanding of both hardware and software design issues. The M.S. is a traditional research-oriented degree that prepares graduates to work in industry or to continue with their graduate studies in either electrical engineering or computer science. The M.Comp.E. is a coursework-only professional engineering degree tailored primarily for working professionals. Students have access to a wide variety of computational and laboratory equipment. Students can focus their studies in several different areas, including computer architecture and system design, compilers, computer-aided design, databases, networks, operating systems, parallel computing, software engineering, and VLSI design and testing.

**Prerequisites for Admission**—Graduate study in computer engineering is open to students with an undergraduate degree in computer engineering, electrical engineering, computer science, or a closely related field, such as mathematics or physics. In some instances, additional preparatory work may be required.

**Special Application Requirements**—All applicants are required to submit three letters of recommendation. Scores from the GRE General Test are required of all students seeking financial aid. Applicants whose native language is not English must also submit TOEFL scores.

**Courses**—Please refer to Computer Engineering (CmpE), Computer Science (CSci), and Electrical Engineering (EE) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses is not allowed on any computer engineering degree program form.

### M.Comp.E. Coursework Only Degree Requirements

The M.Comp.E. degree requires 30 credits of graduate work, including at least 15 credits from the approved list of major field courses (of which at least 6 credits must be taken in electrical engineering and at least 6 credits in computer and information sciences); at least 3 major field credits in 8xxx courses; at least 6 credits from a minor or related field; and a breadth requirement of three courses in three of the four designated areas (system software; computer architecture and networking; VLSI and digital design; and data structures, algorithms, and software engineering). A maximum of 60 percent of coursework credit may be taken from a single

department. Also, students must maintain a GPA of at least 3.00 to continue registration in any master's program in computer engineering (this standard must also be met at the time of graduation). All coursework in the program must be taken A-F.

**Language Requirements**—None.

**Final Exam**—None.

### M.S. Degree Requirements

The M.S. degree requires 31 credits for Plan A or 30 credits for Plan B. Coursework distribution is the same as that of the M.Comp.E. degree above. In addition, Plan A, students must complete 10 thesis credits and Plan B students must complete 3 credits of a Plan B project. Students must maintain a GPA of at least 3.00 to continue registration in any computer engineering master's program (this standard must also be met at the time of graduation). All coursework for the program must be taken A-F.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

## Conflict Management

### Minor Only

**Contact Information**—Director of Graduate Studies, Graduate Minor in Conflict Management, Conflict and Change Center, University of Minnesota, Hubert H. Humphrey Center, 301 19th Avenue S., Minneapolis, MN 55455 (612-625-3046; fax 612-625-3513; [fiuta001@umn.edu](mailto:fiuta001@umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Mario F. Bognanno, Industrial Relations, M  
Eugene Borgida, Psychology, M  
Paul V. Ellefson, Forest Resources, M  
Mark S. Umbreit, Social Work, M

### Associate Professor

Melissa Stone, Humphrey Institute, M

### Lecturer

Thomas R. Fiutak, Independent Study, M

**Curriculum**—The conflict management minor, available to master's (M.A. and M.S.) and doctoral students, promotes inquiry into the origins, processes, dynamics, and consequences of social conflict and its management through various forms of dispute resolution procedures. The origins of this multidisciplinary field include but are not contained by the disciplines of sociology, psychology, socio-psychology, anthropology, management, organizational behavior, and communication.

**Prerequisites for Admission**—Admission is contingent upon prior admission to a master's or doctoral degree-granting program within the Graduate School.

**Special Application Requirements**—None.

**Courses**—Please contact the minor program office for information on relevant coursework.

**Use of 4xxx Courses**—Use of 4xxx courses toward degree requirements is permitted with the approval of the instructor, the adviser, and the conflict management minor director of graduate studies.

### Minor Only Requirements

A master's minor requires 9 credits, including 1 credit of the Proseminar in Conflict Management. A doctoral minor requires 15 credits, including 2 credits of the Proseminar in Conflict Management. It is recommended that courses be selected according to the need to develop theory, practical applications, and skills in conflict management.

## Conservation Biology

**Contact Information**—Director of Graduate Studies, Conservation Biology Graduate Program, 180 McNeal Hall, University of Minnesota, 1985 Buford Avenue, St. Paul, MN 55108 (612-624-7751; [cb-program@fw.umn.edu](mailto:cb-program@fw.umn.edu); [www.consbio.umn.edu](http://www.consbio.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Ira R. Adelman, Fisheries, Wildlife, and Conservation Biology, SM  
 Deborah L. Allan, Soil, Water, and Climate, SM  
 Donald N. Alstad, Ecology, Evolution, and Behavior, SM  
 David E. Andersen, Fisheries, Wildlife, and Conservation Biology, SM  
 Dorothy H. Anderson, Forest Resources, SM  
 David A. Andow, Entomology, SM  
 Sandra O. Archibald, Public Affairs, SM  
 Franklin H. Barnwell, Ecology, Evolution, and Behavior, SM  
 Marvin E. Bauer, Forest Resources, SM  
 John H. Beatty, Ecology, Evolution, and Behavior, SM  
 Jay C. Bell, Soil, Water, and Climate, M2  
 Charles R. Blinn, Forest Resources, SM  
 James L. Bowyer, Wood and Paper Science, SM  
 Thomas E. Burk, Forest Resources, SM  
 Vernon B. Cardwell, Agronomy and Plant Genetics, SM  
 Yosef Cohen, Fisheries, Wildlife, and Conservation Biology, SM  
 Kendall W. Corbin, Ecology, Evolution, and Behavior, SM  
 James W. Curtsinger, Ecology, Evolution, and Behavior, SM  
 Edward J. Cushing, Ecology, Evolution, and Behavior, SM  
 Francesca J. Cuthbert, Fisheries, Wildlife, and Conservation Biology, SM  
 K. William Easter, Applied Economics, SM  
 Mohamed E. El Halawani, Animal Science, SM  
 Nicholas R. Jordan, Agronomy and Plant Genetics, SM  
 Anne R. D. Kapuscinski, Fisheries, Wildlife, and Conservation Biology, SM  
 Scott M. Lanyon, Bell Museum of Natural History, SM  
 Patrice A. Morrow, Ecology, Evolution, and Behavior, SM  
 Claudia Neuhauser, Ecology, Evolution, and Behavior, SM  
 Raymond M. Newman, Fisheries, Wildlife, and Conservation Biology, SM  
 Gerald J. Niemi, Biology, Duluth, SM  
 Karen S. Oberhauser, Ecology, Evolution, and Behavior, SM  
 James A. Perry, Fisheries, Wildlife, and Conservation Biology, SM

A. Stephen Polasky, Applied Economics, SM  
 Anne E. Pusey, Ecology, Evolution, and Behavior, SM  
 Patrick T. Redig, Small Animal Clinical Sciences, SM  
 Philip J. Regal, Ecology, Evolution, and Behavior, SM  
 Peter B. Reich, Forest Resources, SM  
 Carlisle F. Runge, Applied Economics, SM  
 Abdi I. Samatar, Geography, SM  
 Ruth G. Shaw, Ecology, Evolution, and Behavior, SM  
 Donald B. Siniiff, Ecology, Evolution, and Behavior, SM  
 J. L. David Smith, Fisheries, Wildlife, and Conservation Biology, SM  
 Peter W. Sorensen, Fisheries, Wildlife, and Conservation Biology, SM  
 George R. Spangler, Fisheries, Wildlife, and Conservation Biology, SM  
 Anthony M. Starfield, Ecology, Evolution, and Behavior, SM  
 Robert W. Sterner, Ecology, Evolution, and Behavior, SM  
 G. David Tilman, Ecology, Evolution, and Behavior, SM  
 Bruce C. Vondracek, Fisheries, Wildlife, and Conservation Biology, SM  
 Robert M. Zink, Ecology, Evolution, and Behavior, SM

### Adjunct Professor

Robert G. Haight, Forest Resources, SM  
 Diane L. Larson, Ecology, Evolution, and Behavior, SM  
 Clarence L. Lehman, Ecology, Evolution, and Behavior, SM  
 L. David Mech, Fisheries, Wildlife, and Conservation Biology, SM

### Associate Professor

Paul V. Bolstad, Forest Resources, SM  
 Jay S. Coggins, Applied Economics, SM  
 Susan M. Galatowitsch, Horticultural Science, SM  
 Jay T. Hatch, General Science, SM  
 Frances R. Homans, Applied Economics, SM  
 Peter A. Jordan, Fisheries, Wildlife, and Conservation Biology, SM  
 Roderick H. Squires, Geography, SM

### Adjunct Associate Professor

Gerald T. Ankley, Fisheries, Wildlife, and Conservation Biology, SM  
 David L. Garshelis, Fisheries, Wildlife, and Conservation Biology, SM  
 Frederick J. Jannett, Jr., Fisheries, Wildlife, and Conservation Biology, SM  
 Ronald L. Tilson, Fisheries, Wildlife, and Conservation Biology, ASM  
 David Western, Fisheries, Wildlife, and Conservation Biology, SM

### Assistant Professor

Robert B. Blair, Fisheries, Wildlife, and Conservation Biology, SM  
 Eileen V. Carey, Forest Resources, SM  
 David C. Fulton, Fisheries, Wildlife, and Conservation Biology, SM  
 Sharon A. Jansa, Ecology, Evolution, and Behavior, SM  
 John P. Loegering, Agricultural Resources, Crookston, M2  
 Kristen C. Nelson, Forest Resources, SM  
 Daniel J. Philippon, Rhetoric, SM  
 Andrew M. Simons, Fisheries, Wildlife, and Conservation Biology, SM  
 Ellen E. Strong, Ecology, Evolution, and Behavior, SM

### Adjunct Assistant Professor

Charles S. Anderson, Fisheries, Wildlife, and Conservation Biology, AM2  
 David N. Bengston, Forest Resources, SM  
 Donald L. Pereira, Fisheries, Wildlife, and Conservation Biology, ASM

### Lecturer

Thomas R. Fiutak, Public Affairs, SM

### Research Associate

Lee E. Frelich, Forest Resources, SM  
 Loren M. Miller, Fisheries, Wildlife, and Conservation Biology, M2  
 Carl Richards, Duluth, SM  
 Ingrid E. Schneider, Forest Resources, SM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The conservation biology program has two complementary objectives leading to a unique multidisciplinary program. The first is to provide students with sound graduate training in the biological sciences relevant to the global conservation of plants, animals, and ecosystems. The second objective promotes the study of social, political, and economic sciences that relate to recognition and solution of conservation problems. Students may select a named track, fisheries and aquatic biology, which offers an aquatic specialization. Students may also pursue a joint degree in law and conservation biology through the joint law degree program. The overall goal of the program is to prepare students to develop solutions or approaches to address problems that are scientifically and environmentally sound and likely to be acted upon or implemented within their social and political context.

**Prerequisites for Admission**—A B.S. degree in biology or a closely related field is preferred. Applicants with a baccalaureate degree in another field are accepted, but these individuals may be required to take selected courses in biology. In general, Ph.D. applicants holding a baccalaureate degree are expected first to complete a master's degree.

**Special Application Requirements**—A statement of career goals and three letters of recommendation evaluating the applicant's potential for graduate study are required. Letters of recommendation should be sent directly to the Conservation Biology Program Office. Scores less than five years old from the General Test of the GRE are required. TOEFL is required for applicants who speak English as a second language. Applicants to the joint law degree program must also apply to the Law School. Application deadline is January 1. Typically students only are admitted for fall semester.

**Research Facilities**—Faculty are involved in local, regional, national, and international programs of research and education. Local research facilities include Cedar Creek Natural History Area, Cloquet Forestry Center, Lake Itasca Forestry and Biological Station, the Bell Museum of Natural History, and Minnesota Zoo. Fisheries and aquatic biology research is conducted in the many lakes, rivers, and streams that Minnesota is famous for and in 13,000 feet of wet-lab space on the St Paul campus with dedicated wells and water conditioning equipment. The program is strongly linked with on-campus institutes such as the Institute for Social,

Economic, and Ecological Sustainability and the MacArthur Interdisciplinary Program on Global Change, Sustainability, and Justice.

**Courses**—Conservation biology students take courses offered by a variety of colleges and departments across the University, including but not limited to fisheries, wildlife, and conservation biology; ecology, evolution, and behavior; soil, water, and climate; forest resources; geography; sociology; applied economics; and public policy. Acceptable courses for the degree are chosen in consultation with the adviser.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### M.S. Degree Requirements

Students must complete a minimum of 30 credits in the biological and social aspects of conservation biology. For Plan A students, 10 of these credits are thesis credits; for Plan B students, 10 of these credits are for Plan B papers.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor may be earned by completing the two required courses for a major, plus participating in one semester of the conservation biology seminar.

### Ph.D. Degree Requirements

Ph.D. students complete 46 credits, including 10 credits in courses required as part of the major, 12 credits in a minor or supporting program, and 24 thesis credits. Students are expected to show competency in both the biological and social sciences. With their advisory committee, students develop a program that emphasizes the ecological and social aspects of conservation biology. Dissertation research may require proficiency in supporting areas (e.g., statistics, computing, communications).

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—A doctoral minor may be earned by completing the two required courses for a major, participating in one semester of the conservation biology seminar, and completing 6 elective credits. Electives are determined in consultation with the director of graduate studies and the student's advisory committee.

## Control Science and Dynamical Systems

**Contact Information**—Control Science and Dynamical Systems Center, University of Minnesota, 107 Akerman Hall, 110 Union Street S.E., Minneapolis, MN 55455 (612-625-3364; [csdy@aem.umn.edu](mailto:csdy@aem.umn.edu); [www.csdy.umn.edu/](http://www.csdy.umn.edu/)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Regents Professor

Daniel D. Joseph, Aerospace Engineering and Mechanics, ASM

### Professor

Donald G. Aronson, Mathematics, SM  
Gary J. Balas, Aerospace Engineering and Mechanics, SM  
Daniel L. Boley, Computer Science, SM  
Prodromos Daoutidis, Chemical Engineering and Materials Science, SM  
Max Donath, Mechanical Engineering, SM  
David P. Fan, Genetics and Cell Biology, SM  
William L. Garrard, Aerospace Engineering and Mechanics, SM  
Tryphon T. Georgiou, Electrical Engineering, SM  
Maria Gini, Computer Science, SM  
Mostafa Kaveh, Electrical Engineering, SM  
John C. Kieffer, Electrical Engineering, SM  
Larry L. Kinney, Electrical Engineering, SM  
K. S. P. Kumar, Electrical Engineering, SM  
E. Bruce Lee, Electrical Engineering, SM  
Walter Littman, Mathematics, ASM  
Richard P. McGehee, Mathematics, SM  
Katsuhiko Ogata, Mechanical Engineering, SM  
Peter Olver, Mathematics, SM  
Nikolaos P. Papanikolopoulos, Computer Science, SM  
George R. Sell, Mathematics, ASM  
Yasutaka Sibuya, Mathematics, SM  
Kim A. Stelson, Mechanical Engineering, SM  
Ahmed H. Tewfik, Electrical Engineering, SM

### Associate Professor

Perry Y. Li, Mechanical Engineering, SM  
Yiyuan Zhao, Aerospace Engineering and Mechanics, SM

### Adjunct Associate Professor

Dale F. Enns, Aerospace Engineering and Mechanics, ASM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Student programs must emphasize modeling (mathematical and physical analyses of control or dynamical systems, with some computational or numerical expertise) and two areas selected from the following three: control theory for deterministic processes; stability theory and general analysis of dynamical systems; stochastic processes and information theory.

**Prerequisites for Admission**—Applicants must have completed a master's degree in one of the related fields of engineering, computer science, mathematics, statistics, or physics. Master's degrees with an emphasis in control science and/or dynamical systems can be earned in any of these fields at the University of Minnesota. An applicant with a master's degree in another area whose scientific, mathematical, and/or engineering background is adequate to pursue the program also is considered. A high level of proficiency in mathematics is necessary to successfully complete the Ph.D. program. Applicants are strongly encouraged to obtain a faculty adviser before formally applying to the program.

**Special Application Requirements**—Three letters of recommendation evaluating the applicant's scholarship and a complete set of transcripts are required. At least one letter of recommendation must be from a faculty member familiar with the applicant's previous graduate work. Because the faculty is drawn from a number of disciplines and students' programs can reflect a variety of emphases, it is important for applicants to clearly specify career goals and program emphasis desired in their application materials. Submission of GRE scores is strongly encouraged.

**Use of 4xxx Courses**—No 4xxx courses may be used for this program.

### Ph.D. Degree Requirements

Programs are designed by the student and the adviser. Coursework is usually selected from those science, mathematics, engineering, and related fields that are relevant to control science and dynamical systems. Students can prepare for the written preliminary exam by completing three 8xxx or suitably advanced courses in three of the four areas of emphasis. In addition, students typically take substantial coursework in advanced mathematics.

**Language Requirements**—None.

## Counseling and Student Personnel

See Educational Psychology.

## Creative Writing

**Contact Information**—See English. (612-625-6366; [creawrit@umn.edu](mailto:creawrit@umn.edu); <http://english.cla.umn.edu/creativewriting/program/>).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Regents Professor

Patricia M. Hampl, M2

### Professor

Charles Baxter, M2  
Michael Dennis Browne, M2  
Ray Gonzalez, M2  
Valerie Miner, M2  
Madelon M. Sprengnether, M2

### Associate Professor

Maria J. Fitzgerald, M2  
Julie Schumacher, M2  
Charles J. Sugnet, M2  
David Treuer, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The Department of English offers the master of fine arts degree for students committed to pursuing the writing life. This three-year degree provides advanced, graduate level coursework in writing, language, and literature, as well as study in a related field. The third year of the

program focuses on the final development of a book-length manuscript suitable for publication. At the heart of the program are writing workshops in poetry, fiction, and literary nonfiction, and courses in the Reading as Writers and Topics in Advanced Writing series, which enable writers to explore a variety of issues relating to contemporary themes in American and world literature. The program encourages experimentation across genres, fostering the discovery of new and varied forms for a developing voice.

**Courses**—Please refer to English: Creative and Professional Writing (EngW), and English: Literature (EngL), English: Writing, Rhetoric, and Language (EngC) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### M.F.A. Degree Requirements

The M.F.A. requires 45 credits distributed over a three-year period, culminating in a book-length manuscript and an M.F.A. defense.

Required coursework includes EngW 8101 (4 credits); four writing workshops (16 credits), three of which must be in the student's genre of choice and include one 8xxx course, and one of which must be outside the student's primary genre; language and literature courses (7 credits); related field (6 credits); and a creative project, a book-length manuscript suitable for publication (12 credits, 4 of which are for manuscript preparation and 8 for creative project registration).

**Language Requirements**—None.

**Final Exam**—The M.F.A. defense requires students to discuss their creative work as well as a literary essay that they write in response to a booklist of 20 books chosen in consultation with creative writing faculty.

## Dentistry

**Contact Information**—School of Dentistry, University of Minnesota, 15-136 Malcolm Moos Health Sciences Tower, 515 Delaware Street S.E., Minneapolis, MN 55455 (612-624-7934; fax 612-626-6096; [wegne009@umn.edu](mailto:wegne009@umn.edu); [www.dentistry.umn.edu](http://www.dentistry.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Dwight L. Anderson, Oral Sciences, M2  
M. Bashar Bakdash, Preventive Sciences, M2  
Soraya M. Beiraghi, Preventive Sciences, M2  
David O. Born, Preventive Sciences, M2  
Edward C. Combe, Oral Sciences, M2  
Ralph DeLong, Oral Sciences, M2  
Anthony J. DiAngelis, Preventive Sciences, AM2  
William H. Douglas, Oral Sciences, M2  
James R. Friction, Diagnostic/Surgical Sciences, M2  
Mark C. Herzberg, Oral Sciences, M2  
William F. Liljemark, Oral Sciences, M2

Leslie V. Martens, Preventive Sciences, M2  
Karlind T. Moller, Preventive Sciences, M2  
Bruce L. Pihlstrom, Preventive Sciences, M2  
Nelson L. Rhodus, Diagnostic/Surgical Sciences, M2  
Charles F. Schachtele, Oral Sciences, M2  
Burton L. Shapiro, Oral Sciences, M2  
Michael J. Till, Preventive Sciences, M2  
Larry F. Wolff, Preventive Sciences, M2

### Associate Professor

Gary C. Anderson, Restorative Sciences, M2  
James L. Baker, Restorative Sciences, M2  
Pamela R. Erickson, Preventive Sciences, AM2  
James E. Hinrichs, Preventive Sciences, M2  
James R. Holtan, Restorative Sciences, M2  
Ramesh K. Kuba, Diagnostic/Surgical Sciences, M2  
Thomas D. Larson, Restorative Sciences, M2  
Bryan S. Michalowicz, Preventive Sciences, M2  
Kathleen J. Newell, Preventive Sciences, M2  
Paul Olin, Restorative Sciences, M2  
Joy B. Osborn, Preventive Sciences, M2  
Jorge M. Perdigão, Restorative Sciences, M2  
Igor J. Pesun, Restorative Sciences, M2  
Maria R. Pintado, Oral Sciences, M2  
Eric L. Schiffman, Diagnostic/Surgical Sciences, M2  
John K. Schulte, Diagnostic/Surgical Sciences, M2  
Stephen K. Shuman, Preventive Sciences, M2  
Jill L. Stoltenberg, Preventive Sciences, M2  
James Q. Swift, Diagnostic/Surgical Sciences, M2  
Omar A. Zidan, Restorative Sciences, M2

### Assistant Professor

John P. Beyer, Diagnostic/Surgical Sciences, M2  
Walter R. Bowles, Restorative Sciences, M2  
Mary E. Brosky, Restorative Sciences, M2  
Darryl T. Hamamoto, Restorative Sciences, M2  
Kate M. Hathaway, Restorative Sciences, M2  
Donald R. Nixdorf, Diagnostic/Surgical Sciences, M2

### Research Associate

John O. C. Look, Diagnostic/Surgical Sciences, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The M.S. program in dentistry prepares dentists and dental hygienists with clinical expertise for positions of leadership in education, research, and program administration in the oral health field. A multidisciplinary faculty of dental and dental hygiene educators, researchers, and clinicians teach the program, which is housed in the School of Dentistry. All students complete core coursework in teaching and evaluation in dentistry, research methods, and health-care administration. Additional advanced coursework is offered in these same focus areas as well as in selected clinical and oral science topics with interdisciplinary impact, including conscious sedation, craniofacial pain, geriatrics, oral biology, oral medicine and radiology, oral pathology, practice administration, and psychology. Students have flexibility in planning individualized programs to accommodate their specific areas of interest, and courses from other disciplines may be included for credit in the major area.

Students enrolled in an advanced clinical dental training program may be admitted to the dentistry graduate program for concurrent study, but must carefully plan their curriculum with their faculty adviser and the director of graduate studies so that their residency and M.S. programs are

appropriately integrated and satisfy Graduate School registration requirements. American Dental Association-accredited programs in the School of Dentistry that enroll students for the M.S. degree include endodontics, orthodontics, pediatric dentistry, periodontics, prosthodontics, dental hygiene (with baccalaureate degree), and residencies in general practice dentistry (AEGD and GPR). Other dental school clinical and postdoctoral programs that enroll students for the M.S. degree include those in geriatric dentistry and TMJ disorders/orofacial pain.

**Clinical Instruments**—The School of Dentistry dental clinics maintain a centralized instrument usage and sterilization system that provides clinical instrumentation and related services for graduate students enrolled in advanced clinical training programs. Usage fees, where applicable, are listed in the *Class Schedule*.

**Prerequisites for Admission**—Applicants must have received a D.D.S. or D.M.D. degree from an accredited U.S. institution or completed a dental hygiene program along with a baccalaureate degree from an accredited U.S. institution. Students with comparable foreign degrees from recognized colleges or universities may also apply. Applications from individuals who have already completed or are enrolled in an advanced clinical training program (e.g., general dentistry or specialty residency program) are encouraged. A GPA of 3.00 or academic standing in the top one quarter of graduating class is required for admission. Applicants for whom English is a second language must also take the TOEFL.

**Special Application Requirements**—Applicants must submit three letters of recommendation directly to the department from persons familiar with their academic capabilities, along with a complete set of official transcripts and a clearly written, brief statement (under 500 words) which relates the applicant's career goals to the goals of the program. Applicants who are planning concurrent studies in an advanced clinical training program (i.e., dental specialty residency) must contact that program for specific application deadlines and additional application requirements.

**Courses**—Please refer to Dentistry (Dent) in the course section of this catalog for courses that pertain to this program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### M.S. Degree Requirements

The M.S. degree, which usually requires at least 18 months to complete, is offered under Plan A (with thesis) and Plan B (without thesis). Students in both plans must complete 14 credits in the major, including four core courses in teaching and evaluation in dentistry; basic research methodology; introductory biostatistics; and fundamentals of health-care administration. Courses from



other disciplines may also be taken for credit in the major with the approval of the student's adviser and the director of graduate studies. All students must complete a minor or related field consisting of at least 6 credits, as well as program requirements for training in the responsible conduct of research. Additionally, Plan A students must complete 10 thesis credits; Plan B students must complete 10 additional credits of coursework and submit three Plan B papers, one of which must be oriented toward research. Students must maintain a cumulative GPA of at least 3.00 in the program.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

## Design, Housing, and Apparel

**Contact Information**—Director of Graduate Studies, Design, Housing, and Apparel, University of Minnesota, 240 McNeal Hall, 1985 Buford Avenue, St. Paul, MN 55108 (612-626-1219; fax 612-624-2750; [dhagradinfo@che.umn.edu](mailto:dhagradinfo@che.umn.edu); [www.che.umn.edu/dha/](http://www.che.umn.edu/dha/)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Regents Professor

Joanne B. Eicher, SM

### Professor

William J. Angell, M2  
Marilyn R. DeLong, SM  
Edward G. Goetz, ASM  
Denise A. Guerin, SM  
Kim K. P. Johnson, SM

### Associate Professor

Marilyn Bruin, M2  
Jeffrey R. Crump, M2  
Sherri A. Gahrng, M2  
Delores A. Ginthner, M2  
Brad Hokanson, M2  
Karen L. LaBat, SM  
Barbara E. Martinson, SM  
Steven McCarthy, M2  
Gloria M. Williams, SM  
Becky L. Yust, SM  
Ann Ziebarth, SM

### Adjunct Associate Professor

Margaret K. DiBlasio, ASM

### Assistant Professor

James Boyd-Brent, M2  
Elizabeth Bye, M2  
Sauman Chu, M2  
Daniel Jasper, M2  
Seung-Eun Lee, M2  
Fiona L. Shen, SM  
Carol C. Waldron, M2  
Stephanie A. Watson, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The design, housing, and apparel graduate program focuses on the study of relationships between humans and their designed environments. This focus is based on the assumption that design and analysis of environments contributes to the

improvement of the human condition. The program addresses theory, research, and application, using a shared disciplinary base from the social and behavioral sciences. The goal of the program is for students to analyze, evaluate, and integrate theoretical frameworks related to humans and their designed environments.

The M.A., M.S., and Ph.D. degrees are available with four areas of emphasis: apparel, design communication, housing, and interior design. The M.F.A. and M.A. degrees are available with an emphasis in multimedia. The emphasis in *apparel* advances both theoretical knowledge and applications for textile and apparel products related to human behavior. Students may focus on design, aesthetics, apparel product analysis, historic dress, social science aspects of dress, consumer behavior, or retailing. The emphasis in *design communication* focuses on design theory, design process and methodology, visual communication (design and analysis), and color systems and perception. The emphasis in *housing studies* advances both theoretical and applied knowledge in the housing field. Through research, students are prepared to assist people and communities in addressing housing-related issues. Courses emphasize human needs and behavior, analysis of designed environments and technology, policy and community development, and housing for special populations such as the elderly or low-income households. Graduate study in *interior design* emphasizes the theory, research, and specialized practice components of design as applied to the interior environment, including culture, lighting, sustainability, and issues facing design education. Advances in theoretical knowledge and study of the interactions of humans in interior environments prepare students for teaching and research positions as well as design specializations within the profession. The emphasis in *multimedia* provides students with experience in designing for the electronic environment. The program integrates theory with practice in the application of emergent and established technologies to digital design solutions. Students complete a creative thesis.

**Prerequisites for Admission**—Individuals must have adequate undergraduate education in the area of emphasis and background in the basic disciplines of art, social science, physical science, and biological science appropriate to the area of emphasis. To pursue a degree with interior design as the emphasis area, a first professional degree in interior design is required. Students interested in pursuing a Ph.D. must first complete a master's degree. Specific requirements may be obtained by contacting the director of graduate studies.

### Special Application Requirements

Consult the director of graduate studies; scores from the GRE are required. Students pursuing a degree in an emphasis related to

design are required to submit a portfolio consisting of 15-20 slides. Students are admitted fall and spring semesters.

**Courses**—Please refer to Design, Housing, and Apparel (DHA) in the course section of this catalog for courses that pertain to this program.

**Use of 4xxx Courses**—No more than 30 percent of a student's official degree program may be comprised of 4xxx courses. Not all of the department's 4xxx courses are available for graduate credit. Appropriate courses are selected in consultation with the student's advisers.

### M.A. and M.S. Degree Requirements

Minimum requirements include 4 credits in courses that focus on theory building and the theoretical and philosophical bases of inquiry in the discipline; 6 credits in courses on qualitative or quantitative methods of research and evaluation; 8 credits for Plan A students, and 18 credits for Plan B students in the area of emphasis; 10 thesis credits for Plan A students, and 6 credits in a related field. Required courses include DHA 8181—Ethics and Research or the equivalent, and DHA 8101—Philosophical Foundations of Design, Housing, and Apparel. Students may be required to complete additional credits upon recommendation of their committee.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—For a master's minor, a minimum of 9 credits in design, housing, and apparel is required, including DHA 8101. Courses are selected in consultation with the director of graduate studies.

### M.F.A. Degree Requirements

Minimum requirements for the M.F.A. include 7 credits in courses that focus on theory building and the theoretical and philosophical bases of inquiry in the discipline, including DHA 8101—Philosophical Foundations of Design, Housing, and Apparel and DHA 5399—Theory of Electronic Design; 6 credits in evaluation and analysis, including DHA 5388—Design Planning and Analysis; 27 credits in the area of emphasis, including DHA 8114—Design Studio and DHA 8181—Ethics and Research or the equivalent; 12 credits of M.F.A. creative thesis; and 8 credits in a related field. Students may be required to complete additional credits upon recommendation of their committee.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Ph.D. Degree Requirements

Minimum requirements for the Ph.D. include 6 credits in courses that focus on theory building and the theoretical and philosophical bases of inquiry in the discipline; 9 credits in courses on qualitative and quantitative methods of research and evaluation; 12 credits in the area of emphasis; 24 thesis

credits; and 12 credits in a supporting program. Required courses include DHA 8181—Ethics and Research or the equivalent and DHA 8101—Philosophical Foundations of Design, Housing, and Apparel. Students may be required to complete additional credits upon recommendation of their committee.

**Language Requirements**—None.

**Minor Requirements for Students**

**Majoring in Other Fields**—For a doctoral minor, a minimum of 12 credits in design, housing, and apparel is required, including DHA 8101—Philosophical Foundations of Design, Housing, and Apparel. Courses are selected in consultation with the director of graduate studies.

## Development Studies and Social Change

### Minor Only

**Contact Information**—MacArthur Interdisciplinary Program on Global Change, Sustainability, and Justice/ICGC, University of Minnesota, 214 Social Sciences Building, 267 19th Avenue S., Minneapolis, MN 55455 (612-624-0832; fax 612-626-2242; [www.icgc.umn.edu](http://www.icgc.umn.edu); <[www.icgc.umn.edu](http://www.icgc.umn.edu)>)

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### Regents Professor

Allen Isaacman, History, M  
G. Edward Schuh, Public Affairs, M  
John Sullivan, Political Science, M

#### Professor

Dennis A. Ahlburg, Industrial Relations, M  
Ronald R. Aminzade, Sociology, M  
Ragui A. Assaad, Public Affairs, M  
Vernon B. Cardwell, Agronomy and Plant Genetics, M  
Raymond D. Duvall, Political Science, M  
Lawrence Jacobs, Political Science, M  
Amy K. Kaminsky, Women's Studies, M  
Anne R. D. Kapuscinski, Fisheries, Wildlife, and Conservation Biology, M  
Sally Kenney, Public Affairs, M  
Helga Leitner, Geography, M  
John W. Mowitt, Cultural Studies and Comparative Literature, M  
August H. Nimtz, Jr., Political Science, M  
James A. Perry, Forest Resources, M  
Philip J. Regal, Ecology, Evolution, and Behavior, M  
Terry L. Roe, Applied Economics, M  
Abdi I. Samatar, Geography, M  
Eric S. Sheppard, Geography, M  
Kathryn A. Sikkink, Political Science, M  
George R. Spangler, Fisheries, Wildlife, and Conservation Biology, M  
Karen B. Thompson, M  
Dennis N. Valdes, Chicano Studies, M  
Ann B. Waltner, History, M  
Donald Wyse, Agronomy and Plant Genetics, M

#### Associate Professor

Fernando E. Arenas, Spanish and Portuguese Studies, M  
Keleto E. Atkins, African American and African Studies, M  
Daphne J. Berdahl, Anthropology, M  
Elizabeth H. Boyle, Sociology, M  
Bruce P. Braun, Geography, M  
Rose Brewer, African American and African Studies, M  
Jeffrey P. Broadbent, Sociology, M  
Sarah C. Chambers, History, M  
Jay S. Coggins, Applied Economics, M

Lisa J. Disch, Political Science, M  
Douglas R. Hartmann, Sociology, M  
Qadri Ismail, English, M  
Daniel Kelliher, Political Science, M  
Deborah Levison, Public Affairs, M  
Carol A. Miller, American Studies, M  
Richa Nagar, Women's Studies, M  
Jean M. O'Brien-Kehoe, History, M  
Joanna O'Connell, Spanish and Portuguese Studies, M  
Jennifer L. Pierce, Sociology, M  
Ajay Skaria, History, M  
Charles J. Sugnet, English, M  
John S. Wright, African American and African Studies, M

#### Assistant Professor

Catherine C. Choy, American Studies, M  
Jigna Desai, Women's Studies, M  
Vinay Gidwani, Geography, M  
Ann Hironaka, Sociology, M  
Kristen Nelson, Forest Resources, M  
Michele Wagner, History, M

#### Adjunct Assistant Professor

Helene Murray, Agronomy and Plant Genetics, M

#### Senior Fellow

Mary Renwick, Water Resources Center, M

#### Other

Barbara Frey, Human Rights Program, M  
Karen Brown Thompson, Interdisciplinary Center for the Study of Global Change, M

**Curriculum**—This structured interdisciplinary doctoral minor is offered in conjunction with the MacArthur Interdisciplinary Program on Global Change, Sustainability, and Justice. By focusing on the social bases of change in the developing world, the program engages a wide range of academic disciplines including the social sciences, humanities, and biological sciences. The minor focuses on three areas:

- 1) the relationships between macroscopic processes of political, economic, and social change, and the microscopic conditions of lived experience in the developing world;
- 2) specifically interdisciplinary perspectives (encompassing the social sciences, the biological sciences, and the humanities) on this general thematic concern; and
- 3) preparation of doctoral students for research on the developing world.

**Prerequisites for Admission**—Admission is contingent upon prior admission to a doctoral degree-granting program within the Graduate School and upon affiliation with the MacArthur Program.

**Special Application Requirements**—Students enrolled in a doctoral degree-granting program may apply for the minor at any time during the academic year; acceptance will take effect the following term.

**Courses**—Please contact the minor program office for information on relevant coursework pertaining to the program.

**Use of 4xxx Courses**—Courses used to fulfill minor requirements must be 5xxx or above.

### Minor Only Requirements

The doctoral minor requires a sequence of three core seminars (DSSC 8111, 8211-12, 8310) for 9 credits total (8310 is taken twice). Students also take one or two courses (minimum 3 credits total) chosen from an

approved list of courses from across the Graduate School curriculum that are relevant to the field of development studies and social change.

## East Asian Studies

**Contact Information**—East Asian Studies, Area Studies Programs, University of Minnesota, 214 Social Sciences Building, 267 19th Avenue S., Minneapolis, MN 55455 (612-624-8543; [igs@umn.edu](mailto:igs@umn.edu))

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### Professor

Joseph Allen, Asian Languages and Literatures, M2  
Edward L. Farmer, History, M2  
Chin-Chuan Lee, Journalism and Mass Communication, M2  
Michael Molasky, Asian Languages and Literatures, M2  
Robert J. Poor, Art History, M2  
Ann B. Waltner, History, M2

#### Associate Professor

Jeffrey P. Broadbent, Sociology, M2  
Tsan-Kuo Chang, Journalism and Mass Communication, M2  
Keya Ganguly, Cultural Studies and Comparative Literature, M2  
Daniel Kelliher, Political Science, M2  
Liping Wang, History, M2

#### Assistant Professor

Mark Anderson, Asian Languages and Literatures, M2  
Christopher M. Isett, History, M2  
Christine Marran, Asian Languages and Literatures, M2  
Hiromi Mizuno, History, M2  
Maki Morinaga, Asian Languages and Literatures, M2  
William Schaefer, Asian Languages and Literatures, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The program offers an entry point for interdisciplinary study of East Asia, particularly China and Japan. It serves both as a stepping stone to advanced academic work and as a terminal degree for those with non-academic career goals related to East Asia.

**Prerequisites for Admission**—Ideally, an applicant's background should include undergraduate study in fields related to East Asia or East Asian languages. Students from other academic areas may be admitted with the provision that prerequisite coursework be made up after admission.

**Special Application Requirements**—Three letters of recommendation, an academic writing sample, and a statement of purpose should be submitted to the department. GRE test scores are required. Students are admitted each semester.

**Courses**—Please refer to East Asian Studies (EAS) and Global Studies (GloS) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### M.A. Degree Requirements

The program uses an interdisciplinary approach that emphasizes the humanities and social sciences and requires proficiency in a foreign language, a theoretical framework, broad knowledge of the area in question, and a concise understanding of a topical theme to be developed in the Plan A thesis or Plan B papers.

Plan A requires 31 credits: a minimum of 21 course credits (seven courses), including 15 credits (five courses) in the major and 6 credits (two courses) in one or more fields outside the major, and 10 thesis credits. Coursework must include three proseminars/seminars. A Plan A thesis must be written.

Plan B requires 30 course credits in order to provide a broader knowledge of the chosen field and allied subjects. It requires at least 15 credits (five courses) in the major field and 12 credits (four courses) in one or more related fields outside of the major, which must include three proseminars/seminars. Three Plan B papers must be written, at least one of them outside of the major.

**Language Requirements**—The language requirement may be fulfilled by successful completion of either three years (six semesters) of a Chinese or Japanese language sequence, or at least four semesters of Chinese or Japanese language study and an approved study abroad experience in East Asia. For a Korean focus, it is possible to have a comparable level of Korean language in lieu of the Chinese or Japanese requirement. (Note: Proficiency exams and evaluations are provided by relevant language departments.)

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor requires two years of language study or equivalent proficiency, plus at least three courses (minimum of 9 credits) in the field that include at least two semesters of seminars/proseminars.

## Ecology, Evolution, and Behavior

**Contact Information**—Department of Ecology, Evolution and Behavior, Director of Graduate Studies, University of Minnesota, 100 Ecology Building, 1987 Upper Buford Circle, St. Paul, MN 55108-6097 (612-625-5700; fax 612-624-6777; [EEBGrad@biosci.cbs.umn.edu](mailto:EEBGrad@biosci.cbs.umn.edu); [www.cbs.umn.edu/eeb/GraduateProgram/Main\\_page/Index.htm](http://www.cbs.umn.edu/eeb/GraduateProgram/Main_page/Index.htm)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Regents Professor

G. David Tilman, SM

### Professor

Donald N. Alstad, SM  
David A. Andow, Entomology, SM  
Franklin H. Barnwell, SM  
John H. Beatty, SM  
Patrick L. Brezonik, Civil Engineering, SM  
James W. Curtsinger, SM  
Edward J. Cushing, SM  
Margaret B. Davis (emeritus), AM2  
Thomas C. Johnson, Geology, Duluth, SM  
Linda L. Kinkel, Plant Pathology, SM  
Scott M. Lanyon, SM  
Robert O. Megard, SM  
Patrice A. Morrow, SM  
Claudia Neuhauser, SM  
Raymond M. Newman, Fisheries, Wildlife, and Conservation Biology, SM  
Craig Packer, SM  
Stephen Polasky, SM  
Anne E. Pusey, SM  
Philip J. Regal, SM  
Peter B. Reich, Forest Resources, SM  
Michael J. Sadowsky, Soil, Water, and Climate, SM  
Ruth G. Shaw, SM  
Michael J. Simmons, Genetics and Cell Biology, SM  
Akhouri Sinha, Genetics and Cell Biology, SM  
Peter W. Sorensen, Fisheries, Wildlife, and Conservation Biology, SM  
Anthony M. Starfield, SM  
Robert W. Sterner, SM  
Bert E. Stromberg, Jr., Veterinary Pathobiology, SM  
Robert M. Zink, SM

### Adjunct Professor

Lee E. Frelich, SM  
Diane L. Larson, SM  
Clarence Lehman, SM  
L. David Mech, Fisheries, Wildlife, and Conservation Biology, SM  
John Pastor, Duluth, SM

### Associate Professor

James B. Cotner, SM  
Antony M. Dean, SM  
Susan M. Galatowitsch, Horticultural Science, SM  
Georgiana May, SM  
David W. Stephens, SM  
Susan J. Weller, SM

### Assistant Professor

Jacques Finlay, SM  
Sarah E. Hobbie, SM  
Sharon Jansa, SM  
Jennifer King, SM  
Joseph McFadden, SM  
Karen S. Oberhauser, Service/Outreach, SM  
Andrew M. Simons, SM  
Ellen Strong, Fisheries, Wildlife, and Conservation Biology, SM  
Shinya Sugita, SM  
Peter Tiffin, Plant Biology, SM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The graduate program in ecology, evolution, and behavior (EEB) links faculty and students interested in the biology of organisms from molecules to ecosystems. Studies address questions from molecular mechanisms of evolution, the interactions of organisms in social groups and populations, the distributions and abundances of species in communities and ecosystems, to global biogeochemical processes. The program provides broad training in the general areas of ecology, evolution, and animal behavior, and specialized courses and research in

vertebrate and invertebrate zoology; behavior and ethology; evolution; population genetics; molecular evolution; systematics; population, community, and ecosystem ecology; global ecology, limnology, paleoecology, ecology of vegetation, and theoretical ecology. Opportunities for field research are available in Africa, Alaska, Central America, and other parts of the world, as well as in local ecosystems. Seminars and individually designed tutorials are an important part of student programs and provide an exciting intellectual environment.

**Prerequisites for Admission**—Courses in inorganic chemistry, organic chemistry, biochemistry, general physics, one year of college calculus, animal biology, genetics, physiology, and plant biology are strongly recommended and provide an important background to pursue graduate work in EEB. Proficiency in a foreign language is not required but is strongly recommended for students who expect to pursue field work in a country where English is not the native language. Deficiencies must be made up early in the graduate program.

### Special Application Requirements

Students are admitted only in fall semester. Deadline for application is January 2. Three letters of recommendation evaluating the applicant's scholarship are required, plus GRE scores (the Subject Test in biology is recommended, though not required).

**Courses**—Please refer to Ecology, Evolution, and Behavior (EEB) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—As preparation for their preliminary examinations, Ph.D. students are expected to acquire basic knowledge in ecology, evolution, behavior, and organismal biology by taking graduate courses or 4xxx courses that are approved by the director of graduate studies. One of these courses can be a graduate seminar or reading course, and one of these courses can be substituted by an advanced undergraduate course taken prior to entering into the EEB graduate program.

### M.S. Degree Requirements

The M.S. is offered under both Plan A (with thesis) and Plan B (without thesis). Both plans require a minimum of 14 course credits in the major and a minimum of 6 course credits in one or more related fields outside the major; Plan A also requires 10 thesis credits, and Plan B requires 10 additional course credits and one to three research papers, which may be written in conjunction with graduate courses. Significant field or laboratory experience and competence in statistics, to include hypothesis testing, regression, and correlation are required. Degree programs are planned by the student and an advisory committee of three faculty members to meet the student's interests and needs.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students**

**Majoring in Other Fields**—A minimum of 7 credits of EEB 4xxx, 5xxx, and 8xxx courses is required for a master's minor in ecology.

**Ph.D. Degree Requirements**

A minimum of 3 course credits and 24 thesis credits are required in the major, and at least 12 course credits are required for either a minor in another field or a supporting program from several related fields. Significant field or laboratory experience, proficiency in using computers in research, and competence in advanced statistics are required. Students are expected to gain some appreciation of history or philosophy of science and are required to teach a minimum of two semesters 50 percent time. Degree programs are planned by the student and an advisory committee of three to five faculty members.

**Language Requirements**—None.

**Minor Requirements for Students**

**Majoring in Other Fields**—A minimum of 12 credits of EEB 4xxx, 5xxx, and 8xxx courses is required for a doctoral minor in ecology.

**Economics**

**Contact Information**—Director of Graduate Studies, Department of Economics, University of Minnesota, 1035 Heller Hall, 271 19th Avenue S., Minneapolis, MN 55455 (612-625-6833; fax 612-624-0209; [econdgs@econ.umn.edu](mailto:econdgs@econ.umn.edu); <[www.econ.umn.edu](http://www.econ.umn.edu)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

**Regents Professor**

John S. Chipman, SM  
Leonid Hurwicz (emeritus), ASM  
Edward C. Prescott, SM  
G. Edward Schuh, Public Affairs, ASM

**Professor**

Beth E. Allen, SM  
Michele Boldrin, SM  
Varadarajan V. Chari, SM  
Zvi Eckstein, SM  
Roger D. Feldman, Public Health, ASM  
Edward M. Foster, SM  
Thomas J. Holmes, SM  
Larry E. Jones, SM  
Patrick J. Kehoe, SM  
Timothy Kehoe, SM  
Andrew McLennan, SM  
Marcel K. Richter, SM  
Aldo Rustichini, SM  
Craig E. Swan, SM  
Jan Werner, SM

**Adjunct Professor**

Ellen McGrattan, AM2  
Christopher Phelan, AM2  
James A. Schmitz, AM2  
Warren E. Weber, AM2

**Associate Professor**

George D. Green, History, AM2  
Samuel Kortum, SM  
Erzo G. J. Luttmer, SM

**Assistant Professor**

Marco Bassetto, M2  
Mariacristina DeNardi, M2  
Matthew F. Mitchell, M2  
Andrea Moro, M2  
Vasiliki Skreta, M2  
Julia K. Thomas, M2

**Other**

Simran Sahi, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The economics graduate program offers degree work in both theoretical and applied fields of economics. It is possible to pursue thesis research in microeconomic or macroeconomic theory. In addition, the following fields of specialization are offered: econometrics, economic growth and development, financial economics, game theory, industrial organization, international economics, labor economics, mathematical economics, monetary economics, and public economics. Students are admitted only for the Ph.D.; the M.A. is an optional part of the Ph.D. program.

**Prerequisites for Admission**—The general requirement is the capability to pursue Ph.D.-level work. Normally a student should have an undergraduate record from a recognized college that includes coursework in economic theory and mathematics (multivariate calculus and linear algebra).

**Special Application Requirements**—Students should submit their applications, including a record of GRE scores and three letters of recommendation, to the director of graduate studies. Applicants who would like financial aid should submit their materials no later than December 31. Students are admitted in fall semester only.

**Courses**—Please refer to Economics (Econ) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—4xxx or 5xxx economics courses may not be included on degree program form for the economics Ph.D. program. Students may include 4xxx, 5xxx, and 8xxx courses outside economics. Approval of the student's adviser and the director of graduate studies are needed to use 4xxx and 5xxx courses.

**M.A. Degree Requirements**

The M.A. is offered under Plan A (with thesis) or Plan B (without thesis). Coursework for the M.A. is drawn from the Ph.D. program and must include at least 10 credits of economic theory from the first-year Ph.D. sequences in theory (for majors) or microeconomic analysis (for minors) and macroeconomics. Beyond these restrictions, the general Graduate School requirements govern. For the Plan B degree, a Ph.D. student will have completed requirements for the M.A. when the written preliminary exams have been completed. Two Plan B projects

consisting of research papers or literature reviews are required; the Ph.D. written preliminary exams required in two fields outside of economic theory ("field exams") may be used to satisfy either or both of the Plan B projects. Because the standards used to judge whether a preliminary exam has satisfied the requirement for the M.A. are less rigorous than those for the Ph.D., students may qualify for the master's Plan B without having satisfied all requirements for the Ph.D. written preliminary exams.

**Language Requirements**—None.

**Final Exam**—The final exam is oral for Plan A, written for Plan B.

**Minor Requirements for Students**

**Majoring in Other Fields**—A master's minor consists of 6 credits in 4xxx, 5xxx, or 8xxx economics courses, all taken A-F and completed with grades of B or better (one 8xxx course may carry a grade of C). The 6 credits include Econ 5151 and 5152 or more advanced courses in economic theory.

The economic theory requirement may be waived if, in the judgment of the director of graduate studies, the student's previous work in economics has included courses equivalent to Econ 5151 and 5152, though the requirement to complete 6 credits would still stand.

**Ph.D. Degree Requirements**

Emphasis in all aspects of the program is on careful development of the theoretical basis for the work, whether the work is theoretical or applied, and whether the relevant theory is drawn from economics, econometrics, mathematics, statistics, or other related disciplines.

Before undertaking research for a doctoral thesis, the student must pass written preliminary exams in micro- and macroeconomic theory, plus in two of the fields listed under the curriculum section above. A research paper may be substituted for one of the field examinations; see the *Economics Graduate Student Handbook*. The program does not specify a minimum number of courses for the major; rather, the courses taken to help prepare for the preliminary exams constitute the major program. In addition, students must complete 12 credits outside the major for a supporting program, which may include economics courses not included in the major.

**Language Requirements**—None.

**Minor Requirements for Students**

**Majoring in Other Fields**—Requirements for a doctoral minor include five or more from among the following courses: Econ 8001-2-3-4 or 8101-2-3-4, and 8105-6-7-8; plus completion of at least two 8xxx courses in economics other than those listed above. All courses must be taken A-F, with no grade lower than C and no more than two course grades of C.

In addition, students must pass the microeconomics preliminary exam for minors or majors and either the macroeconomics preliminary exam for

minors or majors, or a preliminary exam for majors in one of the fields listed under the program description above.

## Education

Advanced work leading to the professional degree of master of education (M.Ed.) is offered in several areas of study. For more information, see the *College of Education and Human Development Professional Studies Catalog*. This catalog can be found online at <[www.education.umn.edu/catalogs/catalog\\_intro.html](http://www.education.umn.edu/catalogs/catalog_intro.html)>.

**Education Emphases (Twin Cities campus)**—At the Ph.D. level, the education major is divided into two emphases; Recreation, Park, and Leisure Studies and Work, Community, and Family Education.

## Recreation, Park, and Leisure Studies

**Contact Information**—Director of Graduate Studies, School of Kinesiology, University of Minnesota, 220 Cooke Hall, 1900 University Avenue S.E., Minneapolis, MN 55455 (612-625-5300; fax 612-626-7700; [rpls@umn.edu](mailto:rpls@umn.edu); <<http://education.umn.edu/cls/>>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Dorothy H. Anderson, Forest Resources, ASM  
William Gartner, Applied Economics, AM2  
Mary Jo Kane, SM  
Leo H. McAvoy, Jr., SM  
John E. Rynders, Educational Psychology, AM2  
Michael G. Wade, SM

### Associate Professor

Bruce D. Anderson, SM  
Carla E. S. Tabourne, SM  
Diane M. Wiese-Bjornstal, SM

### Assistant Professor

Kenneth Bartlett, Work, Community, and Family Education, AM2  
W. Corliss Outley, SM

### Lecturer

Maurice K. Fahnestock, AM2

### Other

JoAnn Buysse, M2  
Stephan Paul Carlson, Forest Resources, AM2  
Robert Danforth, AM2  
Carol A. Leitschuh, M2  
David W. Lime, Forest Resources, AM2  
Ingrid Elean Schneider, Forest Resources, AM2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Ph.D. students in education with an emphasis in recreation, park, and leisure studies (RPLS) pursue an individualized program specializing in park and recreation administration, outdoor education/recreation, sport management, or therapeutic recreation.

**Prerequisites for Admission**—Although prospective students generally have completed undergraduate and masters' degrees in recreation, park, and leisure

studies, others with a baccalaureate degree may be admitted who have related preparation and a significant background and interest in the subject. Admitted students may be required by their adviser to complete background preparation in undergraduate and graduate recreation and related coursework.

### Special Application Requirements

Applicants must submit a completed University of Minnesota, Twin Cities Graduate School application form including a clearly written statement of academic interests, goals, and objectives, scores from the General Test of the GRE (verbal and quantitative) or Miller Analogies Test that are less than five years old, three letters of recommendation from persons familiar with their scholarship and research potential, a scholarly paper, and copies of official transcripts. Students may apply at any time; however, submission of all application materials by January 15 is strongly encouraged to ensure priority consideration for admission as well as teaching and research assistantships awarded for the next academic year. The three letters of recommendation must be sent directly to the department. Students can be admitted any term.

**Research Facilities**—Research facilities include the Institute on Community Integration and the Tucker Center for Research on Girls and Women in Sport.

**Courses**—Please refer to Recreation, Park, and Leisure Studies (Rec) and Education (Educ) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### Ph.D. Degree Requirements

The Ph.D. requires at least 86 credits, which must include 12 credits in an RPLS common core [including one course from Educational Policy and Administration (EdPA) or the Preparing Future Faculty Program (GRAD)], 21 credits in an RPLS emphasis area, 17 credits in research development, 12 credits in a supporting program or minor, and 24 thesis credits (Educ 8888). A minimum GPA of 3.00 is required to maintain good standing and to graduate.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—A doctoral minor requires at least 12 credits of graduate level courses in RPLS, including Rec 5101 (3 cr) and 8980 (2 cr).

## Work, Community, and Family Education

**Contact Information**—Jerry McClelland, Director of Graduate Studies, Department of Work, Community, and Family Education, University of Minnesota, R-350 Vocational and Technical Education Building, 1954 Buford Avenue, St. Paul, MN 55108

(612-624-1221; fax 612-625-8140; [wcf@umn.edu](mailto:wcf@umn.edu); <[www.education.umn.edu/wcf](http://www.education.umn.edu/wcf)>)

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

James M. Brown, SM  
Judith J. Lambrecht, SM  
Theodore Lewis, SM  
Gary N. McLean, SM  
Roland L. Peterson, SM  
David J. Pucel, SM  
Richard A. Swanson, SM  
Ruth G. Thomas, SM

### Adjunct Professor

Richard A. Krueger, SM

### Associate Professor

Gary W. Leske, SM  
Jerry McClelland, SM  
Rosemarie J. Park, SM  
Marilyn A. M. Rossmann, SM  
Shelia K. Ruhland, SM  
James R. Stone III, SM  
Baiyin Yang, SM

### Assistant Professor

Kenneth R. Bartlett, SM  
Richard M. Joerger, M2  
Shari L. Peterson, SM

### Other

Jeanette R. Daines, AM2  
Barrycraig Johnsen, AM2  
Thomas D. Peacock, Education, Duluth, AM2  
Jerome A. Stein, AM2  
Joyce Walker, AM2

**Curriculum**—The program offers specializations in adult education; agricultural food and environmental education; business and industry education; family education; human resource development; and comprehensive work, community, and family education. Students combine study and related experiences to develop, apply, analyze, synthesize, and evaluate knowledge of the purposes, practices, issues, and problems of work, community, and family education; social, economic, historical, political, cultural, educational, technological, and psychological contexts within which work, community, and family education exist; and types of research that contribute to or apply that knowledge to the specialization.

**Prerequisites for Admission**—Prospective students generally have completed an undergraduate degree or extensive coursework in the specialization area. Prospective doctoral degree students should have academic background and experience in at least one specialization area.

**Special Application Requirements**—Scores from the GRE General Test are required for applicants with a bachelor's degree from a U.S. institution. Applicants should designate the specific specialization to which they seek admission in their goal statement. A current resume is required. Students are admitted each term.

**Courses**—Please refer to Adult Education (AdEd), Agricultural, Food, and Environmental Education (AFEE), Business and Industry Education (BIE), Family Education (FE), Human Resource

Development (HRD), and Work, Community, and Family Education (WCFE) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—A maximum of 15 credits of 4xxx courses may be used in the related field or supporting program. Students who plan to use any 4xxx courses in their program are responsible for determining that the course is available for graduate credit. Degree programs must include rationale for the use of 4xxx course credits.

### M.A. Degree Requirements

The M.A. is offered under Plan A and Plan B. Students in either plan complete a minimum of 30 to 34 credits of 5xxx courses, including 14 credits in the major and 6 credits in the related field. Plan A students also take 10 thesis credits; Plan B students complete a 3- to 6-credit project or paper, with remaining credits taken in either the major or related field.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—The master's minor requires a minimum of 6 credits in one of the specializations, approved by the director of graduate studies.

### Ph.D. Degree Requirements

The Ph.D. requires 60 course credits and 24 thesis credits. Course credits include a minimum of 12 credits in general aspects, a minimum of 20 credits in research, and a minimum of 16 credits in the specialization. Course credits must also include 12 elective credits and 12 credits from outside the department, which may overlap with those in general aspects, research, and the specialization.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—The doctoral minor requires a minimum of 12 credits in one of the specializations, approved by the director of graduate studies.

## Education, Curriculum, and Instruction

**Contact Information**—Department of Curriculum and Instruction, University of Minnesota, 125 Peik Hall, 159 Pillsbury Drive S.E., Minneapolis, MN 55455 (612-625-2545; [cigs@umn.edu](mailto:cigs@umn.edu); [www.education.umn.edu/ci/](http://www.education.umn.edu/ci/)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Patricia G. Avery, SM  
Richard W. Beach, SM  
Carol A. Carrier, Human Resources, AM  
John J. Cogan, Educational Policy and Administration, ASM  
Deborah R. Dillon, SM  
Lee Galda, SM  
Michael F. Graves, SM  
Ilene B. Harris, Medical School, ASM

Roger T. Johnson, SM  
Judith J. Lambrecht, SM  
Frances P. Lawrenz, Educational Psychology, ASM  
John C. Manning, SM  
David O'Brien, SM  
R. Michael Paige, Educational Policy and Administration, SM  
Thomas R. Post, SM  
S. Jay Samuels, Educational Psychology, ASM  
Barbara M. Taylor, SM  
Ruth G. Thomas, Work, Community, and Family Education, AM2

### Associate Professor

Kathleen Cramer, M2  
Margaret K. DiBlasio, SM  
Fred N. Finley, SM  
Patricia A. Heller, SM  
Simon R. Hooper, SM  
Patricia James, General College, AM2  
Timothy Lensmire, SM  
Rosemarie J. Park, Work, Community, and Family Education, AM2  
Diane J. Tedick, SM  
Constance L. Walker, SM  
Susan M. Watts-Taffe, SM

### Assistant Professor

Martha H. Bigelow, M2  
Joan E. Hughes, M2  
Jeremy Kahan, M2  
Julie Kalnin, M2

### Lecturer

Mary Bents, Student and Professional Services, AM2  
L. Joanne Buggey, M2  
Faith M. Clover, M2  
H. Michael Hartoonian, SM  
Richard D. Nunneley, Educational Policy and Administration, AM

### Other

Sara Dexter, Applied Research and Educational Improvement, AM2  
Lesa Covington-Clarkson, M2  
Tara W. Fortune, Applied Research and Educational Improvement, AM2  
Helen Lydia Forstad, AM2  
Jaclyn Marie Michlin, AM  
Michael Michlin, Applied Research and Educational Improvement, AM  
Terrence Wyberg, M2

**Curriculum**—By focusing on the curricular and instructional processes central to all educational endeavors, graduate programs within the Department of Curriculum and Instruction prepare students for professional roles in pre K-12 education, in postsecondary and research settings, and in educational service agencies.

The M.A. (Plan B only) and Ph.D. include formal tracks in art education; elementary education; instructional systems and technology; literacy education (including children's literature, English education, language arts education, reading education, and writing education); mathematics education; science education; second languages and cultures education; and social studies education (including ESL, foreign language, bilingual, and immersion education).

Students must have an interest in educational research; students plan a program of coursework that prepares them to conduct scholarly research in an area of expertise related to curriculum and instruction.

**Prerequisites for Admission**—Generally a bachelor's degree with licensure and/or teaching experience fulfills the requirement. For some areas, however, there is no equivalent undergraduate program. In that case, 15 to 20 credits of undergraduate coursework determined acceptable by advisers and the director of graduate studies is adequate.

**Special Application Requirements**—Scores from the GRE are required. Master's and doctoral applications are reviewed by department faculty twice per academic year.

**Courses**—Please refer to Curriculum and Instruction (CI), and Mathematics Education (MthE) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval. Students from other majors may include such courses subject to their own program's approval.

### M.A. Plan B Degree Requirements

The M.A. requires a minimum of 30 credits, which includes 14 credits in the major and at least 6 credits in one or more related fields outside the major. Core and research course requirements are specified in accord with each major track and are chosen in consultation with the adviser.

**Language Requirements**—Although language requirements for second languages and cultures (SLC) students are not specified in terms of degrees or coursework, each SLC student must give evidence of proficiency in communicating within the second language of choice. There is no language requirement for other tracks.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor requires a minimum of 6 credits, selected according to the student's needs and research interests.

### Ph.D. Degree Requirements

A total of 78 credits is required for the Ph.D. Requirements including three core courses (CI 8131, 8132, 8133 for 9 credits) and at least 15 other credits in the major track. Students must also complete 12 credits in research methodology; 6 credits in educational foundations; 12 credits in a minor or supporting program; and 24 thesis credits. Specific courses and additional work vary depending upon the major track and are planned with the adviser.

**Language Requirements**—Although language requirements for second languages and cultures (SLC) students are not specified in terms of degrees or coursework, each SLC student must give evidence of proficiency in communicating within the second language of choice. There is no language requirement for other tracks.

**Minor Requirements for Students**

**Majoring in Other Fields**—A minimum of 12 credits is required for a minor. A demonstrated understanding of foundational knowledge related to curriculum and instruction and consultation with an adviser from the specific major track is required.

## **Educational Administration**

**Certificate of Specialist**

Applications are not accepted for the certificate of specialist in this program. Students in the program are drawn from currently enrolled doctoral students who apply by submitting a *Change of Status Application*.

## **Educational Policy and Administration**

**Contact Information**—Department of Educational Policy and Administration, University of Minnesota, 330 Wulling Hall, 86 Pleasant Street S.E., Minneapolis, MN 55455 (612-624-1006; fax 612-624-3377; [edpagrad@umn.edu](mailto:edpagrad@umn.edu); <<http://education.umn.edu/edpa/>>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

**Professor**

William M. Ammentorp, SM  
Ayers Bagley (emeritus), ASM  
Robert H. Bruininks, SM  
David W. Chapman, SM  
John J. Cogan, SM  
Gerald W. Fry, SM  
David R. Johnson, SM  
Darrell R. Lewis, SM  
Theodore Lewis, Work, Community, and Family Education, ASM  
Tim L. Mazzoni (emeritus), ASM  
Josef A. Mestenhauer (emeritus), ASM  
Van Dyck Mueller (emeritus), ASM  
Neal C. Nickerson (emeritus), ASM  
R. Michael Paige, SM  
Karen Rose Seashore, SM  
Robert D. Tennyson, Educational Psychology, ASM  
James E. Ysseldyke, Educational Psychology, ASM

**Associate Professor**

Melissa S. Anderson, SM  
C. Cryss Brunner, SM  
Arthur M. Harkins, SM  
Darwin D. Hendel, SM  
Jean A. King, SM  
Thomas D. Peacock, Education, Duluth, ASM  
Byron J. Schneider, M2  
James R. Stone III, Work, Community, and Family Education, AM2  
Jennifer York-Barr, SM

**Assistant Professor**

Nicola A. Alexander, SM  
Scott C. McLeod, M2  
Stuart S. Yeh, M2

**Lecturer**

Laura L. Bloomberg, AM  
Deanne L. Magnusson, AM2  
Kristen L. N. McMaster, AM2  
Joseph H. Nathan, Public Affairs, AM2  
Richard Nunneley, AM2  
Lynn R. Scearcy, AM2  
Patricia S. Seppanen, AM2

Alice M. Thomas, AM2  
Kyla L. Wahlstrom, AM2  
Ann Z. Werner, AM2

**Other**

Joyce Ann Walker, AM2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The Department of Educational Policy and Administration prepares administrators, scholars, and analysts for leadership roles in education. The department is committed to the preparation of leaders who can act effectively and ethically within the structures, processes, and cultural contexts of organized education. Students in the M.A. and Ph.D. programs choose from one of four complementary but distinct program tracks: educational administration, evaluation studies, higher education, and comparative and international development education. In addition, the department offers a variety of Ed.D. programs for practicing professionals and four PK-12 administrative licensure programs.

The department also offers various certificate programs including school technology leadership and, in cooperation with other certificates (program evaluation, staff development, disability policy and services, postsecondary developmental education), an individualized concentration in youth leadership development, and minors in international education and program evaluation. See the department Web site address above for details on minors and certificate programs.

These graduate programs incorporate relevant knowledge from the behavioral and social sciences and the humanities, with primary reliance on sociology, management science, political science, psychology, public affairs, economics, philosophy, history, and anthropology.

**Prerequisites for Admission**—Applicants must have completed appropriate undergraduate and graduate study. In some cases, where previous coursework or degrees are marginally related, otherwise qualified applicants will be asked to complete additional background courses after admission. Applications are encouraged from individuals who may have completed undergraduate and/or master's programs in related areas such as curriculum studies, public affairs, sociology, psychology, economics, political science, international relations, management science, measurement and statistics, and educational psychology. The department offers study opportunities for professionals who are employed full time as well as for those who wish to pursue graduate studies full time.

**Special Application Requirements**—

Applicants must submit scores from the General Test of the GRE, two letters of recommendation from persons familiar with their scholarship and research potential, a complete set of official transcripts, and three brief essays (personal statement, educational issue of interest, career goals). International students must also submit a TOEFL or IELTS score, but international applicants to the M.A. program are exempt from the GRE. Applications are reviewed throughout the year; however, submission of all application materials by February 15 is strongly encouraged to ensure priority consideration for teaching and research assistantships awarded for the next academic year. All new students begin in fall semester unless permission to start earlier is granted by the program coordinator. The department application, letters of recommendation, and essays are sent directly to the department. The Graduate School application, GRE scores, transcripts, and TOEFL/IELTS score are sent to the Graduate School.

**Centers**—College centers directed by department faculty include the Institute on Community Integration (ICI) and the Postsecondary Education Policy Studies Center (PEPSC). Department faculty are also closely affiliated with the Center for Applied Research and Educational Improvement (CAREI). These centers provide research and graduate assistantship opportunities for department graduate students.

**Courses**—Please refer to Educational Policy and Administration (EdPA) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

**M.A. Plan B Degree Requirements**

The master's is available under four program tracks: educational administration, evaluation studies, higher education, and comparative and international development education. All M.A. programs require 12 or more credits in program core courses, 6 or more credits in a related field, 6 or more credits of research methodology courses, 2 to 4 credits for the Plan B paper, and an oral exam. Within the general framework for M.A. requirements, the degree program is developed by the student and his or her adviser and is subject to approval by the department's director of graduate studies and the Graduate School. For specific requirements see the current *Student Handbook* under Student Resources on the department Web site address listed above.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Ph.D. Degree Requirements**

The Ph.D. is available in four program tracks: educational administration, evaluation studies, higher education, or comparative and international development education. All Ph.D. programs include 11 credits in department core courses, 18 or more credits in program core courses, 12 or more credits of research methodology courses, 12 or more course credits in a supporting program or minor, and 24 thesis credits. The minimum total of course credits varies by track (see *Student Handbook* on the Web site for details). Preliminary written and oral exams are required and students must complete a dissertation and a final oral examination. Within the general framework for Ph.D. requirements, the degree program is developed by the student and his or her adviser and is subject to approval by the department's director of graduate studies and the Graduate School.

**Language Requirements**—None.

**Ed.D. Degree Requirements**

The doctor of education (Ed.D.) is a professionally oriented degree program for those who will provide leadership in educational institutions. The program emphasizes breadth of preparation in educational policy and administration and in related fields. Through courses, seminars, and independent study, students learn to apply the products of disciplined inquiry to educational policy issues and practical situations in educational environments.

The Ed.D. is offered in two areas in educational policy and administration: educational administration (PK-12 schools) and higher education. Cohorts include those in the metropolitan area, out state Minnesota, and international schools. The Ed.D. degree is offered only in the context of cohort programs of 20-30 students each.

All Ed.D. cohort programs include department core courses, program core courses, inquiry and research courses, supporting program or minor, and field research project credits. Within the overall 76 or more credit framework (some credits may be brought in from previous graduate work), specific course requirements are developed for each program emphasis and cohort. See the department Web site address above for requirements in specific cohorts.

Preliminary written and oral exams are required, and students must complete a professional field project that contributes to the improvement of educational policy or practice. The final exam is an oral defense.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Educational Psychology**

**Contact Information**—Director of Graduate Studies Assistant, Department of Educational Psychology, University of Minnesota, 204 Burton Hall, 178 Pillsbury Drive S.E., Minneapolis, MN 55455 (612-624-1698; fax 612-624-8241; [epsy-adm@umn.edu](mailto:epsy-adm@umn.edu); [www.education.umn.edu/EdPsych](http://www.education.umn.edu/EdPsych)).

For specific program materials, contact the program areas as follows: Counseling and Student Personnel Psychology, University of Minnesota, 129 Burton Hall, 178 Pillsbury Drive S.E., Minneapolis, MN 55455 (612-624-6827; fax 612-625-4063; [cspp-adm@umn.edu](mailto:cspp-adm@umn.edu)); Psychological Foundations of Education, University of Minnesota, 206 Burton Hall, 178 Pillsbury Drive S.E., Minneapolis, MN 55455 (612-624-0042; fax 612-624-8241; [psyf-adm@umn.edu](mailto:psyf-adm@umn.edu)); School Psychology, University of Minnesota, 344 Elliott Hall, 75 E. River Road, Minneapolis, MN 55455 (612-624-4156; fax 612-624-0879; [schpsych@umn.edu](mailto:schpsych@umn.edu)); Special Education, University of Minnesota, 227 Burton Hall, 178 Pillsbury Drive S.E., Minneapolis, MN 55455 (612-624-0367; fax 612-626-9627; [sped-adm@umn.edu](mailto:sped-adm@umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

**Professor**

William M. Bart, SM  
Robert H. Bruininks, SM  
Sandra L. Christenson, SM  
Eli Coleman, Family Practice and Community Health, ASM  
Mark L. Davison, SM  
Stanley L. Deno, SM  
Byron Egeland, Child Development, ASM  
Christine A. Espin, SM  
Joan B. Garfield, SM  
Sunny Sundal Hansen (emeritus), ASM  
Michael R. Harwell, SM  
Thomas J. Hummel, SM  
Susan C. Hupp, SM  
David R. Johnson, AM2  
David W. Johnson, SM  
Roger T. Johnson, Curriculum and Instruction, AM2  
Frances P. Lawrenz, SM  
Rodney G. Loper, Psychology, AM2  
Geoffrey M. Maruyama, SM  
Scott R. McConnell, SM  
Anthony Pellegrini, SM  
Joe E. Reichle, Communication Disorders, AM2  
John L. Romano, SM  
S. Jay Samuels, SM  
Thomas M. Skovholt, SM  
Robert D. Tennyson, SM  
Paulus W. van den Broek, SM  
Patricia R. McCarthy Veach, SM  
Richard A. Weinberg, Child Development, ASM  
James E. Ysseldyke, SM

**Associate Professor**

Ernest C. Davenport, SM  
V. Lois Erickson, SM  
Jean A. King, Educational Policy and Administration, AM2  
Jeffrey D. Long, M2  
Jennifer J. McComas, SM  
Susan Rose, SM  
Frank J. Symons, M2

**Assistant Professor**

Pearl Barner, Psychology, AM  
Marika Ginsburg-Block, SM  
Michael P. Goh, M2  
Matthew Lau, AM2  
David N. Rapp, M2

Michael C. Rodriguez, M2  
Kay A. Thomas, International Programs, AM2  
Sherri L. Turner, M2  
Kay Herting Wahl, M2

**Lecturer**

Brian H. Abery, AM2  
Ann M. Casey, AM  
Daria Courtney, AM2  
Robert C. DelMas, General College, AM2  
Kristen McMaster, AM2  
Salina M. Renninger, University Counseling and Consulting Services, AM  
Judith Puncochar, AM2  
Teresa L. Wallace, AM

**Other**

Diane Coursol, AM  
Camilla Lehr, AM2  
Ronald P. Matross, AM  
Walter Roberts, AM  
Richard Senese, Extension Services, AM  
Richard J. Spicuzza, AM  
Sandra Thompson, AM  
Martha L. Thurlow, AM  
Joyce D. Weinsheimer, Center for Teaching and Learning Services, AM2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Program areas are counseling and student personnel psychology (CSPP); school psychology; special education; and psychological foundations of education (including research methodology, learning and cognition, human relations, social psychology, human development in education, and educational technology).

**Prerequisites for Admission**—There are no special prerequisites for admission at the M.A. level in any of the four program areas, or at the Ph.D. level in school psychology or psychological foundations of education. Applicants to the CSPP doctoral program should hold either a bachelor's or master's degree with a major in psychology, education, counseling, or a related field. CSPP applicants interested in earning the specialist certificate should hold an M.A. degree; if not, they should apply to both the M.A. and specialist certificate programs.

**Special Application Requirements**—Applicants must submit a department application (*with clear indication of the desired program area*), a statement of goals and interests, three letters of recommendation, and a Graduate School application accompanied by official transcripts from all colleges and universities attended. The GRE is required for all programs; an interview is also required for those who make the initial cut in school psychology.

Applications to CSPP, school psychology, and special education are accepted for fall admission only. Applications to psychological foundations are accepted throughout the year. Please check directly with the program offices for current deadlines.

**Courses**—Please refer to Educational Psychology (EPsy) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—None of the four programs allow 4xxx or 6xxx coursework to be counted toward Graduate School degree program requirements.

### **Educational Psychology— Counseling/Personnel**

The counseling and student personnel psychology (CSPP) program subscribes to the scientist/practitioner model, which assumes that scholarly inquiry and counseling practice are interdependent and complementary. The program's primary mission is to prepare counseling psychologists to bring a well-trained professional's attitude and interest to bear on the application of psychological and education knowledge. In addition to becoming skilled clinicians, students learn to be critical consumers and producers of both qualitative and quantitative research.

#### **M.A. Degree Requirements**

Students must complete at least 42 credits, including credits in EPsy core courses (statistics, measurement, learning, and social psychology), 26 credits in counseling theory and practice, and 6 credits in a related field or minor.

**Language Requirements**—None.

**Final Exam**—The final exam is written; students must also submit a portfolio.

#### **Minor Requirements for Students**

**Majoring in Other Fields**—A master's minor requires at least 6 credits of graduate-level EPsy courses.

#### **Ph.D. Degree Requirements**

Students must complete credits in EPsy core courses (statistics, measurement, learning, social psychology, foundations, and research methods); 51 credits in counseling theory and practice, practica, and internships; 12 credits in a supporting program or minor; and 24 thesis credits.

**Language Requirements**—None.

#### **Minor Requirements for Students**

**Majoring in Other Fields**—A doctoral minor requires at least 15 credits of graduate-level EPsy courses: 9 credits in psychological foundations and 6 credits in applied areas, of which at least 9 credits must be in 8xxx courses.

#### **Certificate of Specialist Requirements**

Students must complete at least 60 credits, including 13 credits in EPsy core courses (statistics, measurement, learning, and social psychology), and 26 credits in counseling theory and practice.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### **K-12 School Counseling (For those seeking licensure only)**

This licensure program is designed for professionals who already hold a master's degree in counseling or a related field but want to broaden their career development with a K-12 school counseling license. It aligns with the licensing requirements of the Minnesota Department of Children, Families, and Learning and state licensing board.

### **Educational Psychology— Psychological Foundations**

Graduate study in psychological foundations of education prepares students for research and teaching positions in colleges and universities, schools, private industry, human service organizations, health science units, government agencies, and other research and development centers. Graduates of the program are typically employed as professors, researchers, directors of testing, instructional designers, evaluation specialists, planning officers, statisticians, and computer programmers. Students may specialize in the methodological or psychological foundations of education.

The program offers M.A. and Ph.D. degrees with emphases in research methodology (with specializations in statistics, statistics education, measurement, and evaluation), social psychology, human development in education, learning and cognition, human relations, and educational technology. Students typically choose one of these areas in addition to achieving broad competence in all aspects of the curriculum.

#### **M.A. Degree Requirements**

Students must complete at least 30 credits, including credits in EPsy core courses (statistics, measurement, learning, social psychology) and 6 credits in a related field or minor.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

#### **Minor Requirements for Students**

**Majoring in Other Fields**—A master's minor requires at least 6 credits of graduate-level EPsy courses.

#### **Ph.D. Degree Requirements**

Students must complete credits in EPsy core courses (statistics, measurement, learning, social psychology, foundations, and research methods), EPsy electives, 12 credits in a supporting program or minor, and 24 thesis credits.

**Language Requirements**—None.

#### **Minor Requirements for Students**

**Majoring in Other Fields**—A doctoral minor requires at least 15 credits of graduate level courses in EPsy: 9 credits in psychological foundations and 6 in applied areas, of which at least 9 credits must be in 8xxx courses.

### **Educational Psychology—School Psychology**

School psychology is an interdepartmental program involving the Departments of Educational Psychology, Psychology, and the Institute of Child Development. It is fully accredited by the American Psychological Association, the Minnesota Board of Teaching, and the National Association of School Psychologists. Through coursework and practica/internships, students develop competencies in assessment, consultation, intervention and program development, research, and evaluation. Graduates are employed as psychologists in local schools, university clinics and hospitals, community mental health centers, and as trainers/researchers in universities. Since 1988, training has focused on the delivery of psychological services in schools and school communities to promote children's and adolescent's academic, social, and behavioral success.

The program integrates didactic and experiential components of training and applied research. Students develop specific competencies through a broad range of applied experiences, including field placements, practica assignments, and a full-year internship.

#### **M.A. Degree Requirements**

The M.A. is offered under Plan A (thesis) and Plan B (paper) and requires at least 30 credits: credits in EPsy core courses (statistics, measurement, learning, and social psychology) and 6 credits in a related field or minor. Plan A students must also take 10 thesis credits; Plan B students take 2 research credits (EPsy 8994).

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

#### **Minor Requirements for Students**

**Majoring in Other Fields**—A master's minor requires at least 6 credits of graduate-level EPsy courses.

#### **Ph.D. Degree Requirements**

The Ph.D. program educates future school-based researchers with emphases in family/school partnerships, outcome assessment, school dropouts, and school outcomes and interventions for children/adolescents at risk. Students must complete credits in EPsy core courses (statistics, measurement, learning, social psychology, foundations, and research methods). In consultation with their advisers, students develop a curriculum and select courses and practica placements that are appropriate for their interests, prior experience, and career directions.

**Language Requirements**—None.

#### **Minor Requirements for Students**

**Majoring in Other Fields**—A doctoral minor requires at least 15 credits of graduate-level EPsy courses: 9 credits in psychological foundations and 6 credits in applied areas, of which at least 9 credits must be in 8xxx courses.

**Certificate of Specialist Requirements**

The specialist program is for students who want to become practitioners. It meets the Minnesota certification requirements for school psychologists.

Students must complete at least 60 credits, including credits in EPsy core courses (statistics, measurement, learning, social psychology, and research methods) and 6 credits of special education foundations. The remaining coursework usually focuses on two or more special education areas, determined in consultation with the adviser.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Educational Psychology—Special Education**

M.A., Ph.D., and certificate of specialist degrees are offered in special education in the following specializations: deaf/hard-of-hearing, social/emotional disabilities, early childhood special education, learning disabilities, mild/moderate disabilities, and severe/profound disabilities. Early involvement in research projects and the development of original research programs in such areas as instructional strategies, social and cognitive development, behavioral and psychological management, child development, and technology are encouraged. Special projects and training programs supplement academic studies.

The program focuses on the attainment of core competencies and related skills, since special education professionals share many common concerns and goals. A complementary emphasis is placed on problems unique to or extremely influential in the field, including social and cultural perceptions about disabilities, and federal, state, and local legislation regarding prevention and the care, treatment, education, training, and support of persons with disabilities.

**M.A. Degree Requirements**

Students may emphasize consulting, college teaching, or research in one or more of the specializations.

Students must complete at least 30 credits, including credits in EPsy core courses (statistics, measurement, learning, and social psychology), 6 credits in special education foundations, and 6 credits in a related field or minor. Plan A students must take 10 thesis credits.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students**

**Majoring in Other Fields**—A master's minor requires at least 6 credits of graduate-level EPsy courses.

**Ph.D. Degree Requirements**

The Ph.D. program trains graduates to address problems related to the full development of individuals with disabilities and their families. Intensive course-related

learning and guided experiences prepare students to assume professional leadership. Further competencies may be achieved in four areas of emphasis: research, professional preparation, administration/policy, and clinical practice/community service.

Students must complete credits in EPsy core courses (statistics, measurement, learning, social psychology, foundations, and research methods), 12 credits in special education (EPsy 8701 and 8702 and 6 additional credits which must be from EPsy 86xx or 87xx offerings), 12 credits in a supporting program or minor, and 24 thesis credits.

**Language Requirements**—None.

**Minor Requirements for Students**

**Majoring in Other Fields**—A doctoral minor requires at least 15 credits of graduate-level EPsy courses: 9 credits in psychological foundations and 6 in applied areas, of which at least 9 credits must be in 8xxx courses

**Certificate of Specialist Requirements**

Students must complete at least 60 credits, including credits in EPsy core courses (statistics, measurement, learning, social psychology, and research methods) and 6 credits of special education foundations. The remaining coursework usually focuses on two or more special education areas, determined in consultation with the adviser.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Electrical Engineering**

**Contact Information**—Director of Graduate Studies, Department of Electrical Engineering, University of Minnesota, 4-178 Electrical Engineering/Computer Science, 200 Union Street S.E., Minneapolis, MN 55455 (612-625-3564; fax 612-625-4583; [graduate\\_studies@ece.umn.edu](mailto:graduate_studies@ece.umn.edu); [www.ece.umn.edu](http://www.ece.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

**Professor**

Vernon D. Albertson (emeritus), SM  
 Stephen A. Campbell, SM  
 Vladimir Cherkassky, SM  
 Philip I. Cohen, SM  
 E. Dan Dahlberg, Physics, ASM  
 David H. Du, Computer Science and Engineering, ASM  
 Tryphon T. Georgiou, SM  
 Georgios Giannakis, SM  
 Anand Gopinath, SM  
 Jack H. Judy (emeritus), SM  
 Mostafa Kaveh, SM  
 John C. Kieffer, SM  
 Richard A. Kiehl, SM  
 Larry L. Kinney, SM  
 K. S. P. Kumar, SM  
 Vipin Kumar, Computer Science and Engineering, ASM  
 E. Bruce Lee, SM  
 James R. Leger, SM  
 David J. Lilja, SM  
 Christine Maziar, SM  
 Ned Mohan, SM  
 Jaekyun Moon, SM  
 Marshall I. Nathan, SM  
 Hal Ottesen, Rochester, ASM  
 Nikolaos P. Papanikolopoulos, Computer Science and Engineering, ASM

Keshab K. Parhi, SM  
 Robert P. Patterson, Physical Medicine and Rehabilitation, ASM  
 William T. Peria (emeritus), SM  
 Dennis L. Polla, SM  
 William P. Robbins, SM  
 P. Paul Ruden, SM  
 Sachin Sapatnekar, SM  
 Guillermo Sapiro, SM  
 Marian S. Stachowicz, Duluth, ASM  
 Ahmed H. Tewfik, SM  
 J. Thomas Vaughan, Radiology, Magnetic Resonance Research, ASM  
 Randall H. Victora, SM  
 Bruce F. Wollenberg, SM  
 Paul R. Woodward, Astronomy, ASM  
 Pen-Chung Yew, Computer Science and Engineering, ASM  
 Ofer Zeitouni, Mathematics, ASM

**Associate Professor**

Mohamed-Slim Alouini, SM  
 Emad Ebbini, SM  
 Douglas W. Ernie, SM  
 Bruce E. Hammer, Radiology, ASM  
 Ramesh Harjani, SM  
 Ted K. Higman, SM  
 James E. Holte, SM  
 Thomas S. Lee (emeritus), ASM  
 Jaijeet Roychowdhury, SM  
 Nicholas D. Sidiropoulos, SM  
 Gerald E. Sobelman, SM  
 Joseph J. Talghader, SM  
 Jian-Ping Wang, SM  
 Zhi-Li Zhang, Computer Science and Engineering, ASM

**Assistant Professor**

Kiarash Bazargan, SM  
 Rhonda Drayton, SM  
 Heinrich O. Jacobs, SM  
 Bethanie J. Stadler, SM  
 Richard M. Voyles, Computer Science and Engineering, ASM  
 Babak Ziaie, SM

**Adjunct**

Gregory T. Cibuzar, Microtechnology Laboratory, AM  
 Gabriel C. Ejebe, Carghill, AM  
 Barry K. Gilbert, Mayo Clinic, ASM  
 Matthew T. O'Keefe, Sistina, ASM  
 Robert A. Sainati, 3M, ASM  
 Frank G. Soltis, IBM, ASM  
 Bapiraju Vinnakota, Intel, ASM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The Department of Electrical and Computer Engineering offers diverse educational programs that encompass nearly all aspects of modern electrical and computer engineering, ranging from the very theoretical system and information theory to highly experimental work in novel device research and microelectronics. Emphases in the major are solid state and physical electronics, surface physics, thin films, sputtering, noise and fluctuation phenomena, quantum electronics, plasma physics, automation, power systems and power electronics theory, wave propagation, communication systems and theory, optics, lasers, fiber optics, magnetism, semiconductor properties and devices, VLSI and WSI engineering in theory and practice, network theory, signal and image processing, and computer and systems engineering. Interdisciplinary work is also available in

bioelectrical sciences, control sciences, computer sciences, solar energy, applications of systems theory to urban transportation and economic planning, and biological modeling.

**Prerequisites for Admission**—Graduate work is open to students who have shown exceptional scholarship and ability in an accredited undergraduate curriculum in electrical engineering or physics. Consideration is given to students who have completed another curriculum in engineering, science, or mathematics that includes sufficient preparation to pursue a graduate program in electrical engineering. In some instances, additional preparatory studies may be required after admission. Students whose training is in engineering technology will not be considered for admission.

**Special Application Requirements**—Scores from the GRE (General Test only) are required of all international students, both those requesting financial assistance and those not needing financial assistance. For U.S. students, the GRE (General Test only) is only required for those requesting financial assistance. International students applying from within the United States should furnish letters from U.S. faculty members attesting to their ability to understand technical instruction in English. Students submitting transcripts from non-American institutions should furnish letters of recommendation that verify their academic standing in a specific way (e.g., class rank). Very few students are accepted for enrollment in spring semester or summer term. Applicants for fall semester admission should file a completed admission application with the Graduate School by December 15 for admission the following September. All students applying for graduate study should submit the *Electrical Engineering Graduate Program Application* form directly to the department. The form is available online at <[www.ece.umn.edu](http://www.ece.umn.edu)> and is also available by contacting the director of graduate studies at [graduate\\_studies@ece.umn.edu](mailto:graduate_studies@ece.umn.edu).

**Courses**—Please refer to Electrical Engineering (EE) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—EE 4xxx courses acceptable for major field credit: EE 4301, 4541, 4701, 4721, and 4741. Non-EE 4xxx courses acceptable for supporting/related field credit: Math 4065, 4151, 4152, 4242, 4337, 4428, 4457, 4458, 4512, 4567, and 4606, and Stat 4101. All 4xxx physics courses are acceptable for graduate credit. No 4xxx computer science, mechanical engineering, or industrial engineering courses are acceptable for graduate credit.

### M.E.E. Coursework Only Degree Requirements

The M.E.E. degree requires 30 credits, including at least 14 credits from EE courses at 5xxx and higher, at least 6 credits from courses numbered 4xxx and higher in a

minor or related field, and 10 credits from EE or a supporting program. Colloquium and seminar credits cannot be used in any M.E.E. program.

**Language Requirements**—None.

**Final Exam**—No final exam is required.

### Minor Requirements for Students

**Majoring in Other Fields**—Credits for the master's minor must be from classroom and laboratory courses graded A-F. In particular, colloquia, seminar, and special investigations credits do not count toward meeting the minor requirements.

### M.S.E.E. Degree Requirements

Every M.S.E.E. degree program must include 30 credits including at least 14 credits from EE courses at 5xxx or higher (a few 4xxx EE courses can be used for the program) and at least 6 credits from courses outside EE at 4xxx or higher (normally from departments in the Institute of Technology or School of Statistics). These credits cannot come from colloquia or seminar registrations. A Plan A program (with thesis) cannot include more than 2 credits from projects, seminars, special investigations, or directed studies; in a Plan B program (without thesis), the limit is 3 credits. The Plan A program should include 10 thesis credits. Part-time students must choose Plan B; full-time students may choose either Plan A or Plan B.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—The 6 credits for the master's minor must be from classroom and laboratory courses graded A-F. Colloquia, seminar, and special investigations credits do not count toward meeting the minor requirements.

### Ph.D. Degree Requirements

The Ph.D. requires at least 40 course credits including at least 6 credits in 8xxx courses, at least 14 credits in EE courses, and at least 12 credits in the supporting program or minor, which cannot include EE courses. In addition, 24 thesis credits are required. The program may contain up to 2 credits from seminars or special investigations registrations and up to 8 credits of M..S. thesis registration, none of which can be used to meet the major requirements above. No credits can be included from colloquia or M..S. Plan B projects. At least 14 credits must be coursework taken at the University of Minnesota. The student's degree program form listing all courses to be included toward the degree should be submitted no later than the end of the second year of the Ph.D. program. Each Ph.D. student must participate in one of the department research area seminars and make at least three oral paper presentations before the thesis proposal is approved.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—The 12 credits for the Ph.D. minor must be from classroom and laboratory courses graded A-F. Colloquia, seminar, and special investigations credits do not count toward meeting the minor requirements.

## Elementary Education

See Education, Curriculum, and Instruction.

## English

**Contact Information**—Director of Graduate Studies, Department of English, University of Minnesota, 204 Lind Hall, 207 Church Street S.E., Minneapolis, MN 55455 (612-625-3882; fax 612-624-8228; [gradeng@umn.edu](mailto:gradeng@umn.edu); <<http://english.umn.edu/graduateprogram/intro.html>>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Regents Professor

Thomas S. Clayton, SM  
Patricia M. Hampl, SM

### Professor

Kent R. Bales, SM  
Timothy Brennan, Cultural Studies and Comparative Literature, SM  
Lillian S. Bridwell-Bowles, SM  
Michael D. Browne, SM  
Andrew Elfenbein, SM  
Genevieve J. Escure, SM  
Peter E. Firchow, SM  
Shirley N. Garner, SM  
Jill Barnum Gidmark, AM2  
Ray Gonzalez, SM  
Edward M. Griffin, SM  
David B. Haley, SM  
Michael Hancher, SM  
Gordon D. Hirsch, SM  
Karen A. Hoyle, Children's Literature Research Collection, AM2  
Richard J. Kelly, Library Collection Development: Arts and Humanities, AM2  
Calvin B. Kendall, SM  
Ellen Messer-Davidow, SM  
Valerie J. Miner, SM  
John W. Mowitz, Cultural Studies and Comparative Literature, SM  
Marcia Pankake, Library Collection Development: Arts and Humanities, AM2  
Paula Rabinowitz, SM  
Donald J. Ross, Jr., SM  
Robert D. Solotaroff, SM  
Madelon Sprengnether, SM  
John A. Watkins, SM  
Joel C. Weinsheimer, SM

### Associate Professor

Robert L. Brown, Jr., Cultural Studies and Comparative Literature, ASM  
Patricia A. Crain, SM  
Maria Damon, SM  
Maria J. Fitzgerald, SM  
Rebecca L. Krug, M2  
Josephine D. Lee, SM  
Archibald I. Leyasmeyer, M2  
Julie Schumacher, SM  
Charles J. Sugnet, SM  
John S. Wright, SM

### Assistant Professor

Thomas E. Augst, M2  
Lois B. Cucullu, M2  
Lianna H. Farber, M2  
Brian B. Goldberg, M2  
Qadri Ismail, M2  
David B. Luke, M2

Daniel J. Philippon, Rhetoric, AM2  
Janette Scandura, M2  
David R. Treuer, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Over the past 20 years, the field of English studies has dramatically changed from a discipline concerned with studying the literary works produced by English speakers in Britain and the United States to encompass writings in English from around the globe. The concerns of literary scholars have broadened to include not only textual analyses but also cultural, social, political, and economic contexts. The field of literature itself now encompasses not only the traditional genres of poetry, prose (fiction and belles-lettres), and drama, but also extra-literary discourses: popular culture, film, television, legal documents, conduct books, and manifestoes. The Department of English has been in the forefront of interdisciplinary projects, thanks to the efforts of a faculty committed to research in American studies, medieval studies, feminist studies, film studies, and cultural studies. At the same time, the department maintains the core concerns of the discipline—the traditional study of the literatures and languages in English—as well as develops writers for the present and future through the master of fine arts in creative writing degree. The department is engaged in two simultaneous projects: to preserve the core curriculum and to reimagine its future shape.

The department offers two master's degrees, the master of arts in English language and literature, and the master of fine arts in creative writing (see listing under Creative Writing). The M.A. offers training in the areas of literary history, literary theory and interpretation, language, linguistics, rhetoric, and composition. Students in the M.A. can develop specific concentrations through consultation with the director of graduate studies.

Course requirements for the Ph.D. and M.A. programs are broadly defined, allowing the student to shape a personal program of study. The English program encourages and supports interdisciplinary work. The M.F.A. program requires coursework in English and writing and emphasizes intensive work on a creative project.

**Admission to the Program**—Students with a bachelor's degree may apply either to the master's program or the doctoral program. An M.A. degree, but not an M.F.A. degree, can be gained en route to the Ph.D. degree. M.A. candidates who wish to continue their studies must formally apply for admission to the Ph.D. program.

**Prerequisites for Admission**—A minimum of four courses in English, three of which must be at the upper division level, is required for degree programs and the graduate minor. The courses should be widely distributed.

**Special Application Requirements**—Three letters of recommendation; scores from the General Test of the GRE; a short essay explaining scholarly, professional, and personal goals and reason(s) for choosing the University of Minnesota; and a writing sample, such as a course paper, are required. Applications to the M.F.A. in creative writing are reviewed by the writing faculty; these applications should include a substantial portfolio of writing. Candidates for all degrees are admitted fall semester only; all materials must be received by December 20.

**Courses**—Please refer to English: Creative and Professional Writing (EngW), and English: Literature (EngL) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—A limited number of 4xxx courses may be included as appropriate for field and area requirements. Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### M.A. Plan B Degree Requirements

The minimum requirement for the M.A. is 30 credits. Coursework must include at least 24 credits in English and 6 credits in related fields outside of English or in a minor field. All M.A. students must complete the introductory sequence EngL 5001-02 on methods and theory of literary study and three Plan B papers.

**Language Requirements**—A reading knowledge of one classical or modern language, approved by the director of graduate studies, is required.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—The master's minor consists of 9 credits in English. Course selection is determined in consultation with the director of graduate studies.

### Ph.D. Degree Requirements

A minimum of 66 credits, including 24 thesis credits, is required. Course requirements for the Ph.D. program are broadly defined, allowing students to shape a personal program of study. The following courses are required: EngL 5001 and 5002, preferably during the first year of doctoral study (6 credits); four English courses distributed among broad areas (minimum of 12 credits); four additional English courses in a focused area of emphasis (minimum of 12 credits); 12 credits in a supporting program. Students are encouraged to enroll in additional courses as appropriate.

**Language Requirements**—A reading knowledge of two languages, classical or modern, approved by the director of graduate studies, is required. Students specializing in medieval or early modern literature and culture are advised to include Latin as one of their languages.

### Minor Requirements for Students

**Majoring in Other Fields**—The Ph.D. minor consists of 12 credits in English. Course selection is determined in consultation with the director of graduate studies.

## English as a Second Language

**Contact Information**—Director of Graduate Studies, English as a Second Language, University of Minnesota, 215 Nolte Center, 315 Pillsbury Drive S.E., Minneapolis, MN 55455 (612-624-3331; fax 612-624-4579; [iles@umn.edu](mailto:iles@umn.edu); <[www.iles.umn.edu/esl.htm](http://www.iles.umn.edu/esl.htm)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Andrew D. Cohen, M2  
Elaine E. Tarone, M2

### Associate Professor

Carol Klee, AM

### Assistant Professor

Martha Bigelow, AM  
Kathryn Kohnert, AM  
Anne Lazaraton, M2

### Other

Jenise Rowekamp, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The program in English as a second language (ESL) offers a course of study leading to an M.A. Degree holders are qualified to teach ESL to adults at the college or university level. The program emphasizes research in language analysis, language acquisition, teaching methodology, materials development, and uses of technology in language teaching. Students are expected to do independent and creative work in one or two of these areas with the aim of developing a more complete understanding of the issues facing professionals in the field of ESL today.

**Prerequisites for Admission**—A bachelor's degree in the liberal arts or sciences with a strong academic record is required.

**Special Application Requirements**—Scores from the General (Aptitude) Test of the GRE and three letters of reference, are required. Non-native speakers of English must submit either TOEFL scores (minimum 600) and TWE scores (minimum 5), or IELTS scores (minimum 7). Students may begin the program fall semester or first summer session. Applications for both admission dates are due on March 1. To be considered for special fellowship opportunities, students must apply by January 15.

**Courses**—Please refer to Teaching English as a Second Language (TESL) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### M.A. Degree Requirements

The M.A. program in ESL normally takes at least two years to complete. The Plan A option requires a thesis demonstrating original work in areas related to the field, familiarity with research methodology, and knowledge of the effective presentation of investigative study results. The Plan B option requires two qualifying papers, usually consisting of course papers which have been rewritten under the supervision of a faculty member.

Plan A and Plan B students must complete 26 credits in required coursework and 6 credits of elective coursework in related fields. Plan A students must complete an additional 10 thesis credits for a total of 42 credits and Plan B students must complete an additional 3 credits in elective coursework for a total of 35 credits. Elective and related field courses must be chosen with the help of an adviser to ensure the relevance of courses to students' goals.

**Language Requirements**—Proficiency, demonstrated by exam or coursework, in one language not native to the student is required upon completion of the program. Non-native speakers of English who are admitted to the program are considered to have fulfilled the language requirement.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—For a minor in ESL, students must take TESL 5721, 5401, and 5402, for a total of 11 credits.

## Entomology

**Contact Information**—Director of Graduate Studies, Department of Entomology, University of Minnesota, 219A Hodson Hall, 1980 Folwell Ave., St. Paul, MN 55108 (612-624-3636; fax 612-625-5299; [entodept@umn.edu](mailto:entodept@umn.edu); [www.entomology.umn.edu](http://www.entomology.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

David A. Andow, SM  
Mark E. Ascerno, Jr., SM  
Ann M. Fallon, SM  
Leonard C. Ferrington, SM  
Ralph W. Holzenthal, SM  
William D. Hutchison, SM  
Timothy J. Kurtti, SM  
Karen A. Mesce, SM  
Roger D. Moon, SM  
Kenneth R. Ostlie, SM  
Edward B. Radcliffe, SM  
David W. Ragsdale, SM  
David D. Walgenbach, SM

### Adjunct Professor

William E. Miller, SM

### Associate Professor

George E. Heimpel, SM  
Vera A. Krischik, SM  
Ian V. MacRae, SM  
Marla Spivak, SM  
Susan J. Weller, SM

### Adjunct Associate Professor

Susan Palchick-Silver, M2

### Assistant Professor

Colleen A. Cannon, SM

### Adjunct Assistant Professor

Steven A. Katovich, M2  
Robert C. Venette, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Entomology centers on the study of insects and includes specializations in ecology, behavior, molecular biology, microbiology, neurobiology, physiology, population dynamics, systematics, and taxonomy. Specialized or applied areas include apiculture, biological control, cell culture, insect conservation, insect-vector relations, integrated pest management, and modeling. Research programs are active in aquatic systems, forest systems, crop and animal agriculture, human health, and the natural and urban environments.

**Prerequisites for Admission**—A bachelor's degree with a major in a biological science is a prerequisite. Preference is given to students with a broad background in the basic sciences. Admissions depends primarily on applicant's undergraduate record and letters of recommendation.

### Special Application Requirements

Applicants must submit a complete set of official transcripts and a clearly written statement of career interests, goals, and objectives. Three letters of recommendation are required from persons well acquainted with the student's academic record, and must be sent directly to the department. Although GRE scores are not required, they are highly recommended for applicants who may qualify for graduate school fellowships. Students may apply at any time; however, submission of all application materials by January 15 is strongly encouraged to ensure priority consideration for fellowships awarded for the next academic year. Applications are reviewed individually when all materials are complete. Students are admitted each semester.

**Courses**—Please refer to Entomology (Ent) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### M.S. Degree Requirements

Requirements for the M.S., supplemental to general Graduate School requirements, include a minimum of 14 course credits in entomology including a core curriculum of

fundamental entomology courses and 1 credit of graduate seminar. Additional requirements include 6 credits from other programs to make a total of at least 20 course credits for Plan A or at least 30 course credits for Plan B students. These courses are flexible and are determined in consultation with the adviser and other members of the student's advisory committee. Plan A is recommended for students contemplating a career in entomological research. Written and oral preliminary exams, in addition to the final oral exam, are required for all entomology graduate degrees.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor requires a minimum of 6 credits in 4xxx, 5xxx, or 8xxx entomology courses.

### Ph.D. Degree Requirements

Ph.D. requirements include a minimum of at least 15 course credits in entomology, including a core curriculum of fundamental entomology courses and 2 credits of graduate seminar. Additional requirements include 12 credits from other programs, and are determined in consultation with the adviser and other members of the student's advisory committee.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—The doctoral minor requires a minimum of 12 credits in 4xxx, 5xxx, or 8xxx entomology courses.

## Environmental Health

**Contact Information**—Student Services Center, School of Public Health, University of Minnesota, MMC 819, 420 Delaware Street S.E., Minneapolis, MN 55455 (612-626-3500 or 1-800-774-8636; fax 612-624-4498; [sph-ssc@umn.edu](mailto:sph-ssc@umn.edu); [www.sph.umn.edu](http://www.sph.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Susan G. Gerberich, SM  
Sagar M. Goyal, Veterinary Diagnostic Medicine, ASM  
Jordan L. Holtzman, Medicine, ASM  
Sheldon B. Sparber, Pharmacology, ASM  
Deborah L. Swackhamer, SM  
William Toscano, SM  
Donald Vesley, SM

### Associate Professor

Lisa M. Brosseau, SM  
Timothy R. Church, SM  
Ian A. Greaves, SM  
Craig Hedberg, SM  
George Maldonado, SM  
Patricia M. McGovern, SM  
Rita B. Messing, Pharmacology, AM2  
Lisa A. Peterson, SM  
Gurumurthy Ramachandran, SM  
Elizabeth V. Wattenberg, SM

**Assistant Professor**

John L. Adgate, SM  
Bruce Alexander, SM  
Claudiu Lungu, SM  
Peter Raynor, SM  
Matthew Simcik, SM

**Adjunct Assistant Professor**

Robert R. Roy, AM2

**Instructor**

Debra K. Olson, SM

**Other**

Alan P. Bender, AM2  
Hillary M. Carpenter, AM2  
L. Ronald French, AM2  
Jeffrey H. Mandel, AM2  
Nicole V. McCullough, AM2  
Robert S. Skoglund, AM2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Environmental health is the study of how exposures to external hazards, including chemical, physical, and biological agents, affect human health. Environmental health researchers and professionals seek to understand how to evaluate exposures that create risk to human health, how those exposures elicit biological responses that lead to disease and injury, and how policy is developed and used to prevent adverse health effects. This division offers academic programs at the master's and doctoral levels, conducts research in diverse areas of environmental health, offers continuing education, and conducts outreach. The academic programs prepare students to be leaders in environmental health in academia, industry, consulting groups, and government agencies. The division's training and research programs emphasize the importance of translating basic scientific knowledge into solutions for current societal problems and concerns.

Applicants must indicate an interest in one of the following specialties within the major: environmental chemistry, environmental health policy, infectious disease, environmental and occupational epidemiology, environmental toxicology, the general environmental health program, occupational health nursing, occupational injury epidemiology and control, or the industrial hygiene program. The industrial hygiene program is accredited by the Applied Science Accreditation Commission of ABET, 111 Market Place, Suite 1050, Baltimore, MD 21202-4012, (410-347-7700).

**Prerequisites for Admission**—Minimum requirements include a baccalaureate degree with coursework in the basic sciences. Each specialty requires slightly different preparation.

**Special Application Requirements**—GRE scores, a letter describing the applicant's professional objectives, and three letters of recommendation are required.

**Courses**—Please refer to Public Health (PubH), particularly numbers 51xx-52xx and 81xx-82xx, in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to the approval of the adviser and the director of graduate studies. Students from other majors may include such courses subject to their own program's approval.

**M.S. Degree Requirements**

The M.S. program prepares students for specialized careers in environmental and occupational health. M.S. students receive a solid technical background in their disciplines and by graduation are proficient in applied or basic research.

The minimum credits required for graduation depends on the chosen specialty area. Most specialty areas require a two-year program. M.S. students have the option of completing a Plan A with a thesis or a Plan B project.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students**

**Majoring in Other Fields**—Students completing a minor in environmental health must complete 7 credits in environmental health, including PubH 5103, 5104, and 5105.

**Ph.D. Degree Requirements**

The Ph.D. focuses on research, supplemented with advanced coursework developed under the guidance of a faculty adviser and a Ph.D. committee. Students are required to register for 24 thesis credits. Students usually need a minimum of two to three years beyond the master's degree to complete a doctorate.

**Language Requirements**—None.

**Minor Requirements for Students**

**Majoring in Other Fields**—Students are required to take a minimum of 12 credits in environmental health, including PubH 5103, 5104, and 5105.

**Epidemiology**

**Contact Information**—Student Services Center, School of Public Health, University of Minnesota, MMC 819, 420 Delaware Street S.E., Minneapolis, MN 55455 (612-626-3500 or 1-800-774-8636; fax 612-626-6931; [sph-ssc@umn.edu](mailto:sph-ssc@umn.edu); [www.sph.umn.edu](http://www.sph.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

**Professor**

Donna K. Arnett, SM  
Henry Blackburn, Jr. (emeritus), ASM  
Richard S. Crow, M2  
John R. Finnegan, Jr., SM  
Aaron R. Folsom, SM  
Jean L. Forster, M2  
Laël C. Gatewood, M2  
John H. Himes, SM  
David R. Jacobs, Jr., SM  
Robert W. Jeffery, SM  
Robert L. Kane, SM  
Harry A. Lando, SM

Russell V. Luepker, SM  
Leslie L. Lytle, SM  
A. Marshall McBean, M2  
Cheryl L. Perry, SM  
Phyllis L. Pirie, SM  
B. R. Rosser, M2  
Eyal Shahar, SM  
Mary T. Story, SM  
Alexander C. Wagenaar, SM  
Carolyn L. Williams, SM

**Adjunct Professor**

Richard H. Grimm, Medicine, SM  
Harry F. Hull, M2  
Arthur S. Leon, SM  
Michael T. Osterholm, SM  
Leslie L. Robison, SM

**Associate Professor**

Kristin E. Anderson, SM  
Timothy R. Church, M2  
Marsha Davis, M2  
Simone A. French, M2  
Lisa J. Harnack, M2  
Craig W. Hedberg, M2  
Wendy L. Hellestedt, M2  
Rhonda J. Jones-Webb, M2  
DeAnn Lazovich, M2  
George Maldonado, M2  
Dianne Neumark-Sztainer, M2  
James S. Pankow, M2  
Pamela J. Schreiner, SM  
Michelle van Ryn, M2  
Seth L. Welles, M2

**Adjunct Associate Professor**

Alan P. Bender, M2  
Richard N. Danila, M2  
James G. Gurney, M2  
Myron D. Gross, M2  
Alan R. Lifson, M2  
Ann C. Mertens, M2  
Joseph P. Neglia, M2  
Julie A. Ross, SM  
Thomas A. Sellers, ASM

**Assistant Professor**

Moise Desvarieux, M2  
Susan J. Duval, M2  
Deborah J. Hennrikus, M2  
Kelli A. Komro, SM  
Michael B. Miller, M2  
J. Michael Oakes, M2  
Kathryn H. Schmitz, M2  
Lyn M. Steffen, M2  
Carol Sweeney, M2  
Traci L. Toomey, M2

**Adjunct Assistant Professor**

Sally A. Bushhouse, M2  
Beth A. Virnig, M2

**Senior Research Fellow**

Peter J. Hannan, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The program provides students with the core methodological skills needed to address chronic or acute diseases, long-term or newly emerging health problems, and behavioral and biologic aspects of health and disease. The doctoral program is for students interested in research and teaching careers in the health sciences. Courses are also available to students from other public health and health-related programs.

Students may select areas of concentration appropriate to their academic interests and career objectives, including the epidemiology and prevention of cancer, infectious diseases, and cardiovascular diseases; nutrition; genetic epidemiology; behavioral interventions; and epidemiologic research methods. A detailed description of the course of study may be obtained online or by writing to the director of graduate studies.

**Prerequisites for Admission**—For the doctoral program, applicants must have completed or be about to complete a master's degree in a related field. Applicants should have prior coursework in life or behavioral sciences. Applicants who have not completed a master's degree in epidemiology or a related field are asked to apply to the master's of public health in epidemiology through the School of Public Health. Because positions in the doctoral program are limited, selection is competitive with respect to academic background and experience.

**Special Application Requirements**—The following materials are required by the department: an acceptable score on the GRE (test results should be forwarded to the department); at least three recommendations (form and separate letter) from faculty or work supervisors with knowledge of the applicant's scholastic and professional capabilities and potential; and a statement of goals and objectives (letter of intent) for seeking a career in epidemiology.

In addition to the above materials, applicants for the Ph.D. program must submit a separate essay (statement of research interests) demonstrating evidence of their capability in or potential for original research in a specific epidemiologic area and, if possible, indicating interest in particular methodologies or study designs. Serious doctoral applicants are encouraged to contact the major coordinator at [gradstudies@epi.umn.edu](mailto:gradstudies@epi.umn.edu) before applying. Students should begin their studies in the fall semester. Applications must be completed by January 15 of the same year for the doctoral program.

**Courses**—Please refer to the epidemiology Ph.D. curriculum sheet available on the School of Public Health Web site for courses pertaining to the program at [www.epi.umn.edu/academic/phd\\_epi.shtm](http://www.epi.umn.edu/academic/phd_epi.shtm).

**Use of 4xxx Courses**—Inclusion of any 4xxx courses on degree program forms of majors or minors is subject to adviser and director of graduate studies approval.

### M.S. Degree Requirements

Students are not admitted directly into the master's program; it is available only by special arrangement with the program. Students interested in a master's level degree in epidemiology should apply for the master's of public health (M.P.H.) degree through the School of Public Health (SPH). For more information on the M.P.H. degree please go to the SPH Web site at [www.sph.umn.edu](http://www.sph.umn.edu).

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—The master's minor requires at least 8 credits.

### Ph.D. Degree Requirements

Students select one of two field concentrations; both have an applied perspective that emphasizes study of design, measurement, quantitative analysis, and interpretation. Behavioral epidemiology focuses on origins and development of human behavior patterns and how they are influenced and formed by personality, family, culture and environment. Etiologic epidemiology focuses on the biological causes of disease states, especially determinants of cardiovascular disease, cancer, and infectious diseases.

The Ph.D. program includes a core curriculum of 67-72 credits. Students must pass written and oral preliminary exams, write and defend a dissertation, and prepare a first-authored manuscript for publication.

Coursework includes 16 credits in epidemiology and biostatistics core courses; 10 credits in advanced courses (epidemiological theory, teaching practicum, writing research grants, seminars on epidemiologic issues); 4-6 credits in Ph.D.-specific electives; 24 thesis credits; 6-8 credits (three courses) of epidemiologic-related interventions/methods taken from a menu of courses (e.g., cancer epidemiology, public health policy as a prevention strategy, smoking intervention); and 7-9 credits in advanced biologically or behaviorally related courses.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—The minor requires 20 credits: 16 credits in epidemiology and biostatistics, and 4 credits in epidemiology elective courses. The director of graduate studies must approve the student's selection of elective credits. Contact the major coordinator in epidemiology for information at [gradstudies@epi.umn.edu](mailto:gradstudies@epi.umn.edu).

## Experimental Surgery

**Contact Information and Faculty**—See Surgery.

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The general surgery program trains medical doctors for the practice of surgery and for academic positions. See the [Medical School Catalog](#) for professional degree requirements; see below for academic degree requirements. Trainees spend two to three years in laboratory research, either in a basic science or in surgery, after which they begin their senior residency and chief residency training. The Medical School's

laboratory departments offer many graduate courses closely related to surgery (see the graduate programs in biochemistry, molecular biology, and biophysics; cellular and integrative physiology; microbiology, immunology, and molecular pathobiology; and pharmacology). These fields also offer opportunities for research work. The Department of Surgery offers supervised work in its experimental research laboratories, as well as in its hospital and outpatient departments, in the areas of surgical diagnosis and operative surgery and in some surgical specialties (such as colon and rectal surgery, transplantation, thoracic and cardiovascular surgery, and pediatric surgery). The experimental surgery program provides an opportunity to gain practical research experience.

**Prerequisites for Admission**—Prospective students must be in the general surgery training program and have two to three clinical years of training completed.

**Courses**—For courses pertaining to the program, please refer to Surgery (Surg) in the course section of this catalog.

**Use of 4xxx Courses**—4xxx courses are not permitted toward degree requirements.

### M.S.Exp.Surg. Plan A Degree Requirements

The M.S.Exp.Surg. is offered under Plan A only. At least 32 course credits (26 in the major and 6 in the minor or related fields) plus 10 thesis credits are required for a total of 42 credits.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

## Family Social Science

**Contact Information**—Department of Family Social Science, University of Minnesota, 290 McNeal Hall, 1985 Buford Avenue, St. Paul, MN 55108-6140 (612-625-3116 or 612-625-1900; fax 612-625-4227; [fsosgrad@che.umn.edu](mailto:fsosgrad@che.umn.edu); <http://fsos.che.umn.edu/graduate/>).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Jean W. Bauer, SM  
Shirley L. Baugher, ASM  
Pauline G. Boss, SM  
Sharon M. Danes, SM  
Daniel F. Detzner, SM  
William J. Doherty, SM  
Martha F. Erickson, AM2  
Harold D. Grotevant, SM  
Mary E. Heltsley, ASM  
M. Janice Hogan, SM  
James W. Maddock, SM  
B. Jan McCulloch, M2  
David H. Olson (emeritus), ASM  
Kathryn D. Rettig, SM  
Paul C. Rosenblatt, SM  
William L. Turner, SM  
Shirley L. Zimmerman (emeritus), ASM

### Associate Professor

Rose M. Brewer, AM2  
Ann W. Garwick, AM2  
William J. Goodman, M2  
Joan M. Patterson, ASM

Beatrice E. Robinson, AM2  
 Martha A. Rueter, SM  
 Catherine A. Solheim, AM2  
 Marlene S. Stum, SM  
 Virginia S. Zuiker, SM

#### Assistant Professor

Jodi B. Dworkin, M2  
 Elizabeth Wieling, SM

#### Lecturer

Wayne A. Caron, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The program of study uses methods of social science to examine family systems and their interactions with various environments. The curriculum supports study in several broad theme areas: family economic well-being, families and mental health, family diversity, and relationships and development across the lifespan.

**Prerequisites for Admission**—The master's program requires two family courses; at least one course in economics, political science, government, or public policy; one course in sociology, anthropology, or human geography; one psychology course; and one statistics course. The doctoral program requirements include all requirements for the master's program plus three additional social or behavioral science courses and two additional statistics or research methods courses. It is important that students, especially those applying for the Ph.D. program, present evidence of interest in research and that they have experience working with families through paid employment or volunteer work. Occasionally, the graduate faculty admits a student who lacks one or more required courses with the understanding that the missing course(s) will be made up soon, ideally before entering the program.

The marriage and family therapy program is accredited by the American Association for Marriage and Family Therapy. Admission to the program is available only to doctoral students with a clinical master's degree. Students cannot earn a clinical master's degree in the Department of Family Social Science.

Students may apply for admission to the Ph.D. program after completing either a bachelor's degree or a master's degree. Students who enter the Ph.D. program with a bachelor's degree are expected to fulfill the requirements for an M.A. degree in the process of working toward the Ph.D.

#### Special Application Requirements

Consult the *Family Social Science Graduate Program Handbook* or the director of graduate studies. The *Graduate Program Handbook* and all materials needed for the application process may be found at <http://fsos.che.umn.edu/graduate/>.

Applicants for the doctoral program and Plan A master's program are reviewed only once per year. The application deadline is December 15 for admission fall semester of

the following year. Applications for the Plan B master's program are considered once they are complete, and students may begin graduate study the semester after the application is approved.

**Courses**—Please refer to Family Social Science (FSoS) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—The inclusion of 4xxx family social science courses is subject to approval of the instructor, the student's adviser, and the director of graduate studies. Students from other majors may take such courses with instructor approval and include them on their degree programs subject to their own program's approval. 4xxx courses counted on graduate programs must be taught by a member of the graduate faculty and must include assignments that are at the graduate level.

#### M.A. Degree Requirements

The M.A. program is offered under Plan A and Plan B. Plan A requires at least 30 credits, including at least 20 course credits, of which 6 credits are outside the department in a related field, and 10 thesis credits. The Plan A master's is recommended for students who intend to pursue a Ph.D. degree.

Plan B requires at least 30 credits, including at least 26 course credits, of which 6 credits are outside the department in a related field, and at least 4 credits for a Plan B project. It is for students who wish to further their education so that they may hold positions of responsibility serving families. Although the instruction is based on research, the Plan B degree is not intended to provide intensive research training. The Plan B program is understood to be a terminal degree and is not recommended for students who intend to pursue the Ph.D. degree. The Plan B program is available to students seeking one of two areas of specialization: family economics and resource management, and family policy. Consult the department for the most current information.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

#### Minor Requirements for Students

**Majoring in Other Fields**—Master's students must complete at least 6 credits of 5xxx or 8xxx in family social science. All courses must be taken A-F and completed with a GPA of at least 3.00.

#### Ph.D. Degree Requirements

The courses in a Ph.D. degree program must contribute to an organized program of study and research. The program includes at least 84 credits, including 60 course credits and 24 thesis credits. Coursework includes at least 12 credits in a minor or supporting program; the remaining 48 credits include at least 18 credits in research methods and statistics and at least 30 credits in family social science. An optional teaching internship program is recommended for students who are planning for careers in higher education.

**Language Requirements**—None.

#### Minor Requirements for Students

**Majoring in Other Fields**—A doctoral minor requires at least 12 credits of 8xxx in family social science. All courses for the minor must be taken A-F and completed with a GPA of at least 3.00.

## Feminist Studies

**Contact Information**—Department of Women's Studies, University of Minnesota, 425 Ford Hall, 224 Church Street S.E., Minneapolis, MN 55455; (612-626-0332; fax 612-624-3573; [wostgrad@umn.edu](mailto:wostgrad@umn.edu); <http://womenstudy.cla.umn.edu>).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

#### Regents Professor

Joanne Eicher, Design, Housing, and Apparel, AM2

#### Professor

Lillian Bridwell-Bowles, English, AM2  
 Karlyn K. Campbell, Communication Studies, AM2  
 Anna Clark, History, AM2  
 Mary Dietz, Political Science, AM2  
 Raymond Duvall, Political Science, AM2  
 Sara M. Evans, History, AM2  
 Mary L. Fellows, Law School, AM2  
 Shirley N. Garner, English, AM2  
 Jane F. Gilgun, Social Work, AM2  
 Ruth-Ellen B. Joeres, German, Scandinavian, and Dutch, ASM  
 Indira Y. Junghare, Linguistics, ESL, and Slavic Languages and Literatures, AM2  
 Amy K. Kaminsky, Women's Studies, SM  
 Mary Jo Kane, Kinesiology, AM2  
 Ruth Karras, History, AM2  
 Sally J. Kenney, Public Affairs, AM2  
 Sally G. Kohlstedt, Geology and Geophysics, AM2  
 Mary M. Lay, Rhetoric, AM2  
 Helga Leitner, Geography, AM2  
 Helen E. Longino, Women's Studies, SM  
 Elaine Tyler May, American Studies, AM2  
 Mary J. Maynes, History, AM2  
 Richard W. McCormick, German, Scandinavian, and Dutch, AM2  
 Ellen Messer-Davidow, English, ASM  
 Valerie J. Miner, English, AM2  
 Riv-Elle Prell, American Studies, AM2  
 Paula Rabinowitz, English, ASM  
 Naomi B. Scheman, Philosophy, SM  
 Edward Schiappa, Communication Studies, AM2  
 Amy L. Sheldon, Communication Studies, AM2  
 Billie J. Wahlstrom, Rhetoric, AM2  
 Ann B. Waltner, History, AM2  
 Gayle Graham Yates, American Studies, AM2

#### Associate Professor

Lisa Albrecht, General College, ASM  
 Maria M. Brewer, French and Italian, AM2  
 Rose M. Brewer, African American and African Studies, ASM  
 Sarah Chambers, History, AM2  
 Susan Craddock, Women's Studies, M2  
 Maria Damon, English, AM2  
 Lisa J. Disch, Political Science, AM2  
 Susanna Ferlito, French and Italian, AM2  
 Amy Lee, General College, AM2  
 Josephine Lee, English, AM2  
 Richa Nagar, Women's Studies, SM  
 Lisa A. Norling, History, AM2  
 Joanna O'Connell, Spanish and Portuguese Studies, AM2  
 Jennifer L. Pierce, American Studies, AM2  
 Gloria Goodwin Raheja, Anthropology, AM2  
 Eileen B. Sivert, French and Italian, AM2  
 Gary Thomas, Cultural Studies and Comparative Literature, AM2  
 Mary Vavrus, Communication Studies, AM2  
 Barbara Y. Welke, History, AM2  
 Monika Zagar, German, Scandinavian, and Dutch, AM2  
 Jacquelyn N. Zita, Women's Studies, SM

### Assistant Professor

Catherine Choy, American Studies, AM2  
Jigna Desai, Women's Studies, M2  
Roderick Ferguson, American Studies, AM2  
Kathleen Hull, Sociology, AM2  
Gwendolyn Pough, Women's Studies, M2  
Karen Taussig, Anthropology, AM2  
Eden Torres, Women's Studies, M2

### Other

Karen Brown-Thompson, AM2  
Linnea Stenson, AM2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The M.A. is available only to students admitted to the Ph.D. program who wish to secure this credential for ABD employment purposes or who must exit the program. It is similar to the Ph.D., but with no dissertation.

The Ph.D. program is an interdisciplinary, multicultural, and international study of women and gender in which students develop competence in interdisciplinary and disciplinary feminist theories, research methods, and pedagogy. The program pays attention to all aspects of women's diversity, nationally and globally. Students select a disciplinary focus from among feminist theory, literary studies, historical studies, social sciences and public policy, and gender in a global perspective. Students may, with the advice and consent of the director of graduate studies, design their own area of concentration.

**Prerequisites for Admission**—The graduate minor program is available only to students who have prior admission to a master's or doctoral degree-granting program within the Graduate School.

**Special Application Requirements**—Applicants for the Ph.D. program must submit scores from the General (Aptitude) Test of the GRE, three letters of recommendation sent directly to the department, a writing sample, a current curriculum vitae, and a clearly written statement of career interests, goals, and objectives. Graduate study in the program begins in the fall semester. The application deadline is Friday of the first week in January; all applications are evaluated once each year in January.

Students interested in the graduate minor program must submit a completed application by April 15 to be considered for admission in fall semester. Applications received after April 15 are considered as space allows. It is expected that no more than 12 students will be admitted into the minor each year. Admission to the minor program does not require an undergraduate major or minor in women's studies. However, applicants are expected to show general knowledge of feminist scholarship as evidenced, for example, in some combination of previous coursework, research, writing, or organizational experience.

**Courses**—Please refer to Women's Studies (WoSt) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx feminist studies courses on degree program forms of feminist studies majors or minors for the Ph.D. degree is discouraged; such courses are only considered in exceptional circumstances, subject to adviser and director of graduate studies approval.

### M.A. Plan B Degree Requirements

Students are not admitted to the master's program, it is available only to students admitted to the Ph.D. program who wish to secure this credential for ABD employment purposes or who must exit the program. The courses required for the M.A. are the same as those required for the Ph.D., see below. In addition, three Plan B papers and a final oral exam on these papers are required

**Language Requirements**—None, but a second language strongly encouraged

**Final Exam**—The final exam is oral and is effectively identical to the Ph. D. preliminary written exam.

### Ph.D. Degree Requirement

The course and credit requirements for the Ph.D. fall into roughly two categories: interdisciplinary courses satisfying core requirements, and courses constituting or enhancing a concentration. Students take 31 credits in required courses, including two elective courses that satisfy core requirements in cultural diversity and two courses that satisfy core requirements in research tools and methods. The remaining coursework includes 12 credits in an area of concentration and 12 credits in the minor field or supporting program (related to the concentration). Students are also expected to register for 4 credits of WoSt 8996 colloquium and to participate in a weekly or biweekly series of faculty, student, and guest lecturer presentations. In addition, students are expected to register for 24 thesis credits while writing the dissertation.

Because some courses may fall into more than one category (e.g., courses in the concentration may also satisfy core course requirements), students are permitted to "double count" credits in the major program in consultation with the director of graduate studies. This means that a student can graduate with less than 55 credits when double counting is approved. Students entering the Ph.D. program with a master's degree may transfer credits from that degree and apply them to the Ph.D. requirements in consultation with the director of graduate studies. All students, however, must take WoSt 8108 and 8109.

**Language Requirements**—None, but a second language is strongly encouraged

**Preliminary Exams**—Ph.D. students are expected to take a three-paper preliminary written exam (which includes an oral exam on these papers) and a preliminary oral exam on their dissertation proposal.

**Final Exam**—The final Ph.D. exam on the dissertation is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—The graduate minor focuses on skills and competencies in four areas: interdisciplinary knowledge of women and gender; feminist theories and methods; feminist research in a specific field; feminist practice through teaching or internships. To complete a Ph.D. minor, students must complete WoSt 8108 and 8109 and three graduate-level electives (9 credits), including at least one 5xxx or 8xxx course in women's studies and at most one feminist studies-approved graduate course from a student's home department. Students must apply for admission into the graduate minor program.

## Fisheries

See Conservation Biology.

## Food Science

**Contact Information**—Graduate Program in Food Science, Department of Food Science and Nutrition, University of Minnesota, 1334 Eckles Avenue, St. Paul, MN 55108 (612-624-1290; fax 612-625-5272; [fsgrad@umn.edu](mailto:fsgrad@umn.edu); <<http://fscn.che.umn.edu/fscigrad/>>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Paul B. Addis, SM  
Mrinal Bhattacharya, SM  
Linda J. Brady, SM  
Francis F. Busta (emeritus), ASM  
Agnes S. Csallany, SM  
R. Gary Fulcher, SM  
Theodore P. Labuza, SM  
Larry L. McKay, SM  
Gary A. Reineccius, SM  
Rongsheng R. Ruan, SM  
Joanne L. Slavin, AM2  
David E. Smith, SM  
Sita R. Tatini, SM  
Zata M. Vickers, SM

### Associate Professor

Joellen M. Feirtag, SM  
Craig A. Hassel, AM2  
Daniel J. O'Sullivan, SM  
H. William Schafer, SM

### Assistant Professor

Francisco Diez-Gonzalez, SM  
Leonard F. Marquart, SM  
Lloyd E. Metzger, SM

### Adjunct Assistant Professor

Mary K. Schmidl, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Food science applies scientific principles to the manufacture, distribution, marketing, and consumer aspects of food. Food scientists apply the basic principles and techniques of many disciplines, including chemistry, physics, microbiology, and nutrition, to food

processing and preservation, new product development, and food marketing. Food scientists are concerned with the theoretical and practical aspects of the food chain, from the production of raw materials to the use of food products by consumers. Students may emphasize the chemistry, engineering, microbiology, nutrition, or technology of food products.

**Prerequisites for Admission**—Applicants with an undergraduate major in any physical or biological science usually have completed the necessary prerequisites. The minimum requirements are general chemistry, organic chemistry with laboratory, physics with laboratory, and calculus. If preparation appears inadequate, certain additional courses may be required after admission.

**Special Application Requirements**—Submission of GRE scores is required. Submission of three letters of reference is also required whether or not the prospective student is applying for financial assistance.

**Courses**—Please refer to Food Science and Nutrition (FScN) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx food science courses on degree program forms is permitted with adviser and director of graduate studies approval.

### M.S. Degree Requirements

The M.S. offers both Plan A (with thesis) and Plan B (without thesis) options. Both options require at least 14 course credits in the major and 6 course credits in the minor or related field. Plan A also requires at least 10 thesis credits. Plan B also requires at least an additional 10 graduate credits in approved courses and a Plan B paper. The minor may be chosen from fields such as biochemistry, chemistry, chemical engineering, microbiology, nutrition, and statistics.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—For a master's minor, two of the following courses must be taken: FScN 4111, 4121, or 4331. The minor must be approved by the food science director of graduate studies.

### Ph.D. Degree Requirements

The number of credits required will vary depending on preparation and the research undertaken. Most students take a total of about 60 credits. Of these, at least 12 credits must be in the minor or related fields and 24 credits must be doctoral thesis credits. The student and the adviser, with the approval of the graduate studies committee, determine coursework in the major.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—For a Ph.D. minor, students must take FScN 4111, 4121, 4331, and 3 additional FScN credits, for a total of 12 credits. The minor must be approved by the food science director of graduate studies.

## Forestry

See Natural Resources Science and Management.

## French and Italian

**Contact Information**—A department general information bulletin and a projection of graduate-level courses to be offered is available from the Department of French and Italian, University of Minnesota, 260 Folwell Hall, 9 Pleasant Street S.E., Minneapolis, MN 55455 (612-624-4308; fax 612-624-6021; [frit@umn.edu](mailto:frit@umn.edu); <http://cla.umn.edu/frit/>).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

F. R. P. Akehurst, SM  
Susan Noakes, SM, Italian, M  
Maria Paganini, SM

### Associate Professor

Daniel Brewer, SM  
Mária M. Brewer, SM  
Susanna Ferlito, SM, Italian, M  
Betsy Kerr, SM  
Catherine Liu, Comparative Literature, SM  
Judith Preckshot, SM  
Peter H. Robinson, SM  
Eileen B. Sivert, SM

### Assistant Professor

Bruno Chaouat, M2  
Juliette Cherbuliez, M2  
Alan Smith, M2, Italian, M

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The French program, which offers M.A. and Ph.D. degrees, covers all areas of French literature and culture from the Middle Ages to the present. Traditional areas of study and scholarship are inflected by the faculty's interests, expertise, and research in areas that have shaped—and continue to shape—the discipline of French studies. The program, which fosters interdisciplinary research, has particular strengths in literary and cultural studies, critical theory, feminist studies, medieval studies, and francophone studies.

The Italian M.A. program adopts an interdisciplinary approach to the study of the literatures and cultures of Italy. The curriculum emphasizes the study of cultural identities in Italy through literary and historical discourses. The program has special strengths in Dante and Early Modern studies, and in the Romantic and Modern periods.

**Prerequisites for Admission**—A B.A. in French or Italian (or equivalent), with a literary emphasis, is required for the M.A. programs. Prospective students whose undergraduate degree is in another field, but who have taken substantial coursework in French or Italian and are strongly motivated to pursue literary studies, are invited to

contact the director of graduate studies. For the Ph.D. program, an M.A. in French (or equivalent) is required.

### Special Application Requirements

Applicants must submit scores from the General Test of the GRE, three letters of recommendation from persons familiar with their scholarship and research potential, a complete set of official transcripts, a sample of their academic writing, an audiotape of their spoken French or Italian, and a written statement of career interests and goals. International student applicants should also submit scores for the TOEFL. Students may apply at any time; however, submission of all application materials by January 15 is encouraged to ensure priority consideration for fellowships and teaching and research assistantships awarded for the next academic year. New teaching assistants and fellowship recipients are only admitted for fall semester; others may be admitted in mid-year.

**Affiliated Research Centers**—Students are encouraged to explore interdisciplinary approaches through outside coursework or participation in one of several academic centers with which the programs are affiliated. These centers include the Center for Advanced Feminist Studies, the Center for Advanced Research in Language Acquisition, the Center for German and European Studies, the Center for Medieval Studies, the Immigration History Research Center, and the University of Minnesota Humanities Institute. Students specializing in francophone literatures and cultures may pursue these interests through the African American and African studies program or the interdisciplinary MacArthur Program.

**Courses**—Please refer to French (Fren), French and Italian (Frit), and Italian (Ital) in the course section of this catalog.

**Use of 4xxx Courses**—4xxx courses may, in exceptional cases, be used for graduate credit. Students should consult the director of graduate studies or adviser before registering.

### M.A. Degree Requirements

In French, students may pursue Plan A (with thesis) or Plan B (with two papers). Plan A requires at least 24 credits, Plan B at least 33 credits. Both plans require at least 18 credits in the major and 6 credits in related fields or, in a minor, the number of credits required by the minor program (usually 6 credits). Plan A also requires at least 10 thesis credits. (Detailed information is available through the program office.)

In Italian, the M.A. is offered under Plan A (with thesis) or Plan B (with paper). Plan A requires at least 22 course credits and 10 thesis credits. Plan B requires at least 30 course credits. (Detailed information is available through program office.)

**Final Exam**—The final exams in both French and Italian programs are written and oral.

**Language Requirements**—For the M.A. degree in French, students must demonstrate proficiency in one foreign language besides English and French. For the M.A. in Italian, by the time of their final exam, students must demonstrate proficiency in one ancient or modern language besides Italian and English; French, Spanish, or Latin is recommended.

### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor in French requires at least 9 credits; a minor in Italian requires at least 6 credits.

### Ph.D. Degree Requirements

The Ph.D. requires at least 57 course credits and 24 thesis credits. Coursework involves at least 45 credits in the major and at least 12 credits (usually four courses) in related fields or, in a minor, the number of credits required by the major program (usually 12 credits). Detailed information is available through program office.

**Language Requirements**—For the Ph.D., students must demonstrate proficiency in one foreign language besides English and French, at a level higher than for the M.A. and suitable for use in research. Doctoral students specializing in the Middle Ages, Renaissance, or Early Modern period (roughly to 1666) must also demonstrate knowledge of Latin.

### Minor Requirements for Students

**Majoring in Other Fields**—A Ph.D. minor requires at least 12 credits.

## Genetics

See Molecular, Cellular, Developmental Biology, and Genetics.

## Geographic Information Science

**Contact Information**—Master of Geographic Information Science Program, Department of Geography, University of Minnesota, 414 Social Sciences Building, 267 19th Avenue South, Minneapolis, MN 55455 (612-624-1498, 612-625-6080; fax 612-624-1044; [smcmaster@geog.umn.edu](mailto:smcmaster@geog.umn.edu); <[www.geog.umn.edu/graduate/mgis](http://www.geog.umn.edu/graduate/mgis)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

John S. Adams, M2  
Marvin E. Bauer, Forest Resources, M2  
James Bell, Soil, Water, and Climate, M2  
Dwight A. Brown, M2  
Philip J. Gersmehl, M2  
Robert B. McMaster, M2  
Shashi Shekhar, Computer Science, M2  
Richard H. Skaggs, M2

### Senior Cartographer

Mark Lindberg, M2

### Associate Professor

Paul V. Bolstad, Forest Resources, M2  
Roderick H. Squires, M2

### Assistant Professor

Francis Harvey, M2  
Steven Manson, M2

### Adjunct Associate Professor

William J. Craig, M2

### Associate Program Director

Susanna McMaster, M2

### Teaching Specialist

Robert Maki, AM2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The master of geographic information science (M.G.I.S.), administered by the Department of Geography, provides graduate-level work in the theory, applications, and technology of geographic information science (GIS). Courses for the program are divided into four broad categories. Core courses provide the conceptual and theoretical underpinnings for a comprehensive, well-rounded knowledge of GIS. A set of technology courses focus on specific software and techniques of GIS. M.G.I.S. seminars include an introductory seminar for entering students (GIS 8501) and a capstone seminar (GIS 8990) focused on developing an applied project that serves as a culminating experience for the program. Elective courses provide additional breadth to the program by allowing students to take courses related to their area of interest and capstone project.

**Prerequisites for Admission**—Admission to the program requires a bachelor's degree with a minimum 3.00 GPA. Prospective students also should have completed a college-level mathematics course, statistics course, and computer programming course.

### Special Application Requirements

Applicants must submit an M.G.I.S. program application form, transcripts, a clearly written statement of career interests, goals, and objectives, and three letter of recommendation from persons familiar with their academic and/or employment background. The GRE is not required. All materials must be submitted by March 30 for fall semester entrance and by September 1 for spring semester entrance.

**Courses**—Please refer to Geography (Geog) and Geographic Information Science (GIS) in the course section of this catalog for courses pertaining to the program. Also refer to Forest Resources (FR) and Natural Resources and Environmental Studies (NRES) in the course section of this catalog for additional GIS and remote sensing courses.

**Use of 4xxx Courses**—No more than two 4xxx courses may be included in the program without consent of the adviser and director of graduate studies.

### M.G.I.S. Plan B Degree Requirements

The degree is offered Plan B (without thesis) and requires at least 35 credits, with 18 credits in core/technology classes (a minimum of 9 credits of core courses and 3 credits of technology courses), 6 credits of electives, and 3 credits of capstone seminar

(GIS 8990). All students are required to take Geog 5561, 5563, GIS 5571 and an approved 8xxx geography seminar. Students must also take GIS 8501 during the fall semester of their first year in the program. At least 6 credits must be taken outside the geography department (Geog and GIS designators) but may include the core GIS classes (e.g., forestry and natural resources). Finally, students must complete a final oral examination with three faculty members.

**Language Requirements**—None

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor is developed in consultation with a faculty adviser. Consult the M.G.I.S. director of graduate studies about selecting an adviser. The minor requires at least 9 credits (3 courses).

## Geography

**Contact Information**—Department of Geography, University of Minnesota, 414 Social Sciences Building, 267 19th Avenue South, Minneapolis, MN 55455 (612-625-6080; fax 612-624-1044; [willi046@umn.edu](mailto:willi046@umn.edu); <[www.geog.umn.edu](http://www.geog.umn.edu)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

John S. Adams, SM  
Dwight A. Brown, SM  
Philip J. Gersmehl, SM  
John Fraser Hart, SM  
Helga Leitner, SM  
Judith A. Martin, SM  
Robert B. McMaster, SM  
Abdi I. Samatar, SM  
Earl P. Scott, SM  
Eric S. Sheppard, SM  
Richard H. Skaggs, SM

### Adjunct Professor

Lawrence M. Knopp, Jr., Geography, Duluth, AM2  
Ann R. Markusen, Public Affairs, AM2

### Associate Professor

Bruce W. Braun, M2  
George L. Henderson, M2  
Katherine Klink, SM  
Roger P. Miller, SM  
Roderick H. Squires, SM  
Connie H. Weil, SM

### Adjunct Associate Professor

Susan L. Craddock, Women's Studies, AM2  
William J. Craig, Center for Urban and Regional Affairs, AM2  
Mark B. Lindberg, Director, University of Minnesota Cartography Lab, M2  
Richa Nagar, Women's Studies, AM2

### Assistant Professor

Vinay K. Gidwani, M2  
Francis J. Harvey, M2  
Steven M. Manson, M2  
Karen E. Till, M2  
Susy S. Ziegler, M2

### Other

Pat Farrell, Geography, Duluth, AM  
Scott Freundshuh, Geography, Duluth, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The discipline of geography is rooted in concepts of place, location, and scale. Geographers draw on theories and methods from diverse fields of inquiry to form synergistic overlaps among four primary areas of geographic inquiry: human geography, physical geography, nature-society relationships, and spatial analysis and mapping.

Human geography seeks to understand the creation and changing nature of places and regions, and how peoples and places are interconnected through social, economic, political, and cultural processes. Physical geography focuses on the earth's interrelated physical environmental systems (climate, vegetation, landforms, water, and soil), and the interactions between the physical environment and social, economic, and political systems. Nature-society geography examines how the human and biophysical worlds interact and affect one another in and across different societies, and how environments shape and are shaped by human and non-human processes. Geographic inquiry also addresses cartographic representation, such as new methods in geographic visualization, and undertakes fundamental and applied research into all aspects of geographic information science, including the societal dimensions of geographic technologies.

The program emphasizes research and teaching in political economy, international development, and globalization; urban geography; physical environmental systems; nature-society relationships; cultural and political landscapes; the geography of population and health; geographic information science and cartography; geographic education; and the history and philosophy of geography. The program is highly individualized with a limited number of requirements. Students work with their advisers to design individual programs suited to their educational and professional goals.

**Prerequisites for Admission**—Prospective students should have completed the equivalent of introductory courses in physical and human geography and at least seven upper division courses in systematic and regional geography. Students who were not undergraduate geography majors are encouraged to apply but may be required to make up deficiencies.

**Special Application Requirements**—Three letters of recommendation must be sent to the department. Scores from the General (Aptitude) Test of the GRE that are less than five years old are required of students with baccalaureate degrees from U.S. institutions. Graduate study in the program begins in the fall semester. The application deadline is January 1. All applications are evaluated once each year in early February.

**Courses**—Please refer to Geography (Geog) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—No more than two 4xxx courses may be included on the degree program form without consent of the adviser and director of graduate studies.

### M.A. Degree Requirements

The M.A. is offered under Plan A (with thesis) and Plan B (without thesis). Plan A requires at least 21 course credits (plus 10 thesis credits); Plan B requires at least 31 course credits and three Plan B papers. Each student is required to take Geog 8001 and 8002, plus two additional Geog 81xx and/or Geog 82xx courses. Geog 8970 and 8980 may be used for Geog 81xx or 82xx coursework with permission of the adviser. The M.A. program usually is completed within two years.

**Language Requirements**—M.A. students are expected to acquire competency in the foreign language/research methodology necessary for their graduate research. This requirement is set by the advising committee, which is also responsible for certifying that the requirement has been met before the final exam.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor must be developed in consultation with a faculty adviser. Consult the director of graduate studies about selecting an adviser. The minor requires at least 6 credits (two courses).

### Ph.D. Degree Requirements

Each student is required to take Geog 8001 and 8002, two additional Geog 81xx and/or 82xx courses, and a third Geog 82xx course. Geog 8970 and 8980 may be used for Geog 81xx or 82xx coursework with permission of the adviser. Students are also required to take 24 thesis credits and at least three elective courses. Course credits from the M.A. program may be transferred to the Ph.D. program. Further details on degree requirements may be found in the department publication *The Graduate Program in Geography at the University of Minnesota*.

**Language Requirements**—Ph.D. students are expected to acquire competency in the foreign language/research methodology necessary for their graduate research. This requirement is set by the advising committee, which is also responsible for certifying that the requirement has been met before the final exam.

### Minor Requirements for Students

**Majoring in Other Fields**—A doctoral minor program must be developed in consultation with an appropriate faculty adviser. Consult the director of graduate studies about selecting an adviser. The minor requires at least 9 credits (three courses).

## Geological Engineering

**Contact Information**—Geological Engineering Program, University of Minnesota, Civil Engineering Building, 500 Pillsbury Drive S.E., Minneapolis, MN 55455 (612-625-5522; fax 612-626-7750; [gradsec@ce.umn.edu](mailto:gradsec@ce.umn.edu); <[www.ce.umn.edu](http://www.ce.umn.edu)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Steven L. Crouch, SM  
Peter A. Cundall, Civil Engineering, ASM  
Emmanuel M. Detournay, SM  
Andrew Drescher, SM  
Efi Fofoulou-Georgiou, SM  
Catherine E. French, SM  
Joseph F. Labuz, SM  
Gary Parker, SM  
Henryk K. Stolarski, SM  
Otto D. L. Strack, SM  
Vaughan R. Voller, SM

### Associate Professor

Randal J. Barnes, SM  
Gary A. Davis, M2  
Bojan B. Guzina, SM  
Jerome F. Hajjar, SM  
Miki Hondzo, M2  
Carol K. Shield, SM  
Karl A. Smith, SM

### Assistant Professor

William A. Arnold, M2  
Timothy M. LaPara, SM  
Mihai O. Marasteanu, SM  
Fernando Porté-Agel, M2

### Senior Research Associate

Sofia G. Mogilevskaya, AM2  
Eugene L. Skok, Jr., AM2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Emphases are in fundamental aspects of geomechanics and its applications. Research focuses on the use and development of discrete and continuum theories such as elasticity, plasticity, fracture mechanics, and poroelasticity for solving engineering problems. Numerical methods are being developed for obtaining solutions; experimental methods and novel apparatus are being developed for gathering physical evidence. Applications include processes of comminution, flow of granular materials, hydraulic fracturing, and nondestructive testing. The graduate program in geological engineering is administered in the Department of Civil Engineering.

**Prerequisites for Admission**—A bachelor's degree in engineering, basic science, or mathematics is required. Admission depends primarily on the applicant's academic record and letters of recommendation. Applicants who lack geological engineering training are often required to complete at least one appropriate course from the undergraduate program. Graduate degree credit is not awarded for such preparatory work. For the M.Geol.E. program, an ABET-accredited bachelor's degree in geological engineering is preferred.

**Special Application Requirements—**

Applicants are required to submit results of the GRE in support of their applications. The TOEFL is required of foreign applicants from non-English-speaking countries. A TOEFL score of at least 550 on the paper-based test or 213 on the computer-based test is required for admission. Admission requirements also include three letters of recommendation and a statement of purpose that outlines the prospective student's research interests, reasons for pursuing graduate studies, and career plans after graduation. Students are admitted each semester, but applicants are encouraged to begin fall semester and to submit their applications by December 31 before the year their studies are expected to begin.

**Courses—**Please refer to Geological Engineering (GeoE) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses—**Inclusion of 4xxx departmental courses on degree program forms is subject to adviser and director of graduate studies approval. Students from other majors may include such courses subject to their own program's approval.

**M.Geol.E. Design Project Degree Requirements**

The master of geological engineering (M.Geol.E.) degree is for the practicing engineer who would like to obtain an advanced degree, enrolling part-time or full-time. Students who intend to proceed to the Ph.D. program or think they may later wish to be admitted to the Ph.D. program should apply for the master of science program. Students are expected to follow a coherent program of coursework selected with the help of a faculty adviser and approved by the director of graduate studies. Students also must demonstrate professional competence by carrying out and defending a design project. The degree typically takes 12 to 18 months, full-time, to complete.

The M.Geol.E. requires at least 30 credits and is offered under two plans. One requires at least 20 course credits and preparation of a design project (10 credits); the design project must be carried out by the student in consultation with a faculty adviser. The other plan is a coursework-only degree program and requires at least 30 course credits. At least 6 of the course credits must be taken outside the department for either plan.

**Language Requirements—**None.

**Final Exam—**A final oral exam is required of all M.Geol.E. students.

**Minor Requirements for Students**

**Majoring in Other Fields—**For a master's minor, two or more 5xxx to 8xxx courses from the same area of geological engineering are required, for a total of 6 or more credits.

**M.S. Degree Requirements**

The master of science (M.S.) degree balances education in engineering fundamentals and design with research and development. The M.S. degree is for students wishing to pursue a career in industry or to continue toward a Ph.D. degree. Students follow a program selected with the help of a faculty adviser and approved by the director of graduate studies. A program typically takes 18 to 24 months to complete.

The M.S. requires at least 30 credits and is offered under two plans. Plan A emphasizes research and preparation of a thesis; Plan B emphasizes coursework. The thesis is written on a research project carried out in consultation with a faculty adviser. Under Plan B, students complete one to three Plan B papers as determined by the faculty adviser. Plan B papers can include computer programs, annotated bibliographies, field investigations, and analysis/design of special engineering problems. Plan A requires at least 20 course credits and 10 thesis credits. Plan B requires at least 30 course credits. At least 6 credits of coursework must be from outside the department for either Plan A or Plan B.

**Language Requirements—**None.

**Final Exam—**The final exam is oral.

**Minor Requirements for Students**

**Majoring in Other Fields—**For a master's minor, two or more 5xxx to 8xxx courses from geological engineering are required, for a total of 6 or more credits.

**Ph.D. Degree Requirements**

The Ph.D. degree couples independent research with coursework in a comprehensive program. Research performance, as judged by preparation of a dissertation on an independently pursued research topic, is the primary requirement for the Ph.D. degree. Students usually enter the program after completing the M.S. degree. The program is typically completed in 5 to 6 years following the bachelor's degree.

Each program of study is designed in consultation with a faculty adviser and must be approved by the director of graduate studies. A typical program consists of 45 credits of coursework and 24 thesis credits. A supporting program or minor of at least 12 credits outside the department must be included. Credits earned in a M.S. program may be presented in partial fulfillment of the Ph.D. requirements.

**Language Requirements—**None.

**Minor Requirements for Students**

**Majoring in Other Fields—**For a Ph.D. minor, four or more 5xxx to 8xxx courses are required, for a total of at least 12 credits.

**Geology**

**Contact Information—**Department of Geology and Geophysics, University of Minnesota, 310 Pillsbury Drive S.E., Minneapolis, MN 55455 (612-624-1333; fax 612-625-3819; [geology@umn.edu](mailto:geology@umn.edu); <[www.geo.umn.edu](http://www.geo.umn.edu)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

**Regents Professor**

Herbert E. Wright, Jr. (emeritus), ASM

**Professor**

E. Calvin Alexander, Jr., SM  
Subir K. Banerjee, M2  
R. Lawrence Edwards, SM  
Peter J. Hudleston, SM  
Emi Ito, SM  
Thomas C. Johnson, Geological Sciences, Duluth, ASM  
Ronald L. Morton, Geological Sciences, Duluth, ASM  
V. Rama Murthy, SM  
Christopher Paola, SM  
Hans-Olaf Pfannkuch, SM  
William E. Seyfried, SM  
Robert E. Sloan (emeritus), ASM  
James H. Stout, SM  
Christian P. Teyssier, SM  
Paul W. Weiblen (emeritus), ASM

**Adjunct Professor**

James Almendinger, AM  
Michael E. Berndt, AM  
Val W. Chandler, AM2  
Mark Edlund, AM  
Daniel R. Engstrom, AM2  
Carrie Jennings, AM  
Robert G. Johnson, AM  
Peter L. McSwiggen, AM  
James D. Miller, AM  
Anthony C. Runkel, AM  
Wayne C. Shanks III, AM

**Associate Professor**

Erik Brown, ASM  
Marc Hirschmann, SM  
Karen L. Kleinspehn, SM  
Howard D. Mooers, Geological Sciences, Duluth, ASM  
Nigel J. Wattrus, Geological Sciences, Duluth, ASM  
Donna L. Whitney, SM

**Assistant Professor**

David Fox, SM  
Christina Gallup, Duluth, ASM  
Lee Penn, AM2  
John Swenson, ASM

**Senior Research Associate**

Kang Ding, AM  
Paul H. Glaser, AM  
Linda C. K. Shane, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum—**The geology major includes the areas of Quaternary studies, structural geology, stratigraphy, paleontology, mineralogy, metamorphic geology, experimental and theoretical petrology, isotopic and aqueous geochemistry, experimental geochemistry, geomorphology, groundwater geology, hydrogeology, limnology, climate change, and sedimentology. Students may accommodate other areas of interest such as earth resources, engineering geology,

environmental geology, materials science, soil science, and paleoecology by choosing a minor or supporting field from outside the department.

**Prerequisites for Admission**—Most candidates for advanced degrees have completed a bachelor's degree in geology, geophysics or in the broad field of earth and material sciences. However, applications from students in fields such as chemistry, physics, or biology are encouraged. At least one year of study in calculus, chemistry, and physics; and a full-time geological field course of at least five weeks' duration are required. In general, an outstanding academic record is expected.

**Special Application Requirements**—The student's statement of purpose, three letters of recommendation, and official GRE scores are required for admission and financial aid consideration. Applications for admission are considered at any time, although applications for financial aid should be submitted to the department by January 15 to ensure consideration. Studies may begin in any semester or summer session, although fall semester is preferable.

**Courses**—Please refer to Geology and Geophysics (Geo) in the course section of this catalog for courses pertaining to the program. All courses must all be taken at 4xxx and 5xxx, with several formal courses to be included at 8xxx.

**Use of 4xxx Courses**—For both the M.S. and Ph.D., typically no more than 30 percent of the total course credits are 4xxx.

### M.S. Plan A, Plan B, and Plan C Degree Requirements

The M.S. is offered Plan A (with thesis), Plan B (with project), and Plan C (coursework only with emphasis in hydrogeology and environmental geoscience). Plan A requires a minimum of 30 course credits consisting of at least 14 course credits in the major, 6 course credits in the related field, and 10 thesis credits. Plan B requires of minimum of 30 course credits consisting of at least 14 credits in the major and 8 credits in the related field. Plan C is the coursework-only option which requires a minimum of 30 course credits consisting of at least 14 credits in the major and 9 credits in the related field or a minor. Courses in the minor and related field are normally taken from outside the department, although they may be taken from within in special cases.

**Language Requirements**—None.

**Final Exam**—Plan A and Plan B students must pass the final oral examination.

#### Minor Requirements for Students

**Majoring in Other Fields**—The master's minor is established individually with approval by the graduate studies committee. Typically no more than 50 percent of the total course credits are 4xxx.

### Ph.D. Degree Requirements

The Ph.D. requires a minimum of 36 course credits consisting of at least 24 course credits in the major and 12 course credits in a supporting program. In addition, a minimum of 24 thesis credits is required. Courses in the minor and supporting program are normally taken from outside the department, although they may be taken from within in special cases.

**Language Requirements**—None.

**Final Exam**—Ph.D. students must pass the final oral examinations in defense of their thesis.

#### Minor Requirements for Students

**Majoring in Other Fields**—The Ph.D. minor is established individually with approval by the graduate studies committee. Typically, no more than 50 percent of the total course credits are 4xxx.

## Geophysics

**Contact Information**—Department of Geology and Geophysics, University of Minnesota, 310 Pillsbury Drive S.E., Minneapolis, MN 55455 (612-624-1333; fax 612-625-3819; [geology@umn.edu](mailto:geology@umn.edu); [www.geo.umn.edu](http://www.geo.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

#### Professor

Subir K. Banerjee, SM  
David L. Kohlstedt, SM  
Bruce M. Moskowitz, SM  
V. Rama Murthy, SM  
Chris Paola, M2  
James H. Stout, SM  
Christian P. Teyssier, M2  
David A. Yuen, SM

#### Associate Professor

Marc Hirschmann, M2  
Karen L. Kleinspehn, M2  
Renata M. Wentzcovitch, Chemical Engineering and Materials Science, AM2

#### Adjunct Professor

Val W. Chandler, AM2  
Michael J. Jackson, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The geophysics major includes the areas of applied and theoretical geophysics, paleomagnetism and rock magnetism, and mineral and rock physics. Students may accommodate other areas of interest such as earth resources, engineering geology, environmental geology, materials science, soil science, and paleoecology by choosing a minor or supporting field from outside the department.

**Prerequisites for Admission**—Most candidates for advanced degrees have completed a bachelor's degree in geology, geophysics, or earth and material sciences. However, applications from students in fields such as chemistry, physics, or biology are encouraged. At least one year of calculus,

chemistry, and physics and a full-time geological field course of at least five weeks' duration are required. In general, an outstanding academic record is expected.

**Special Application Requirements**—The student's statement of purpose, three letters of recommendation, and official GRE scores are required for admission and financial aid consideration. Applications for admission are considered at any time, although applications for financial aid should be submitted to the department by January 15 to ensure consideration. Studies may begin in any semester or summer session, although fall semester is preferable.

**Courses**—Please refer to Geology and Geophysics (Geo) in the course section of this catalog for courses pertaining to the program. All courses must all be taken at 4xxx and 5xxx, with several formal courses to be included at 8xxx.

**Use of 4xxx Courses**—For both the M.S. and Ph.D., typically no more than 30 percent of the total course credits are 4xxx.

### M.S. Degree Requirements

The M.S. is offered Plan A (with thesis) and Plan B (with project). Plan A requires a minimum of 30 course credits consisting of at least 14 course credits in the major, 6 course credits in the related field, and 10 thesis credits. Plan B requires a minimum of 30 course credits consisting of at least 14 credits in the major and 8 credits in the related field. Plan C is the coursework-only option which requires a minimum of 30 course credits consisting of at least 14 credits in the major and 9 credits in the related field or a minor. Courses in the minor and related field are normally taken from outside the department, although they may be taken from within in special cases.

**Language Requirements**—None.

**Final Exam**—Plan A and Plan B students must pass a final oral exam.

#### Minor Requirements for Students

**Majoring in Other Fields**—The master's minor is established individually with approval by the graduate studies committee. Typically no more than 50 percent of the total course credits are 4xxx.

### Ph.D. Degree Requirements

The Ph.D. requires a minimum of 36 course credits consisting of at least 24 course credits in the major, 12 course credits in a supporting program. In addition, a minimum of 24 thesis credits is required. Courses in the minor and supporting program are normally taken from outside the department, although they may be taken from within in special cases.

**Language Requirements**—None.

**Final Exam**—Ph.D. students must pass the final oral examination in defense of their thesis.

**Minor Requirements for Students Majoring in Other Fields**—The Ph.D. minor is established individually with approval by the graduate studies committee. Typically, no more than 50 percent of the total course credits are 4xxx.

## Germanic Studies

**Contact Information**—Department of German, Scandinavian, and Dutch, University of Minnesota, 205 Folwell Hall, 9 Pleasant St. SE, Minneapolis, MN 55455 (612-625-2080; fax 612-624-8297; [gdsd@umn.edu](mailto:gdsd@umn.edu); <[www.folwell.umn.edu/gsd/](http://www.folwell.umn.edu/gsd/)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Evelyn S. Firchow, German, Germanic Medieval, SM  
Poul Houe, Scandinavian, SM  
Ruth-Ellen B. Joeres, German, SM  
Ruth M. Karras, History, Scandinavian, AM  
Calvin B. Kendall, English, ASM  
Anatoly Liberman, German, Germanic Medieval, Scandinavian, SM  
Richard W. McCormick, German, SM  
James A. Parente, Jr., German, Scandinavian, Germanic Medieval, SM  
Jochen Schulte-Sasse, German, SM  
Goran K. N. Stockenstrom, Scandinavian, SM  
Arlene A. Teraoka, German, SM  
Jack D. Zipes, German, SM

### Associate Professor

Leonard L. Duroche, Sr., German, SM  
G. Lee Fullerton, German, M2  
Kaaren E. Grimstad, Scandinavian, Germanic Medieval, SM  
Charlotte A. Melin, German, SM  
Leslie Morris, German, SM  
Ray M. Wakefield, German, Germanic Medieval, SM  
Monika Zagar, Scandinavian, SM

### Assistant Professor

Eric Baker, German, M2  
Patrizia C. McBride, German, M2

Along with the program- and track-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—There are five tracks within the Germanic studies graduate program: German (M.A. and Ph.D.), Scandinavian Studies (M.A.), Teaching (M.A.), Germanic Medieval Studies (M.A., and Ph.D.), and German and Scandinavian Studies (Ph.D.).

**Prerequisites for Admission**—For major work, a B.A. or equivalent concentration in German, Scandinavian, or related field (depending on the track to which one applies) is required. Applicants to the Scandinavian studies M.A. must have a strong competency in a Scandinavian language, and they should have taken at least four Scandinavian literature courses or the equivalent. Applicants to the German and Scandinavian Studies Ph.D. should have either near-native fluency in German plus an advanced level of proficiency in a Scandinavian language or near-native fluency in a Scandinavian language plus an advanced level of proficiency in German. Candidates whose

preparatory work evidences gaps may be asked to complete supplemental work before admission.

**Special Application Requirements**—The following must be forwarded to the department: three letters of recommendation; a complete set of transcripts (in addition to transcripts sent to the Graduate School); a copy of one or more papers representative of the applicant's level of scholarly development; and a statement of professional goals describing the applicant's intellectual development and plans for the future. For master's program applicants, and for all students who wish to be considered for fellowships, the General (Aptitude) Test of the GRE is required; the GRE is optional for those applicants whose native language is not English and who are required to take the TOEFL. For the doctoral program, applicants must have a master's degree from an accredited institution or present other evidence of adequate background and competence. Prospective students should contact the department for further information. Students are admitted in the fall semester only. All application materials must be received by January 10.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to the approval of the director of graduate studies.

### Minor Requirements for Students

**Majoring in Other Fields**—M.A. minors are required to take the basic seminar in either German (Ger 8002) or Scandinavian (Scan 8002) and two other courses, for at least 9 credits. Ph.D. minors who have not completed one of the basic seminars at the M.A. level must fulfill this requirement at the Ph.D. level. In addition, Ph.D. minors must complete at least three other courses for a total of at least 12 credits (usually four courses).

## German Track

### M.A. Plan B Degree Requirements

The M.A. offers students the opportunity to do advanced work in German studies and prepares them with the theoretical and practical tools to enter a Ph.D. program. The M.A. requires at least 35 credits, including an introductory course in contemporary literary and cultural theory (CLit 8001) and an introductory course in German studies (Ger 8002), four courses in different periods of German literature, a philology course, an elective in German literature/culture, a pedagogy course, two courses outside the German track, and one Plan B paper. The M.A. examination is oral.

**Courses**—Please refer to German (Ger); German, Scandinavian, and Dutch (GSD); Dutch (Dtch); and Comparative Literature (CLit) in the course section of this catalog for courses pertaining to this track.

**Language Requirements**—Oral and written proficiency in German. Students who intend to continue in the Ph.D. program are encouraged to acquire a reading proficiency in one other foreign language during their M.A. program (refer to requirements for the Ph.D.).

### Ph.D. Degree Requirements

The Ph.D. offers students the opportunity to do advanced work in German studies and prepares them with theoretical and practical tools to serve as researchers, scholars, and teachers.

The Ph.D. requires at least 39 credits, including six courses in German literature/culture, a course in Germanic philology, a pedagogy course (if it has not been taken for the M.A.), the dissertation seminars (one before and one after the Ph.D. preliminary exams), and four courses outside the German track. At least 24 thesis credits are required.

**Courses**—Please refer to German (Ger); German, Scandinavian, and Dutch (GSD); and Dutch (Dtch) in the course section of this catalog for courses pertaining to this track.

**Language Requirements**—The program requires reading competence in at least two languages or a high degree of proficiency in one language other than German or English.

## Scandinavian Studies Track

### M.A. Plan B Degree Requirements

The M.A. offers students the opportunity to do advanced work and prepares them with the theoretical and practical tools to enter the Ph.D. track in German and Scandinavian at the University of Minnesota, to enter a Ph.D. program in Scandinavian at another university, or to embark on a career that requires specialized knowledge of Scandinavia. Students enrolled in the M.A. in the Scandinavian track emphasize one of the three Scandinavian languages and literatures while acquiring a general knowledge of the other two. The M.A. in the Scandinavian track may also include Finnish.

The M.A. requires at least 35 credits, including an introductory course in contemporary literary and cultural theory (CLit 8001), and a course introducing students to graduate studies in Scandinavian (Scan 8002), five courses in different periods of Scandinavian literature/culture, a course in Old Norse or Scandinavian linguistics, a pedagogy course, two courses outside the Scandinavian track and one Plan B paper. The M.A. examination is written and oral.

**Courses**—Please refer to German (Ger); German, Scandinavian, and Dutch (GSD); Scandinavian (Scan); and Comparative Literature (CLit) in the course section of this catalog for courses pertaining to this track.

**Language Requirements**—The track requires advanced competency in at least one Scandinavian language or Finnish, and reading knowledge of two other Scandinavian languages.

## Teaching Track

### M.A. Plan B Degree Requirements

The M.A. in teaching combines a disciplinary focus in Germanic studies with a concentration in foreign language teaching and second language acquisition. The track does not lead to teacher licensure. Students interested in teacher licensure should contact the College of Education and Human Development.

The M.A. requires at least 34 credits, including a pedagogy course; three courses on the history and structure of the German language; Introduction to Second Language Acquisition (Ling 5505); Issues in Second Language Curriculum Design (CI 5662); two or more courses in language teaching, curriculum and instruction or teaching English as a second language or linguistics; two German literature and culture courses; one elective and one Plan B paper. The M.A. examination is oral.

**Courses**—Please refer to German (Ger); Linguistics (Ling); Curriculum and Instruction (CI); Language, Teaching, and Technology (LgTT); and Teaching English as a Second Language (TESL) in the course section of this catalog for courses pertaining to this track.

**Language Requirement**—Oral and written proficiency in German.

### Germanic Medieval Studies Track

#### M.A. Plan B Degree Requirements

The M.A. offers students the opportunity to do advanced work and prepares them with theoretical and practical tools to enter the Ph.D. track.

The M.A. requires at least 35 credits, including an introductory course on contemporary literary and cultural theory (CLit 8001) and a course introducing students to graduate studies in either German or Scandinavian (Ger 8002 or Scan 8002); four courses in each of two medieval foundation languages, literatures, and cultures chosen from Middle High German, Old Norse, and Old and Middle English; two courses in Germanic medieval studies; a pedagogy course; at least two courses in related fields or a designated minor and one Plan B paper. The M.A. examination is both written and oral.

**Courses**—Please refer to English (EngL, EngC); Dutch (Dtch); German (Ger); German, Scandinavian, and Dutch (GSD); Scandinavian (Scan); and Comparative Literature (CLit) in the course section of this catalog for courses pertaining to this track.

**Language Requirement**—Oral and written proficiency in German. Students who intend to continue in the Ph.D. program are encouraged to acquire a reading proficiency in Dutch or a modern Scandinavian language.

### Ph.D. Degree Requirements

The Ph.D. offers students the opportunity to do advanced work in Germanic medieval studies and prepares them with theoretical and practical tools to serve as researchers, scholars, and teachers. The Ph.D. requires at least 39 credits, including four courses in Germanic Medieval Studies, two courses in a third medieval Germanic language (supplementing the two languages for the M.A.), a pedagogy course (if it has not been taken for the M.A.), the dissertation seminars (one before and one after the Ph.D. preliminary exams), and four courses in a designated minor or supporting field. 24 thesis credits are also required.

**Courses**—Please refer to English (EngL, EngC); Dutch (Dtch); German (Ger); German, Scandinavian, and Dutch (GSD); and Scandinavian (Scan) in the course section of this catalog for courses pertaining to this track.

**Language Requirement**—Reading competence in Medieval Latin and one modern Germanic language other than German or English (e.g., Dutch or one of the Scandinavian languages).

### German and Scandinavian Studies Track

#### Ph.D. Degree Requirements

The Ph.D. offers the student the opportunity to do advanced work in German and Scandinavian studies and prepares students with theoretical and practical tools to serve as researchers, scholars, and teachers in either German or Scandinavian studies, with a basic foundation in the other field as well.

The Ph.D. requires at least 39 credits. The German emphasis requires at least four courses from the German list and one course from each of the three Scandinavian groups. The Scandinavian emphasis requires at least one course from each of the three Scandinavian groups plus an additional course from any of them and three courses from the German list. Students in both emphases are required to take a pedagogy course (if it has not been taken for the M.A.), the dissertation seminars (one before and one after the Ph.D. preliminary exams), and 4 courses in a designated minor or supporting program. 24 thesis credits are required.

**Courses**—Please refer to Dutch (Dtch); German (Ger); German, Scandinavian, and Dutch (GSD); and Scandinavian (Scan) in the course section of this catalog for courses pertaining to this track.

**Language Requirements**—Reading competence in one language other than German, English, or a Scandinavian language.

## Gerontology

### Minor Only

**Contact Information**—Graduate Minor Program in Gerontology, Center on Aging, University of Minnesota, MMC 197, 420 Delaware Street S.E., Minneapolis, MN 55455 (612-624-3904; fax 612-624-8448; [coa@umn.edu](mailto:coa@umn.edu); <[www.hsr.umn.edu/coa/](http://www.hsr.umn.edu/coa/)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Dennis A. Ahlburg, Industrial Relations, M  
David O. Born, Preventative Services, M  
Pauline G. Boss, Family Social Science, M  
James C. Cloyd, Pharmacy Practice, M  
Jim Curtsinger, Ecology, Evolution, and Behavior, M  
Daniel F. Detzner, Family Social Science, M  
Richard P. DiFabio, Physical Medicine and Rehabilitation, M  
William Durfee, Mechanical Engineering, M  
Maurice W. Dysken, Psychiatry, M  
Nancy N. Eustis, Public Affairs, M  
Judith M. Garrard, Public Health, M  
Cynthia R. Gross, Pharmacy Practice, M  
David R. Guay, Pharmacy Practice, M  
Joseph T. Hanlon, Pharmacy, M  
Lois J. Heller, Medicine, Duluth, M  
Robert L. Kane, Public Health, M  
Rosalie A. Kane, Public Health, M  
Helen Q. Kivnick, Social Work, M  
Thomas E. Lackner, Pharmacy, M  
Alice Larson, Veterinary Pathobiology, M  
Tom A. Larson, Pharmacy Practice, M  
Chap Le, Biostatistics, M  
Matthew K. McGue, Psychology, M  
Susan S. Meyers, Social Work, M  
Steven H. Miles, M  
Jeylan T. Mortimer, Sociology, M  
Frank M. Lassman, Otolaryngology, AM  
Jean K. Quam, Social Work, M  
Stephen Schondelmeyer, Pharmacy Practice, M  
Virginia Seybold, Cell Biology and Neuroanatomy, M  
Mariah Snyder, Nursing, AM  
Marc Swionkowski, Orthopedic Surgery, M  
David Thomas, Biochemistry, M  
Michael Wade, Kinesiology, M  
Jonathan D. Wirtschafter, Ophthalmology, M  
Jean Wyman, Nursing, M  
Shirley L. Zimmerman (emeritus), AM

### Associate Professor

Donna Z. Bliss, Nursing, M  
Karen S. Feldt, Nursing, M  
James Gambucci, Preventative Sciences, M  
Leslie A. Grant, Carlson School of Management, M  
Kenneth W. Hepburn, Family Practice and Community Health, M  
Merrie J. Kaas, Nursing, M  
Kathleen Krichbaum, Nursing, M  
Christine A. Mueller, E, Nursing, M  
James T. Pacala, Family Practice and Community Health, M  
Rosemarie J. Park, Work, Community, and Family Education, M  
James R. Reinardy, Social Work, M  
Jon Schommer, Pharmaceutical Care and Health Systems, M  
Robert C. Serfass, Kinesiology, M  
Stephen K. Shuman, Preventive Sciences, M  
Marlene S. Stum, Family Social Science, M  
Carla E. S. Tabourne, Kinesiology, M  
LaDora V. Thompson, Physical Medicine and Rehabilitation, M

### Assistant Professor

Lynn Blewett, Public Health, M  
Debra Ferrington, Ophthalmology, M  
Priscilla A. Gibson, Social Work, M  
Jeremy L. Holtzman, Medicine, M  
Elizabeth Lightfoot, Social Work, M  
Dawn Annette Lowe, Biochemistry, M

Terry Lum, Social Work, M  
Teresa C. McCarthy, Family Practice and Community Health, M

**Clinical Assistant Professor**

Patrick W. Irvine, Medicine, M

**Lecturer**

Wayne Caron, Family Social Science, M  
Celia W. Gershenson, Psychology, M

**Research Associate**

Lois Cutler, Public Health, M

**Other**

Ursula Bea Krinke, Health, M

**Curriculum**—The gerontology minor is available to master’s (M.A. and M.S.) and doctoral students. The minor provides a multidisciplinary foundation in gerontology for master’s minors and a more intensive preparation in aging for Ph.D. minors. Students who have minored in gerontology have majored in many departments, including but not limited to: curriculum and instruction (adult education); communication disorders; dentistry; design, housing, and apparel; family practice and community health; family social science; journalism and mass communication; kinesiology; nursing; psychology; social work; and sociology. The program of courses is tailored in advance consultation between the student and the director of graduate studies of the gerontology minor.

**Prerequisites for Admission**—Students must have gained admission to a master’s or doctoral degree-granting program within the Graduate School, and have prepared a minor program of coursework approved by the director of graduate studies in gerontology.

**Courses**—Courses are ordinarily taken from a designated course list provided by the Center on Aging and annually updated by the minor program. Students are welcome to identify and propose to the director of graduate studies additional courses on aging that might fulfill the minor requirements.

**Use of 4xxx Courses**—4xxx courses may not be included on degree program forms.

**Minor Only Requirements**

The master’s and doctoral minors are developed in consultation with, and should be approved in advance by, the director of graduate studies for gerontology. The master’s minor requires at least 8 credits, including Gero 5105—Multidisciplinary Perspectives on Aging (3 cr), or an alternative course approved by the director of graduate studies.

The doctoral minor requires at least 12 credits, ordinarily including Nurs 8320—Multidisciplinary Seminar on Social Perspectives of Aging (3 cr). Other courses may be substituted upon the recommendation of the director of graduate studies.

**Greek**

See Classical and Near Eastern Studies.

**Health Informatics**

**Contact Information**—Director of Graduate Studies in Health Informatics, Division of Health Informatics, University of Minnesota, MMC 511, 420 Delaware Street S.E., Minneapolis, MN 55455 (mailing address) (612-625-8440; fax 612-625-7166; [mhi@umn.edu](mailto:mhi@umn.edu), <[www.hinf.umn.edu/MHI/mhi.htm](http://www.hinf.umn.edu/MHI/mhi.htm)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

**Professor**

Christopher G. Chute, M2  
Donald P. Connelly, SM  
Shawn Curley, Information and Decision Sciences, SM  
Lynda B. Ellis, SM  
David P. Fan, Genetics and Cell Biology, SM  
Stanley M. Finkelstein, SM  
John R. Finnegan, Jr., Epidemiology, SM  
James R. Friction, Diagnostic/Surgical Sciences, SM  
Laël C. Gatewood, SM  
Ilene B. Harris, SM  
Paul E. Johnson, Information and Decision Sciences, SM  
George G. Klee, M2  
Robert P. Patterson, Physical Medicine and Rehabilitation, SM  
Stuart M. Speedie, SM  
Stephen C. Strother, Radiology, M2  
Douglas R. Wholey, Health Services Research and Policy, SM  
George L. Wilcox, Neuroscience, SM

**Associate Professor**

Sandra J. Potthoff, Healthcare Management, SM

**Assistant Professor**

Marcelline Harris, M2  
Stephen T. Parente, Healthcare Management, M2  
Edward Ratner, Medicine, M2  
Alexander Ruggieri, M2  
Amy Wilson, Health Sciences Research/Policy, M2

**Other**

Denton R. Peterson, M2  
Ernest F. Retzel, M2  
Brian J. Westrich, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Health informatics is an interdisciplinary field of scholarship that applies computer, information, and cognitive sciences to promote the effective and efficient use and analysis of information, ultimately improving the health, well-being, and economic functioning of society. Students take a sequence of core courses in health informatics and biostatistics, and electives in technical and health science areas. Possible areas of emphasis include health information systems, telemedicine, bioinformatics, user interface design, system impact evaluation, database construction and analysis, clinical decision-making, evaluation of health programs, image and signal processing, and physiological monitoring and control.

**Prerequisites for Admission**—Applicants are expected to have at least a bachelor of science or equivalent degree from a recognized institution of higher education. Although students are accepted into the program with different backgrounds and varying degrees of experience, some prerequisites are required, usually in the form of college coursework. Acceptance into the program is not precluded by minor deficiencies in background; rather it is conditional on these being made up before or during the first year of study. See the prerequisites listed in the table below for areas of study that must be completed before admission to the program. Courses used to fulfill prerequisites are not given graduate credit. Courses in the curriculum assume that these prerequisite courses have been taken.

**Note:** These prerequisites are subject to change. Please check our Web site for the current information on prerequisites.

<b>Health Informatics Admission Prerequisites</b>				
<b>Area</b>	<b>Amount</b>	<b>For M.H.I.</b>	<b>For M.S.</b>	<b>For Ph.D.</b>
Biological or Life Sciences	1 course	Yes	Yes	Yes
<b>Mathematics</b>				
Calculus or equivalent	two semesters	Yes	Yes	Yes
Linear Algebra (qtr or sem)	1 course	No	No	Yes
Computer Programming (FORTRAN, C, C++, JAVA, etc)	1 course	Yes	Yes	Yes

**Special Application Requirements**—The GRE or similar professional examination (e.g., MCAT, GMAT, PCAT) is required. Three letters of recommendation and a statement of purpose must be submitted with the application. Students are advised to apply for admission for fall semester, since spring semester admission may entail the student taking longer to complete the program.

**Courses**—Please refer to Health Informatics (HInf) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—4xxx courses in computer science may be used to satisfy the elective requirements for the M.H.I., M.S., and Ph.D. degrees if the student has not previously taken a computer science course in the same sub area (e.g., database design) at a higher level. Acceptance of 4xxx courses from other departments or programs requires the approval of the adviser and the director of graduate studies.

### M.H.I. Degree Requirements

The master of health informatics emphasizes the role of informatics-trained professionals as liaisons who brings both a background of medicine and a knowledge of information technology to the task of solving health care problems. The curriculum consists of 32 credits of coursework that includes: 8 credits of health informatics, 4 credits of technology-focused health administration, 3 credits of statistics and research design, 6 credits of coursework in the student's chosen area of specialization, 6 credits of electives, 2 credits of seminar, and a 3 credit capstone course in which the student completes a project directly applicable to their own work environment. The program is designed to be completed in one calendar year for full-time students and in up to three years for part-time students. Many of the classes are offered in the late afternoon and on Saturdays; classes may also meet monthly or semi-monthly. Distance learning technologies facilitate work and class participation at off-campus locations.

### M.S. Degree Requirements

The research-oriented Plan A master's degree is available to advanced applicants, such as those with a professional degree in a health sciences discipline. It requires 32 course credits and 10 thesis credits. The Plan B option requires 42 course credits, including 6-7 credits from a technical area and 6-7 credits from the health sciences. Both plans require seven core courses, a sequence in statistics or biostatistics, and registration in the health informatics seminar (5436) for the first year and for at least two semesters after that (1 credit each semester). For most students, the program requires two academic years and one summer.

### Ph.D. Degree Requirements

The Ph.D. program is for students who want to obtain advanced training and conduct research. Students are expected to complete the same requirements as those for the Plan B master's program (a survey of health informatics, biostatistics, selected health science areas, and advanced training in selected informatics areas), as well as advanced coursework in health informatics and an area of concentration complementary to health informatics. The work is completed with an original research project reported in the doctoral dissertation. Students are expected to have earned the equivalent of at least 70 credits including 24 thesis credits.

**Language Requirement**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—Master's students must successfully complete the introductory sequence in health informatics (HInf 5430 and HInf 5431). Ph.D. students must take the introductory sequence and one 8xxx course in health informatics.

## Health Journalism

**Contact Information**—Graduate Studies Office, Health Journalism M.A. Program, School of Journalism and Mass Communication, University of Minnesota, 110 Murphy Hall, 206 Church Street S.E., Minneapolis MN 55455 (612-625-4054; fax 612-626-8251; [sjmcgrad@umn.edu](mailto:sjmcgrad@umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

John R. Finnegan, Jr., M2  
Russell V. Luepker, M2  
Nancy L. Roberts, M2  
Daniel J. Sullivan, M2  
Douglas R. Wholey, M2

### Associate Professor

Kenneth O. Doyle, Jr., M2  
Ian A. Greaves, M2

### Assistant Professor

Donald Brazeal, M2  
Shelly L. Rodgers, M2  
Gary Schwitzer, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—A joint program of the School of Journalism and Mass Communication and the School of Public Health, the professional master's in health journalism promotes improved public communication about health matters by combining knowledge, skills, and experience from both disciplines. Professionals in journalism and public health earn an M.A. degree in health journalism. Those pursuing other master's degrees, (e.g., master's in public health), earn the M.A. in health journalism in addition to the other degree.

**Prerequisites for Admission**—The minimum requirement for admission is a B.A. or equivalent.

### Special Application Requirements

Applicants must submit a departmental application; a clearly written statement of career interests, goals, and objectives; three letters of recommendation; a complete set of transcripts; academic work samples; and scores from the GRE. The director of graduate studies may waive the GRE requirement for students who have at least two years of professional experience and a strong academic record. This program uses a rolling admission process: the sooner an application is received, the sooner the applicant receives a decision. The deadline for application is March 15.

**Courses**—Please refer to Journalism and Mass Communications (Jour) and Public Health (PubH) in the course section of this catalog for courses pertaining to this program.

**Use of 4xxx Courses**—Use of 4xxx courses is discouraged.

### M.A. Degree Requirements

A minimum of 32 credits and a capstone project are required. All students must take a minimum of 16 credits in journalism. All coursework must be taken A-F.

**Language Requirements**—Foreign language study is recommended for students who plan to work internationally.

**Final Exam**—The final examination is oral.

## Health Services Research, Policy, and Administration

**Contact Information**—Division of Health Services Research and Policy (HSRP), School of Public Health, University of Minnesota, MMC 729 Mayo Building, 420 Delaware Street S.E., Minneapolis, MN 55455 (612-626-3500; fax 612-624-4498; [sph-ssc@umn.edu](mailto:sph-ssc@umn.edu); [www.sph.umn.edu](http://www.sph.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

James W. Begun, Health Care Management, SM  
Jon B. Christianson, Health Care Management, SM  
Bryan E. Dowd, Public Health, SM  
Roger D. Feldman, Public Health, SM  
Judith M. Garrard, Public Health, SM  
Robert L. Kane, Public Health, SM  
Rosalie A. Kane, Public Health, SM  
John E. Kralewski, Public Health, SM  
A. Marshall McBean, Public Health, SM  
Ira S. Moscovice, Public Health, SM  
John A. Nyman, Public Health, SM  
Stuart M. Speedie, Health Informatics, SM  
Vernon E. Weckwerth, Health Care Management, SM  
Douglas R. Wholey, Public Health, SM

### Associate Professor

Kathleen T. Call, Public Health, SM  
Robert A. Connor, Health Care Management, SM  
Michael D. Finch, Public Health, SM  
Susan Bartlett Foote, Public Health, SM  
Leslie A. Grant, Health Care Management, SM  
Sandra J. Potthoff, Health Care Management, SM  
William J. Riley, Public Health, M2

### Assistant Professor

Jean Marie Abraham, Health Care Management, M2  
Boris Bershadsky, Public Health, M2  
Lynn A. Blewett, Public Health, M2  
Jeremy L. Holtzman, Medicine, M  
Yvonne Catharina Maria Jonk, Public Health, M  
Donna D. McAlpine, Public Health, M2  
Stephen T. Parente, Health Care Management, M2  
David M. Radosevich, Surgery, M  
Todd H. Rockwood, Public Health, M2  
Robert James Town, Public Health, SM  
Beth A. Virnig, Public Health, M2  
Amy Reed Wilson, Public Health, M2

### Other

Tor Dahl, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Health services research focuses on the organization and delivery of cost-effective health services. It deals with policy issues related to costs, access, and quality of health services and equitable distribution of health resources. The M.S. program prepares health services researchers and health policy analysts to carry out empirical studies, formulate policy options, work in the political arena to shape and implement policies, and evaluate policies once implemented.

Health services research at the Ph.D. level is for those interested in affecting public policy related to health-care systems. Students come from a variety of educational backgrounds, including economics, political science, sociology, and public affairs. Strong quantitative skills are essential. The program is primarily for students interested in academic careers or senior research positions in government or the private sector. The core curriculum is a multidisciplinary examination of the social, political, and economic forces that affect the organization, financing, and delivery of health-care services. The emphasis is on theory, modeling, and quantitative methods. Coursework is supported by the student's involvement with faculty on research projects. The program provides further interchange with faculty through research seminars and doctoral colloquia.

**Prerequisites for Admission**—The M.S. program does not have specific course prerequisites, but some college level math is recommended. The Ph.D. program requires calculus, statistics, and intermediate microeconomics. Applicants who have not completed the prerequisites, but are otherwise qualified for admission, are required to take relevant courses at the University or another accredited institution before beginning the program.

**Special Application Requirements**—Above average performance on the GRE is required for admission. For GRE exams taken before October 1, 2002, minimum required scores are: 1500 for the M.S., 1800 for the Ph.D. Exams taken after October 1, 2002, require a minimum combined verbal and quantitative score of 1000 (500/500) for the M.S., and analytical score of 3.5. The Ph.D. program requires a minimum combined verbal and quantitative score of 1200 (600/600). The analytical writing section of the exam is evaluated independently; no minimum score was established at the time of this publication. Non-native English speakers also must take the TOEFL with a minimum score of 600 (or 250 on the computer exam). All applicants submit the following: grade transcripts from all previous academic institutions, a statement indicating reasons for seeking the health services research, policy, and administration M.S. or Ph.D.,

three letters of reference attesting to the applicant's academic ability and potential for a career in research or teaching, evaluation forms to accompany each letter, resume or CV. Students are admitted in fall semester only. The program is full time.

**Courses**—Please refer to Public Health (PubH), particularly numbers 58xx and 88xx, in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses toward degree requirements requires the approval of the director of graduate study.

### M.S. Degree Requirements

The M.S. offered under Plan A is in outcomes research. Plan A requires a thesis (publishable research paper), and a final oral exam. Plan B requires an internship and project. Both Plan A and Plan B are full-time, two-year programs.

Plan A requires 47-50 credits, including 31-34 core credits, 6 elective credits in one or more related fields outside the major, and 10 thesis credits. Plan B requires 46 credits, including 40 core credits and 6 elective credits in one or more related fields outside the major.

### Ph.D. Degree Requirements

The Ph.D. requires at least 76 credits, including 40 core credits in the major, a minimum of 12 credits in the minor or supporting program, and 24 thesis credits. The minor or supporting program may be in areas such as economics, statistics, sociology, bioethics, gerontology, business administration, or epidemiology.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—The minor is developed uniquely for each student with the advice and counsel of the director of graduate studies.

## Hispanic and Luso-Brazilian Literature and Linguistics

**Contact Information**—Department of Spanish and Portuguese Studies, University of Minnesota, 34 Folwell Hall, 9 Pleasant Street S.E., Minneapolis, MN 55455 (612-625-5858; fax 612-625-3549).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

René Jara, SM  
Amy K. Kaminsky, Women's Studies, ASM  
Antonio Ramos-Gascón (emeritus), ASM  
Nicholas Spadaccini, SM  
Hernán Vidal (emeritus), ASM

### Associate Professor

Fernando E. Arenas, SM  
Carol A. Klee, SM  
Francisco A. Ocampo, SM  
Joanna O'Connell, SM  
Luis Ramos-García, SM  
Constance A. Sullivan, SM  
Barbara Weissberger, SM

### Assistant Professor

Timothy Face, M2  
Alberto Egea Fernández-Montesinos, M2  
Ofelia Ferrán, M2  
Horacio Machín, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The department offers three M.A. programs: Hispanic literature, Luso-Brazilian literature, and Hispanic linguistics. The department offers a Ph.D. in Hispanic and Luso-Brazilian literature and linguistics. The Ph.D. offers four areas of emphasis: Spanish peninsular literature, Spanish-American literature, Luso-Brazilian literature, and Hispanic linguistics.

The department integrates cultural and language areas into each degree program. Students study the main problems, issues, topics, and polemics that constitute their various fields and develop skills, theories, and methodologies to research, analyze, organize, reproduce, and communicate the material. Ph.D. students are expected to make scholarly contributions based on a thorough understanding of the history of the field of specialization and of the approaches used to study it. The department encourages and promotes a diversity of philosophies, approaches, and methods.

**Prerequisites for Admission**—Prospective students generally have completed an undergraduate degree or substantial coursework in the field, although individuals with other backgrounds may be admitted. The Graduate Studies Committee may require completion of background coursework, without graduate degree credit, for admitted students with insufficient preparation.

**Special Application Requirements**—Three letters of recommendation from previously attended institutions evaluating the applicant's scholarship, a sample of a writing project, and a complete set of transcripts in addition to that required by the Graduate School should be sent to the director of graduate studies. The GRE is required. The deadline for application for admission and financial aid is January 15 for fall entry. Applicants who wish to be considered for teaching assistantships or Graduate School fellowships are encouraged to apply early.

**Courses**—Please refer to Portuguese (Port), Spanish (Span), and Spanish-Portuguese (SpPt) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### Ph.D. Degree Requirements

The Ph.D. requires at least 54 course credits (seventeen courses, excluding SpPt 5999), including 39 credits in the major and 15 credits (five courses) in either a supporting

work or a minor, depending on the requirements of the minor program. The program also requires 24 thesis credits.

**Language Requirements**—Normally students have proficiency in Spanish and Portuguese and at least one other foreign language. Proficiency is usually demonstrated by use of the language in written and oral forms (see the department's *Graduate Handbook*).

#### Minor Requirements for Students

**Majoring in Other Fields**—The doctoral minor requires at least 18 credits of 5xxx or 8xxx courses (six courses), to be determined in consultation with the director of graduate studies.

## Hispanic Linguistics

**Contact Information**—See Hispanic and Luso-Brazilian Literature and Linguistics.

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

#### Associate Professor

Carol A. Klee, M2  
Francisco A. Ocampo, M2

#### Assistant Professor

Timothy Face, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—See Hispanic and Luso-Brazilian Literatures and Linguistics for program description.

**Prerequisites for Admission**—Prospective students generally have completed an undergraduate degree or substantial coursework in the field, although individuals with other backgrounds may be admitted. The Graduate Studies Committee may require completion of background coursework, without graduate degree credit, for admitted students with insufficient preparation.

**Special Application Requirements**—Three letters of recommendation from previously attended institutions evaluating the applicant's scholarship, a sample of a writing project, and a complete set of transcripts in addition to that required by the Graduate School should be sent to the director of graduate studies. The GRE is required. The deadline for application for admission and financial aid is January 15 for fall entry. Applicants who wish to be considered for teaching assistantships or Graduate School fellowships are encouraged to apply early.

**Courses**—Please refer to Portuguese (Port), Spanish (Span), and Spanish-Portuguese (SpPt) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

## M.A. Degree Requirements

The M.A. is offered under Plan A and Plan B. Plan A requires at least 33 credits, including 15 credits in the major field taken from among designated 5xxx core courses, 6 credits outside the program, and 12 thesis credits. Plan B requires at least 33 course credits and two Plan B papers. Most students pursue Plan B.

**Language Requirements**—Students must have a reading knowledge of English and at least one foreign language in addition to Spanish and Portuguese.

**Final Exam**—The final exams are written and oral.

#### Minor Requirements for Students

**Majoring in Other Fields**—For a master's minor, students may choose any 6 credits (two courses), preferably in related areas, in consultation with the director of graduate studies.

## Hispanic Literature

**Contact Information**—See Hispanic and Luso-Brazilian Literature and Linguistics.

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

#### Professor

René Jara, M2  
Antonio Ramos-Gascón (emeritus), AM2  
Nicholas Spadaccini, M2  
Hernán Vidal (emeritus), M2

#### Associate Professor

Fernando E. Arenas, M2  
Joanna O'Connell, M2  
Luis A. Ramos-García, M2  
Constance A. Sullivan, M2  
Barbara Weissberger, M2

#### Assistant Professor

Alberto Egea Fernández-Montesinos, M2  
Ofelia Ferrán, M2  
Horacio Machín, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—See Hispanic and Luso-Brazilian Literatures and Linguistics for program description.

**Prerequisites for Admission**—Prospective students generally have completed an undergraduate degree or substantial coursework in the field, although individuals with other backgrounds may be admitted. The Graduate Studies Committee may require completion of background coursework, without graduate degree credit, for admitted students with insufficient preparation.

**Special Application Requirements**—Three letters of recommendation from previously attended institutions evaluating the applicant's scholarship, a sample of a writing project, and a complete set of transcripts in addition to that required by the Graduate School should be sent to the director of graduate studies. The GRE is required. The

deadline for application for admission and financial aid is January 15 for fall entry. Applicants who wish to be considered for teaching assistantships or Graduate School fellowships are encouraged to apply early.

**Courses**—Please refer to Portuguese (Port), Spanish (Span), and Spanish-Portuguese (SpPt) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

## M.A. Degree Requirements

The M.A. is offered under both Plan A and Plan B. Plan A requires at least 33 credits, including 15 credits in the major field taken from among designated 5xxx core courses, 6 credits outside the program, and 12 thesis credits. Plan B requires at least 33 course credits and two Plan B papers. Most students pursue Plan B.

**Language Requirements**—Students must have a reading knowledge of English and at least one foreign language in addition to Spanish or Portuguese.

**Final Exam**—The final exams are written and oral.

#### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor requires at least 6 credits.

## History

**Contact Information**—Department of History, University of Minnesota, 646 Social Sciences Building, 267 19th Avenue S., Minneapolis, MN 55455 (612-624-5840; fax 612-624-7096; [histdgs@umn.edu](mailto:histdgs@umn.edu); [www.hist.umn.edu/](http://www.hist.umn.edu/)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

#### Regents Professor

Allen F. Isaacman, SM

#### Professor

Josef L. Altholz, SM  
Frederich Asher, Art History, AM2  
Bernard S. Bachrach, SM  
Hyman Berman, SM  
Clarke A. Chambers (emeritus), ASM  
Anna K. Clark, SM  
Gary Cohen, SM  
John K. Evans, SM  
Sara M. Evans, SM  
John M. Eyster, History of Medicine, ASM  
Caesar E. Farah, SM  
Edward L. Farmer, SM  
Stephen C. Feinstein, Holocaust and Genocide Studies, AM  
David F. Good, SM  
Ruth M. Karras, SM  
Sally G. Kohlstedt, History of Science and Technology, ASM  
Elaine Tyler May, American Studies, SM  
Lary May, American Studies, SM  
Mary Jo Maynes, SM  
Robert E. McCaa, SM  
Russell R. Menard, SM  
John K. Munholland, SM  
David W. Noble, American Studies, ASM  
Carla R. Phillips, SM  
William D. Phillips, Jr., SM  
Kathryn L. Reyerson, SM

Steven Ruggles, SM  
Joel B. Samaha, SM  
Theofanis G. Stavrou, SM  
James D. Tracy, SM  
Dennis N. Valdes, ASM  
Rudolph J. Vecoli, SM  
Ann B. Waltner, SM  
Eric D. Weitz, SM

**Associate Professor**

Catherine Asher, Art History, AM2  
Keletso E. Atkins, African American and African Studies, AM2  
Sarah C. Chambers, SM  
Brenda Child, American Studies, AM2  
Kirsten Fischer, SM  
George D. Green, SM  
Lisa A. Norling, SM  
Jean M. O'Brien-Kehoe, SM  
Ajay Skaria, SM  
Liping Wang, SM  
Barbara Welke, SM

**Assistant Professor**

Jennifer Alexander, History of Science and Technology, AM2  
David Chang, M2  
Catherine Choy, American Studies, AM2  
Victoria B. Coifman, African American and African Studies, AM2  
Tracey Deutsch, M2  
Christopher M. Isett, M2  
Erika Lee, M2  
Michael Lower, M2  
Patrick J. McNamara, M2  
Hiromi Mizuno, M2  
Kevin Murphy, M2  
Helena Pohlandt, AM  
J.B. Shank, M2  
Eva Von Dassow, Classical and Near Eastern Studies, AM2  
Michele Wagner, M2  
Thomas C. Wolfe, M2

**Post Doctoral Associate**

Renee E. Worringer, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Areas of concentration include Africa; ancient; East and South Asia; British Isles; comparative women's history; medieval, early modern, and modern Europe; early modern world; Latin America; and the United States and its colonial background. Scholarly resources include Center for Austrian Studies, Center for Advanced Feminist Studies, Center for German and European Studies, Center for Medieval Studies, Immigration History Research Center, Minnesota Population Center, Modern Greek Studies, Center for Early Modern History, and Social Welfare History Archives.

**Prerequisites for Admission**—Applicants for the M.A. and the Ph.D. degree(s) normally should have completed general undergraduate survey courses in two or three broad areas of history, two years of advanced undergraduate work in two areas of history, and training in a foreign language. Some prerequisites may be made up after admission. In admitting students, priority is given to applicants who are likely to continue on to a doctoral degree even if they are originally admitted to the M.A. program.

**Special Application Requirements**—The following are required by the department: a statement of purpose, three letters of recommendation, a writing sample, training in a foreign language, a statement of specific areas and subareas of interest, and scores from the General (Aptitude) Test of the GRE. Deadline for applications is December 15. Forms and instructions should be requested from the department or may be downloaded from the Web site at [www.hist.umn.edu](http://www.hist.umn.edu).

**Courses**—Please refer to History (Hist) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—4xxx history courses may not normally be included on degree program forms for the History graduate major or minor.

**M.A. Degree Requirements**

The M.A. is offered under Plan A and Plan B. Both plans require six history courses (one of which is 8015) and two courses in other departments (at least 6 credits). Plan A also requires 10 thesis credits, for a total of at least 31 credits, and Plan B requires an additional two courses in history or another department, for a total of at least 30 credits.

**Language Requirements**—A reading knowledge of one foreign language is required before admission to the master's exam.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students**

**Majoring in Other Fields**—The master's minor in history typically involves a concentration in a single sub area of history and the completion of a minimum of three graduate courses in history (6 credit minimum). Normally, there is a representative from the history department on the student's oral examining committee.

**Ph.D. Degree Requirements**

The Ph.D. requires 36 credits in twelve history courses (including Hist 8015) plus 12 credits in four supporting program courses; 24 thesis credits are also required.

**Language Requirements**—A reading knowledge of two foreign languages is required before admission to the preliminary exam. Some areas of concentration may require additional foreign languages. In some cases, competence in quantitative methods may replace one of the foreign languages.

**Minor Requirements for Students**

**Majoring in Other Fields**—For the doctoral minor, students are expected to take four to five history courses including Hist 8015. Students must prepare for a written examination or substantial written project either in one general area and an associated sub area, or in two sub areas. The selections must be logically related to the student's major work. One or two representatives from the history department must serve on the student's preliminary oral examining and thesis committees. The preliminary oral exam also serves as the exam for the minor.

## History of Medicine and Biological Sciences

**Contact Information**—Program in the History of Medicine, University of Minnesota, MMC 506, 420 Delaware Street S.E., Minneapolis, MN 55455 (612-624-4416; fax: 612-625-7938; [www.med.umn.edu/history/home.htm](http://www.med.umn.edu/history/home.htm)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

**Professor**

John H. Beatty, Ecology and Behavioral Biology, SM  
C. Carlyle Clawson, Pediatrics, M2  
John M. Eyler, SM  
Sally Gregory Kohlstedt, History of Science and Technology, SM  
Elaine Tyler May, American Studies, SM

**Assistant Professor**

Jennifer L. Gunn, SM

**Adjunct Assistant Professor**

Jon Harkness, M2  
Jole Shackelford, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalogue for Graduate School requirements that apply to all major fields.

**Curriculum**—The history of medicine explores the changing ideas of health and disease, the evolution of health care, and the changing patterns of disease from antiquity to the present. It employs the methods of intellectual, social, and cultural history to explicate the forces that created the biomedical world in which we live. Students enter with diverse backgrounds, typically in medicine, science, or history. Some begin their graduate study immediately after receiving the bachelor's degree. Others do their training in mid-career. The Ph.D. program is for those who seek a career of historical research and teaching. The M.A. is especially suitable for those who intend to combine historical pursuits with a career in one of the health sciences.

**Prerequisites for Admission**—There are no universal prerequisites for admission, but some training in both history and the biological sciences is desirable.

**Special Application Requirements**—

Applicants must submit scores from the General Test of the GRE and have three persons who know their academic work well submit letters of recommendation on their behalf to the director of graduate studies for the program. Applicants should submit a statement describing their historical interests and their goals for graduate study. They are also encouraged to submit a writing sample. New students are ordinarily admitted for fall semester. For an applicant to be considered for financial aid, the applicant's materials must be received by December 31.

**Courses**—Please refer to History of Medicine (HMed) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses is permitted only with permission of the director of graduate studies.

### M.A. Degree Requirements

The M.A. is offered under Plan A or Plan B. The degree is normally completed in two to three semesters of full-time study or its part-time equivalent.

For Plan A, 12 credits of required courses in the history of medicine, plus 2 elective credits in the history of medicine, 6 credits in a minor or related field, and 10 thesis credits.

For Plan B, 12 credits of required courses in the history of medicine, plus an approved program of 12 credits of electives in history of medicine and related subjects, and 6 credits in a minor or related field.

**Language Requirements**—M.A. students must demonstrate competence in one foreign language, preferably French or German.

**Final Exam**—The final exam is oral. For Plan A, the examination centers on the thesis. For Plan B, it focuses on two or more revised course or seminar papers.

### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor requires 6 credits in the history of medicine and biological sciences.

### Ph.D. Degree Requirements

Twelve credits of required courses in the history of medicine, plus 9 additional elective credits in history of medicine, a minor or related field of 12 credits, and 24 thesis credits. A comprehensive written and oral preliminary examination precedes admission to candidacy.

**Language Requirements**—Ph.D. students must demonstrate competence in two foreign languages, preferably French and German. One language examination must be passed before the end of the first academic year.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A Ph.D. minor requires at least 12 credits in the history of medicine and biological sciences.

## History of Science and Technology

**Contact Information**—Program in History of Science and Technology, University of Minnesota, Tate Laboratory of Physics, 116 Church Street S.E., Minneapolis, MN 55455 (612-624-7069; fax 612-624-4578; [HST@physics.umn.edu](mailto:HST@physics.umn.edu); <http://groups.physics.umn.edu/hsci>).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

John Beatty, Ecology, Evolution, and Behavior, SM  
John M. Eyster, History of Medicine, SM  
Ronald N. Giere, Philosophy, AM  
Evelyn Fox Keller, Philosophy, AM  
Sally Gregory Kohlstedt, Geology and Geophysics, SM  
Helen E. Longino, Women's Studies, Philosophy, AM

Arthur L. Norberg, Computer Science, SM  
Robert W. Seidel, Chemical Engineering, SM  
Alan E. Shapiro, Physics, SM

### Assistant Professor

Jennifer Karns Alexander, Mechanical Engineering, SM  
Michel H. P. Janssen, Physics, SM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The program offers opportunities for advanced research and study in four general areas: history of the physical sciences, history of the biological sciences, history of technology, and history of American science and technology. Students focus on the following approaches: conceptual development of the disciplinary fields; social, economic, and cultural contexts; the interactions among science, technology, and society; or a combination of these. The faculty's interests span the period from the Scientific Revolution into the twenty-first century.

**Prerequisites for Admission**—Students must have a bachelor's degree with a minimum grade average of B and should be capable of interdisciplinary study. Depending on background and career objectives, additional preparatory studies may be necessary in either the science-technology area or in the humanities and social sciences.

**Special Application Requirements**—In addition to the application sent to the Graduate School, a complete copy of the application must be submitted to the program including three letters of recommendation. A writing sample and GRE scores are also recommended.

**Courses**—Please refer to History of Science and Technology (HSci) in the course section of this catalog for courses pertaining to this program.

**Use of 4xxx Courses**—Use of 4xxx courses on degree programs is subject to approval by the director of graduate studies.

### M.A. Degree Requirements

The M.A. is offered under Plan A and Plan B. Plan A requires a minimum of 20 course credits and 10 thesis credits; Plan B requires a minimum of 30 course credits. M.A. students must choose two of the general areas (history of the physical sciences, biological sciences, technology, or American science and technology). Six courses (18 credits) must be taken in these two areas with at least two courses (6 credits) in any one area. Two courses (6 credits) must cover the pre-1800 period and two courses (6 credits) the post-1800 period. Courses used to satisfy the area requirements also can be used to satisfy these period requirements. Because of this possible overlap, these course credits may not add up to 18 credits. In addition, each student must take the historiography course (HSci 8111) and two courses (6 credits) in a minor or related field. Under the Plan A option,

students must also take 10 thesis credits. All of the courses selected for the requirements must be passed with a grade of B or better. HSci 4xxx courses may be included as appropriate for the area and period requirements.

**Language Requirements**—M.A. students must demonstrate reading proficiency in one foreign language, normally French or German.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—The master's minor requires 6 credits and is structured for the student's interests.

### Ph.D. Degree Requirements

The Ph.D. is for those planning professional careers that require a high degree of scholarly competence, including teaching and research. Students must choose two of the general areas (history of the physical sciences, the biological sciences, technology, or American science and technology) in preparation for preliminary written and oral exams. Six courses (18 credits) must be taken in these two areas with at least two courses (6 credits) in any one area. Two courses (6 credits) must cover the pre-1800 period and two courses (6 credits) the post-1800 period. Courses used to satisfy the area requirements also can be used to satisfy these period requirements. In addition, each student must take the historiography course (HSci 8111) and a minor or supporting program consisting of four courses (12 credits). Students must also take 24 thesis credits. All of the courses selected for the requirements must be passed with a grade of B or better.

**Language Requirements**—Before taking the preliminary exams, students must demonstrate reading proficiency in two foreign languages, normally French and German.

### Minor Requirements for Students

**Majoring in Other Fields**—The doctoral minor requires 12 credits and is structured for each student's interests in discussion with the director of graduate studies.

## Housing Studies

### Postbaccalaureate Certificate

**Contact Information**—Housing Studies Certificate, College of Continuing Education, Student Support Services, 101 Westbrook Hall, 77 Pleasant Street S.E., Minneapolis, MN 55455 (612-624-4000; [adv@cce.umn.edu](mailto:adv@cce.umn.edu); [www.cce.umn.edu/certificates](http://www.cce.umn.edu/certificates)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

William Angel, M

### Associate Professor

Marilyn Bruin, M  
Jeff Crump, M  
Becky Yust, M  
Ann Ziebarth, M

**Curriculum**—The housing studies certificate is designed for individuals interested, or currently working in, housing related professions to expand their knowledge in areas including housing and community development, housing policy, residential environment and energy use, rural housing issues, housing management, and housing finance.

**Prerequisites for Admission**—Students must have a bachelor's degree from an accredited U.S. university or its foreign equivalent. A GPA of 3.00 is required. Students must apply for admission to the certificate with the Graduate School after completing no more than one course.

**Courses**—Required course: DHA 5170—Special Topics: Seminar for Certificate Students in Housing Studies (2 cr). Elective courses: DHA 4461, 4465, 4482, 5170, 5192, 5463, 5467, 5481, 5484, and 5484.

Classes are offered on a rotating basis; students need to check the *Class Schedule* at <<http://onestop.umn.edu/schedule/html/tc.html>> or contact the department for schedules.

### Certificate Requirements

The certificate consists of at least 15 credits; 2 credits in the required course and at least 13 credits from the elective options. Courses are drawn primarily from the Department of Design, Housing, and Apparel. Some elective courses require prerequisites that may be waived with instructor permission following University policy.

Early in the program, students should file a certificate program plan with CCE indicating the courses they plan to take, subject to faculty approval. All courses must be completed with a grade of B or better and an overall GPA of 2.80 or better.

## Human Factors/ Ergonomics Minor Only

**Contact Information**—Doctoral Minor Program in Human Factors/Ergonomics, Human Factors Research Laboratory, School of Kinesiology, College of Education and Human Development, University of Minnesota, 141 Mariucci Arena, 1901 Fourth Street S.E., Minneapolis, MN 55455 (612-625-5300).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Arthur G. Erdman, Mechanical Engineering, AM  
Laël C. Gatewood, Laboratory Medicine and Pathology, AM  
Susan G. Gerberich, AM  
Denise A. Guerin, Design, Housing, and Apparel, AM  
Tarald O. Kvalseth, Mechanical Engineering, AM  
Gordon E. Legge, Psychology, M  
Shashi Shekhar, Computer Science, AM  
Michael Wade, Kinesiology, M

### Associate Professor

Karen L. LaBat, Design, Housing, and Apparel, AM  
Joseph A. Konstan, Computer Science, M  
Thomas Stoffregen, Kinesiology, M

### Assistant Professor

John C. Carmody, AM

### Senior Research Fellow

Victor Koscheyev, Kinesiology, M

### Senior Research Fellow

Thomas Smith, Kinesiology, M

**Curriculum**—Human factors/ergonomics (HF/E) is an interdisciplinary area of study focusing on how human performance and behavior are influenced by design factors in the performance environment. HF/E has its roots in psychology, engineering, physiology, kinesiology, cognitive science, computer science, software engineering, and operations research. The minor, which is available to master's (M.A. and M.S.) and doctoral students, provides integrated coursework that emphasizes conceptual, empirical, and practical aspects of HF/E. The minor complements graduate training in traditional disciplines as a foundation for diverse career opportunities in the field.

Coursework addresses the question of how and why variability in human performance—with quality, productivity, efficiency, safety, and health implications—is influenced by interaction with designs of systems and system components such as machines and tools, computers and software, complex technological systems, jobs and working conditions, organizations, and sociotechnical institutions.

**Prerequisites for Admission**—Admission to the minor is contingent upon prior admission to a doctoral degree-granting program within the Graduate School. Admission is limited and only by permission of the director of graduate studies in the human factors/ergonomics minor.

**Courses**—Please refer to Human Factors/Ergonomics (HumF) in the course section of this catalog for courses pertaining to this program.

**Use of 4xxx Courses**—Use of 4xxx courses is permitted based on adviser and director of graduate studies approval.

### Minor Only Requirements

A master's minor requires 10 graduate credits, including 7-8 credits of core courses and 2-3 credits of electives. A doctoral minor requires 16 credits, including the three core courses (7-8 credits) and 8-9 credits of electives. The core courses consist of HumF 5001, 8001, and 8002.

## Human Resources and Industrial Relations

**Contact Information**—Industrial Relations Center, University of Minnesota, 3-300 Carlson School of Management, 321 19th Avenue S., Minneapolis, MN 55455-0438 (612-624-5810; fax 612-624-8360; [hrrgrad@umn.edu](mailto:hrrgrad@umn.edu); <[www.irc.csom.umn.edu](http://www.irc.csom.umn.edu)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Dennis A. Ahlburg, SM  
Richard D. Arvey, SM  
Avner Ben-Ner, SM  
Hyman Berman, History, SM  
Mario F. Bognanno, SM  
John W. Budd, SM  
John P. Campbell, Psychology, SM  
Zvi Eckstein, Economics, SM  
John A. Fossum, SM  
Jo-Ida C. Hansen, Psychology, SM  
Morris M. Kleiner, Public Affairs, SM  
Brian P. McCall, SM  
Jeylan T. Mortimer, Sociology, SM  
John Remington, SM  
Paul R. Sackett, Psychology, SM  
James G. Scoville, SM  
Andrew F. Whitman, SM  
Mahmood A. Zaidi, SM

### Associate Professor

Ross E. Azevedo, SM  
Maria J. Hanratty, Public Affairs, SM  
Deniz S. Ones, Psychology, SM  
Connie R. Wanberg, SM  
Yijiang Wang, SM

### Assistant Professor

Joyce E. Bono, Psychology, AM2  
Theresa M. Glomb, M2  
Stephanie Lluis, M2  
Andrew G. Miner, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Human resources and industrial relations studies the employment relationship. Teaching and research are guided by the belief that the employment relationship must be investigated through the lenses of different disciplines using systems thinking. The professional M.A. degree is for individuals interested in private and public sector careers in human resource management, labor relations, and related fields. The Ph.D. degree is a research degree for individuals interested in academic careers.

The curriculum is structured around five areas: staffing, training, and development; organization behavior and theory; compensation and benefits; labor market analysis; and labor relations and collective bargaining. Research methods and quantitative analysis of employment problems and issues are also included. Specialization in two areas is required for Ph.D. candidates, while M.A. candidates are encouraged to choose electives to support a generalist orientation.

**Prerequisites for Admission**—An undergraduate course in microeconomics must be completed with a grade of at least C before enrolling.

**Special Application Requirements**—Applicants must submit three letters of recommendations, a complete set of transcripts, a résumé, GRE scores, and a clearly written statement of career interests, goals, and objectives. M.A. applicants may substitute the GMAT for the GRE. Applicants whose native language is not English must also submit score results from the TOEFL.

Entry in both the day and evening M.A. programs is in fall or spring semester, and the application deadlines are June 15 and October 15. The M.A. financial aid deadline for fall semester is February 1. Entry in the Ph.D. program is only in the fall, and the application deadline is January 1. Applicants for all programs are encouraged to apply early, particularly for fall semester.

**Courses**—Please refer to Human Resources and Industrial Relations (HRIR) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—4xxx courses are not permitted toward M.A. or Ph.D. degree requirements.

### M.A. Degree Requirements

The M.A. is offered under Plan A (thesis) and coursework only (capstone project) in day (full-time) and evening (part-time) programs. Coursework only requires at least 48 credits and a capstone project. Major coursework includes 8011, 8012, 8031, 8041, 8051, 8061, and 8071 and 14 credits of HRIR electives. At least 8 credits must be earned in related fields. Plan A requires at least 38 course credits and 10 thesis credits. Major coursework includes 8011 and 8012; three courses from among 8031, 8041, 8051, 8061, and 8071; and 10-14 additional HRIR credits. Also required are 6-10 credits in an approved field or fields of study related to human resources and industrial relations. Plan A is generally limited to students who have considerable related graduate coursework.

Commonly-selected related fields include accounting, finance, operations management, managerial communications, economics, human resource development, law, psychology, public affairs, sociology, and research methods.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Ph.D. Degree Requirements

Students must complete at least 12 credits of research methods (most complete 18 or more credits); at least 6 credits of human resources and industrial relations doctoral seminars in each of two areas of specialization and other credits in these areas as needed; at least 3 credits in each of the other three subfields; and at least 12 credits in a minor or supporting program in one or more of the following behavioral sciences—anthropology, business administration, economics, history, political science, psychology, and sociology. Research methods courses taken outside the program may be applied toward the minor or supporting program requirement. Specific coursework is planned in consultation with the student's adviser, the Ph.D. coordinator, and the director of graduate studies. Students must pass preliminary exams in each of their subfields and research methods.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—A doctoral minor or supporting program may be selected by students majoring in business administration, education, hospital and healthcare administration, or the social and behavioral sciences. The minor must consist of at least 21 credits, including five courses in at least four subfields, plus a doctoral seminar.

## Human Rights

### Minor Only

**Contact Information**—Graduate Minor in Human Rights, Institute for Global Studies, University of Minnesota, 232 Social Science Building, 267 19th Avenue South, Minneapolis, MN 55455 (612-626-1879; fax 612-626-2242; [hrp@umn.edu](mailto:hrp@umn.edu); <http://hrp.cla.umn.edu>).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

#### Professor

Stephen Feinstein, Holocaust and Genocide Studies, M  
Dario Menanteau, Social Work, M  
Kathryn Sikkink, Political Science, M  
Hernán Vidal, Spanish and Portuguese Studies, M  
David Weissbrodt, Law, M  
Mahmood A. Zaidi, Human Resources and Industrial Relations, M

#### Associate Professor

Elizabeth Heger Boyle, Sociology, Law, M  
Eric D. Weitz, History, M

#### Assistant Professor

Michele D. Wagner, History, M

#### Other

Laura M. Sayles, Institute for Global Studies, M  
Karen B. Thompson, Institute for Global Studies, M  
John R. Vreyens, Agricultural, Food and Environmental Sciences, M

**Curriculum**—The human rights minor, available to master's (M.A. and M.S.) and doctoral students, provides an interdisciplinary foundation in human rights studies and practical experience in human rights work. The core requirements include two three-credit courses (Pol 8460—Topics in International Relations and Glos 5900—Topics in Global Studies) and one six-week internship. A guide to human rights internships can be found at <http://hrp.cla.umn.edu/internships.htm>. Students select at least two additional electives outside their major field from a designated course list and may take other courses with the approval of the program director. Qualifying courses taken prior to approval of the minor will be applied retroactively.

**Prerequisites for Admission**—Admission to a master's or doctoral degree-granting program within the Graduate School. Admission is limited and only by permission of the director of graduate studies in human rights.

**Special Application Requirements**—Contact the director of graduate studies in human rights for an *Intent to Enroll* form. Students are encouraged to submit the form by the end of fall semester the year before initiating the coursework. Late submissions are considered as space permits.

**Courses**—Elective courses are taken from a designated course list at <http://hrp.cla.umn.edu/minor.htm#elective>.

**Use of 4xxx Courses**—4xxx courses may not be included on degree program forms for the minor.

### Minor Only Requirements

A master's minor in human rights requires 9 credits: 1 core course, at least 2 elective courses taken from a designated course list, and one six-week internship approved by the program director. A doctoral minor requires 12 credits: 2 core courses, at least 2 elective courses, and one six-week internship approved by the program director.

## Immunology

See Microbiology, Immunology, and Cancer Biology.

## Industrial Engineering

**Contact Information**—Mechanical Engineering and Industrial Engineering Graduate Programs, University of Minnesota, 1120 Mechanical Engineering, 111 Church Street S.E., Minneapolis, MN 55455 (612-625-2009; fax 612-624-2010; [gradinfo@me.umn.edu](mailto:gradinfo@me.umn.edu); [www.me.umn.edu](http://www.me.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

#### Professor

Sant Ram Arora, SM  
Saifallah Benjaafar, SM  
Diwakar Gupta, SM  
Arthur V. Hill, Operations and Management Sciences, ASM  
Tarald O. Kvalseth, SM  
Patrick J. Starr, SM

#### Associate Professor

Caroline C. Hayes, SM

#### Assistant Professor

William C. Cooper, SM  
Karen L. Donohue, Operations and Management Sciences, ASM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Industrial engineering offers coursework and research in industrial engineering, operations research, and human factors. Special emphasis is on methodologies for design, planning, and management of manufacturing and production systems. Additional emphases are in logistics, transportation, computer-aided design and manufacturing, health systems, and management of technology.

**Prerequisites for Admission**—An undergraduate degree in engineering or in a closely related scientific field such as mathematics, statistics, business, or psychology, is required. Unusually well-qualified students with a baccalaureate degree may be admitted directly to the Ph.D. program.



### Special Application Requirements—GRE

General Test scores are required for admission and also are used in evaluating requests for financial aid. For the Ph.D. program, three letters of recommendation from faculty members at the previous educational institution are required. Students are admitted in fall and spring semesters only, the departmental deadlines for which are December 15 and October 15, respectively.

**Courses**—Please refer to Industrial Engineering (IE) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Selected 4xxx courses from other departments may be applied toward the degree in consultation with the student's adviser and the director of graduate studies. No 4xxx IE courses may be applied toward the degree.

### M.S.I.E. Degree Requirements

The M.S.I.E. requires at least 30 credits, including at least 14 course credits in the major and 6 course credits in a minor or related field. At least 1 credit of graduate seminar is to be included in the 30 credits.

Plan A (thesis) required courses include three of the five following courses: IE 5531, 5545, 5551, 8532 and 8541, along with 10 thesis credits.

Plan B (non-thesis) required courses include four of the five following courses: IE 5531, 5545, 5551, 8532, and 8541. Students must either take the Plan B course, IE 8951/8953, or must complete one to three Plan B papers, determined in consultation with the adviser.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—At least 6 credits in industrial engineering is required for a master's minor.

### Ph.D. Degree Requirements

The Ph.D. requires at least 44 course credits, including at least 12 course credits in a minor field or supporting program and at least 2 credits of graduate seminar; 24 thesis credits are also required. Four of the following five courses are required for the Ph.D. degree: IE 5531, 5545, 5551, 8532, and 8541.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—At least 12 credits in industrial engineering is required for a doctoral minor.

## Industrial Relations

See Human Resources and Industrial Relations.

## Infrastructure Systems Engineering

**Contact Information**—Center for the Development of Technological Leadership, University of Minnesota, 1300 South Second Street, Suite 510, Minneapolis, MN 55454 (612-624-5474; fax 612-624-7510; [degrees@cdtl.umn.edu](mailto:degrees@cdtl.umn.edu); [www.cdtl.umn.edu](http://www.cdtl.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Andrew Drescher, M2  
 Catherine E. French, M2  
 John S. Gulliver, M2  
 Joseph F. Labuz, M2  
 Panos G. Michalopoulos, M2  
 Michael J. Semmens, M2  
 Heinz G. Stefan, M2  
 Vaughan R. Voller, M2

### Associate Professor

Randal J. Barnes, M2  
 Gary A. Davis, M2  
 Robert J. Dexter, M2  
 Raymond M. Hozalski, M2  
 Arturo E. Schultz, M2  
 Carol K. Shield, M2  
 Karl A. Smith, M2

### Lecturer

Charles Hathaway, AM2  
 Bradford Henry, AM2  
 Peter Hilger, AM2  
 Patrick Hirl, AM2  
 Richard Kavaney, AM2  
 Eil Kwon, AM2  
 Tom Maze, AM2  
 Steven Olson, AM2  
 Howard Preston, AM2  
 Raymond Spack, AM2  
 Edward Warn, AM2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The master of science in the infrastructure systems engineering (M.S.I.S.E.) program focuses on developing management and engineering tools that address the issues in local, county, and state infrastructure. It is an interdisciplinary program offered through the Institute of Technology's Center for the Development of Technological Leadership and the Department of Civil Engineering. The two-year, professional-format program integrates the fields of water systems, pavement, structures, mechanics modeling, traffic engineering, transportation policy, and environmental issues, among others.

**Prerequisites for Admission**—A B.S. degree in engineering plus a minimum of one year of professional work experience in an infrastructure area or a B.S. degree in a related science or technology field and a minimum of two years professional work experience in an infrastructure area are required.

**Special Application Requirements**—None.

**Courses**—Please refer to Infrastructure Systems Engineering (ISE) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Applying 4xxx courses toward degree requirements is extremely limited. Such requests will be reviewed on a case by case basis and will require director of graduate studies approval.

### M.S.I.S.E. Plan B Degree Requirements

The M.S.I.S.E. in infrastructure systems engineering requires 30 credits with 23 credits in required core courses and 7 credits in related fields, such as geography and public administration. In addition students must complete a capstone project to address an on-the-job issue or problem.

**Language Requirements**—None.

**Final Exam**—An oral presentation and defense of the capstone project is required.

## Interdisciplinary Archaeological Studies

Admissions have been suspended for this program.

## International Education Minor Only

**Contact Information**—Director of Graduate Studies, International Education Minor, R. Michael Paige, Comparative and International Development Education, Educational Policy and Administration, University of Minnesota, 330 Wulling Hall, 86 Pleasant Street S.E., Minneapolis, MN 55455 (612-626-7456 or 612-624-1006; [r-paig@umn.edu](mailto:r-paig@umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Patricia G. Avery, Curriculum and Instruction, M  
 William M. Bart, Educational Psychology, M  
 David Chapman, Educational Policy and Administration, M  
 John J. Cogan, Curriculum and Instruction, M  
 Gerald W. Fry, Educational Policy and Administration, M  
 Gary N. McLean, Work, Community, and Family Education, M  
 Josef A. Mestenhauser, Educational Policy and Administration, M  
 R. Michael Paige, Educational Policy and Administration, M

### Associate Professor

Philip R. Goodrich, Biosystems and Agricultural Engineering, M  
 Robert C. Serfass, Kinesiology, M

### Assistant Professor

Kay A. Thomas, Educational Psychology, M

### Assistant Professor

Deanne L. Magnusson, Educational Policy and Administration, M  
 Kyla L. Wahlstrom, Applied Research and Educational Improvement, M

**Curriculum**—The interdisciplinary minor in international education is for students enrolled in any M.A. or doctoral program who wish to enter careers in research, consulting, administration, and teaching in an international context. The minor offers a coordinated set of courses from the Departments of Curriculum and Instruction; Educational Policy and Administration; Educational Psychology; Work, Community, and Family Education; School of Kinesiology; and Institute of Child Development.

**Prerequisites for Admission**—Admission to the international education minor is contingent upon prior admission to the Graduate School and to an M.A. or Ph.D. program at the University of Minnesota. Admission to the minor program is limited and only by permission of the International Education Committee and the director of graduate studies. Students interested in this option are welcome to consult with the director of graduate studies.

**Courses**—Please contact the minor program office for information on relevant coursework.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree programs is subject to adviser and director of graduate studies approval.

### Minor Only Requirements

At least 9 graduate credits at the master's level, 12 at the doctoral level. Each program is developed in consultation with the student, the student's adviser, major director of graduate studies, and director of graduate studies for international education. Requirements include EdPA 5103—Comparative Education and 5124—Critical Issues in International Education and Educational Exchange (one for M.A., both for doctoral minor); research (EdPA 5121; for doctoral students only); and area-specific coursework (at least one course for M.A. and doctoral minors: AFEE 5351, CI 5055, 5747, EdHD 5001, EdPA 5032, 5048, 5080, 5101, 5102, 5104, 5121, 5132, EPsy 5101, 5112, 5113, 5401, 5431, 5432, 5461, 8403, HRD 5408, 5496, HRD/WCFE 5821, Kin 5371, 8607, WCFE 8142).

## Interpersonal Relationships Research Minor Only

**Contact Information**—Doctoral Minor Program in Interpersonal Relationships Research, Institute of Child Development, University of Minnesota, 104 Child Development, 51 East River Road, Minneapolis, MN 55455 (612-624-2396; fax 612-624-6373; [wcollins@umn.edu](mailto:wcollins@umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Regents Professor

Ellen S. Berscheid, Psychology, M

### Professor

W. Andrew Collins, Child Development, M  
Nicki R. Crick, Child Development, M  
Byron Egeland, Child Development, M  
Patricia A. Frazier, Psychology, M  
Harold D. Grotevant, Family Social Science, M  
Dean E. Hewes, Communication Studies, M  
James W. Maddock, Family Social Science, M  
Anthony D. Pellegrini, Educational Psychology, M  
Mark Snyder, Psychology, M  
L. Alan Sroufe, Child Development, M  
Ruth G. Thomas, Work, Community, and Family Education, M

### Assistant Professor

Terry A. Kinney, Communication Studies, M  
Ascan F. Koerner, Communication Studies, M  
Richard M. Lee, Communication Studies, M  
Shigehiro Oishi, Communication Studies, M

**Curriculum**—The minor in interpersonal relationships research provides doctoral students with a broad theoretical and methodological foundation for research on behavioral interaction patterns between two persons and the impact of these interactions.

A recently recognized and rapidly advancing interdisciplinary field of scientific inquiry, interpersonal relationships research has its roots in psychology, sociology, family studies, communication, and nursing. The program brings together faculty and students from eight University departments and schools.

**Prerequisites for Admission**—Admission to the interpersonal relationships research graduate minor is contingent upon prior admission to the Graduate School and to a doctoral program in a degree-granting department. Admission to the minor program is limited and only by permission of the director of graduate studies in interpersonal relationships research.

**Courses**—Please refer to Interpersonal Relationships Research (IRel) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—4xxx courses, other than those required by the program, are permitted based on director of graduate studies approval.

### Minor Only Requirements

The doctoral minor requires at least 14 graduate credits, including three required core courses and additional elective courses selected from an approved list. The required courses are IRel 8001 (2 credits), 8021 (2 credits), and Psy 5204 (3 credits).

## Italian

See French and Italian.

## Japanese

See Asian Languages and Literatures.

## Journalism

See Mass Communication.

## Kinesiology

**Contact Information**—Suzannah Mork, Coordinator of Graduate Studies, School of Kinesiology, University of Minnesota, 219 Cooke Hall, 1900 University Avenue S.E., Minneapolis, MN 55455 (612-625-6718, 612-625-5300; fax 612-626-7700; [kin@umn.edu](mailto:kin@umn.edu); <http://education.umn.edu/cls/>).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Fred S. Apple, Laboratory Medicine and Pathology, ASM  
Richard S. Crow, Epidemiology, AM2  
Arthur Erdman, Mechanical Engineering, AM2  
Mary Jo Kane, SM  
Arthur S. Leon, SM  
Herbert L. Pick, Jr., Child Development, AM2  
Michael Wade, SM  
Albert Yonas, Child Development, AM2

### Associate Professor

Bruce D. Anderson, SM  
James R. Carey, Physical Medicine and Rehabilitation, AM2  
Donald Dengel, SM  
Juergen Konczak, SM  
Virgil G. Mathiowetz, AM2  
Robert C. Serfass, SM  
Thomas Stoffregen, SM  
Diane M. Wiese-Bjornstal, SM

### Adjunct Associate Professor

Catherine M. Kotz, Food Science and Nutrition, AM2

### Assistant Professor

Dawn A. Lowe, Biochemistry, AM2  
M. Kathryn Schmitz, Epidemiology, AM2

### Lecturer

JoAnn Buysse, M2  
Christopher Draheim, M2  
Stacy Ingraham, M2  
James Larson, M2  
Aynsley Smith, AM2  
Thomas J. Smith, M2

### Senior Fellow

Victor S. Koscheyev, M2

### Research Associate

Carol Leitschuh, M2

### Other

Anthony Brown, Recreational Sports, AM2  
Paul E. Cassidy, AM2  
Carol Gruber, Athletics, AM2  
James C. Turman, Recreational Sports, AM2  
Nicholas J. Ward, Mechanical Engineering, AM2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Emphasis areas in the master's and doctoral programs are adapted physical education, biomechanics/neural control, exercise physiology, human factors/ergonomics, motor learning/development, sport management, sport psychology, or sport sociology.

**Prerequisites for Admission**—Although prospective masters students generally have an undergraduate degree in kinesiology, physical education, or sport and exercise science, others with a baccalaureate degree who have related preparation and a

significant background and interest in the scientific study of physical activity may be admitted. Prospective doctoral students have generally completed a master's degree in a field related to kinesiology. Admitted students may be required by their adviser to complete background preparation in undergraduate and graduate kinesiology and related coursework.

### Special Application Requirements—

Applicants must submit a University of Minnesota Graduate School application form, a completed kinesiology application form; written statement of academic interests, goals, and objectives; scores from the General Test of the GRE (verbal and quantitative) or Miller Analogies Test that are less than five years old; three letters of recommendation from persons familiar with their scholarship and research potential; scholarly paper; and copies of official transcripts. Students may apply at any time; however, submission of all application materials by January 15 is encouraged to ensure priority consideration for admission and for teaching and research assistantships awarded for the next academic year. The three letters of recommendation must be sent directly to the department. Students can be admitted any term.

**Research Facilities**—Research facilities for graduate students in kinesiology include the following: Human Factors Research Laboratory; Human Sensorimotor Control Laboratory; Gait and Posture Laboratory, Laboratory of Physiological Hygiene and Exercise Science; Tucker Center for Research on Girls and Women in Sport.

**Courses**—Please refer to Kinesiology (Kin) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### M.A. Degree Requirements

M.A. students select an emphasis in adapted physical education, biomechanics/neural control, exercise physiology, human factors/ergonomics, motor learning/development, sport management, sport psychology, or sport sociology.

The M.A. is offered under Plan A and Plan B. Plan A requires 30 credits, including at least 14 course credits in kinesiology, 6 course credits in a minor or related field, and 10 thesis credits (8777). Plan B also requires 30 credits, including at least 14 course credits in kinesiology, 6 course credits in a minor or related field, 4 credits of a research project (8995), and 6 additional credits in any of these areas. For both Plan A and Plan B, students must take Kin 5981 (3 credits), Kin 8980 (1 credit), and in the related field or minor, EPsy 5261 (3 credits) or EPsy 8261 (3 credits) or equivalent. A 3.00 GPA of at least is required to maintain good standing and to graduate.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor requires at least 6 credits of graduate-level kinesiology courses.

### Ph.D. Degree Requirements

Ph.D. students pursue an individualized program with an emphasis in adapted physical education, biomechanics/neural control, exercise physiology, human factors/ergonomics, motor learning/development, sport management, sport psychology, or sport sociology.

The Ph.D. requires at least 48 course credits and 24 thesis credits, for a total of 72 credits. Course credits include 24 credits in kinesiology, 9 credits in statistical methods, 12 credits in a supporting program or minor (statistical methods courses may be included), and an additional 3 credits in any of these areas. Kinesiology course credits must include 5171 and 5981 (achieving a grade of A or B in each), 2 to 6 credits of 8980, and at least 12 credits of 8xxx. Statistical methods courses must include EPsy 8261 or equivalent and EPsy 8262 or equivalent (achieving a grade of A or B in each). A GPA of at least 3.00 is required to maintain good standing and to graduate.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—A doctoral minor requires at least 12 credits of graduate-level kinesiology courses, including 5171 (3 credits) and 8980 (1 credit).

## Landscape Architecture

**Contact Information**—Department of Landscape Architecture, University of Minnesota, 144 Ralph Rapson Hall, 89 Church Street S.E., Minneapolis, MN 55455 (612-625-6860; fax 612-625-0710; [gsland@umn.edu](mailto:gsland@umn.edu); <[www.cala.umn.edu/landscape\\_architecture/](http://www.cala.umn.edu/landscape_architecture/)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Ann Forsyth, M2  
John F. Hart, Geography, M2  
Lance M. Neckar, M2  
Peter J. Olin, Horticultural Science, M2  
David G. Pitt, M2

### Associate Professor

Susan M. Galatowitsch, Horticultural Science, M2  
Clinton Hewitt, M2  
John A. Koepke, M2  
Robert D. Sykes, M2

### Assistant Professor

Rebecca J. Krinke, M2  
Kristine F. Miller, M2

### Adjunct Assistant Professor

Robert J. Gunderson, AM  
Joseph R. Favour, AM  
Jon Erik Kingstad, AM  
Richard T. Murphy, AM  
Daniel B. Shaw, AM

### Lecturer

Dean F. Abbott, M2  
Jim Gordon Hagstrom, AM  
L. Peter Macdonagh, AM  
Aaron A. Mikonowicz, AM

### Senior Research Fellow

M. Christine Carlson, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Students are directed toward developing professional design skills rooted in a deep understanding of the intrinsic physical and aesthetic characteristics of natural systems in the landscape. The faculty believes this is the best way for landscape architects to help people transform, conserve, rebuild, and steward the natural and cultural places within which their lives and communities unfold. Students learn to develop and apply place-based design to address local, urban, and regional landscape issues. The curriculum is structured to teach students to be professional landscape architects who use ecological systems-thinking as the basis for artistic design, and to develop in them design literacy based on ecology, art, technology, history, behavior, and place theory.

The department offers the professional master of landscape architecture (M.L.A.), required to become a registered landscape architect, and the master of science (M.S.), a research-oriented (non-professional) degree offering opportunity for a specialized focus within the field of landscape architecture in the context the professional curriculum. The department also offers a dual degree with urban and regional planning (M.L.A./M.U.R.P.).

**Prerequisites for Admission**—M.L.A. program applicants must have completed a baccalaureate degree. M.S. program applicants must have completed an accredited baccalaureate or graduate degree in landscape architecture or a related discipline. All applicants are asked to explain the relationship of their previous academic work and work experience to their proposed graduate study.

**Special Application Requirements**—M.L.A. program applicants must apply by January 15 for entry the following fall. In addition to submitting the standard application form to the Graduate School, the following additional materials must be sent directly to the department: a copy of the applicant's completed standard application form; a clearly written statement of intent that discusses the applicant's understanding of landscape architecture, goals, objectives, and career interests specific to the profession; three letters of reference (use the special form available from the department); and photocopies of all official transcripts. An 8.5 x 11 inch portfolio of examples of creative work is encouraged. A portfolio is required to obtain advanced standing in design. Applicants with degrees in related design

professions such as architecture, environmental design, or planning should clearly indicate in their letter of intent an interest in being evaluated for advanced standing. The GRE is not required for entry but can be helpful to applicants seeking fellowships and assistantships. Students are admitted only for the fall term.

M.S. prospective students may apply at anytime, however application by January 15 is strongly encouraged to ensure priority consideration for fellowships and assistantships awarded for the next academic year. The department requires GRE scores, with the essay option for the analytical portion preferred; a statement of intent outlining research objectives that also indicates whether the applicant is interested in financial aid; and examples of previous research or design work related substantively or methodologically to the applicant's proposed research, or examples of academic or professional work that include 10 to 30 pages of writing, published or unpublished. Successful applicants will have secured the participation of a faculty adviser before completing their applications. Prospective students are encouraged to contact the director of graduate studies to discuss areas of focus and potential faculty advisers. Students can be admitted any term.

**Courses**—Please refer to Landscape Architecture (LA) in the course section of this catalog for courses pertaining to the programs.

**Use of 4xxx Courses**—Inclusion of 4xxx courses in degree programs is subject to approval by adviser and director of graduate studies.

### **M.L.A. Plan B, Coursework Only Degree Requirements**

The M.L.A. program, which is accredited by the national Landscape Architecture Accreditation Board (LAAB), is for students who wish to become registered professional landscape architects. Areas of required coursework within the program include design, technology and ecology, graphic and written communication, landscape history, and research methods. To develop a special focus or to explore areas in more depth, students are encouraged to select from among the graduate seminars offered to fulfill elective requirements. To meet the LAAB standards, 89 graduate credits are required for students without previous design experience. Because coursework is organized in a sequential framework of six design studios, commitment to the program for three successive years is important.

Students who hold an accredited professional bachelor's degree in landscape architecture may complete the M.L.A. with 30 credits, including 12 credits of landscape architecture studio courses, 3 credits of landscape architecture research issues and methods, and 15 elective credits, 6 credits of which must be outside of the department. Up to 9 credits earned as part of the M.L.A. may be applied to the M.S.

**Language Requirements**—None.

**Final Exam**—The final examination is a design portfolio.

### **M.L.A./M.U.R.P. Plan B Dual Degree Requirements**

This option allows students to earn both a master of landscape architecture (M.L.A.) and a master of urban and regional planning (M.U.R.P.) by careful coordination of coursework. Typically, students will be able to achieve both professional degrees in three and a half to four years by cross-counting specified courses. The specific M.U.R.P. specializations for which this option is most appropriate are land use/urban design, housing and community development, and environmental planning.

Students may elect the Plan A option as part of the dual degree, but doing so will require slightly more time to complete both degrees. Consult with the director of graduate studies for details.

To meet the LAAB standards, 88 graduate credits are required to earn an M.L.A., including 36 credits of landscape architecture studio courses, 3 credits of research issues and methods, 9 elective credits (which may be chosen from a list of selected M.U.R.P. program courses), and 40 credits of history, theory, and technology courses. A maximum of 18 credits taken to fulfill M.U.R.P. degree requirements may also be counted toward fulfillment of the M.L.A. degree requirements. Please refer to the urban and regional planning program for M.U.R.P. degree requirements.

### **M.S. Plan A Degree Requirements**

The M.S. is for students with a clear focus in research related to landscape architecture. M.S. students build expertise related to the practice of landscape architecture as they learn how to conduct research. Students specialize within areas of faculty expertise, which may include art and landscape architecture, landscape ecology, landscape architectural history and theory, park and recreation design, rural and suburban landscape planning, transportation, planning of world heritage sites, and urban design.

The M.S. requires 30 credits, including at least 6 credits within landscape architecture, 10 thesis credits, and at least 6 credits in an area of focus outside of landscape architecture.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### **Minor Requirements for Students**

**Majoring in Other Fields**—Minor requirements are determined in consultation with the director of graduate studies.

## **Latin**

See Classical and Near Eastern Studies.

## **Law**

### **Minor Only**

**Contact Information**—Meredith M. McQuaid, Associate Dean of Students and Director of International and Graduate Programs, Law School, University of Minnesota, 285 Law Building, 229 19th Avenue S., Minneapolis, MN 55455 (612-625-3025; fax 612-626-1874; [lsserv@umn.edu](mailto:lsserv@umn.edu)).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### **Professor**

Edward S. Adams, AM  
 Stephen F. Befort, M  
 David P. Brydem (emeritus), M  
 Dan Burk, M  
 Ann Burkhart, AM  
 Jim Chen, AM  
 Carol Chomsky, E  
 Laura Cooper, AM  
 John J. Cound (emeritus), M  
 Donald Dripps, AM  
 Daniel A. Farber, AM  
 Barry C. Feld, AM  
 Mary L. Fellows, AM  
 Richard S. Frase, AM  
 Daniel J. Gifford, AM  
 Joan S. Howland, AM  
 Robert J. Levy (emeritus), AM  
 Donald G. Marshall, AM  
 John H. Matheson, AM  
 C. Robert Morris (emeritus), M  
 Fred L. Morrison, AM  
 Michael S. Paulsen, AM  
 Ferdinand P. Schoettle, Jr., AM  
 Robert A. Stein, AM  
 Michael Tonry, AM  
 David Weissbrodt, AM  
 Susan Wolf, M  
 Judith T. Younger, AM

### **Other**

Beverly Balos, AM  
 Maury S. Landsman, AM  
 Meredith M. McQuaid, M  
 Kathryn J. Sedo, AM  
 Stephen M. Simon, AM  
 Carl M. Warren, AM

**Curriculum**—A law minor is available to both master's (M.A. and M.S.) and doctoral students and is individually tailored to their academic interests.

**Prerequisites for Admission**—Admission to the law graduate minor is contingent upon prior admission to a master's or doctoral degree-granting program within the Graduate School. Enrollment in Law School courses is on a space-available basis, with preference given to law-degree-seeking candidates.

**Courses**—Please contact the minor program office for information on relevant coursework.

### **Minor Only Requirements**

A master's minor requires at least 6 graduate credits; a doctoral minor requires at least 12 graduate credits.

## Liberal Studies

**Contact Information**—College of Continuing Education, University of Minnesota, 170 Wesbrook Hall, 77 Pleasant Street S.E., Minneapolis, MN 55455 (612-626-8724; fax 612-626-0077; [mls@cce.umn.edu](mailto:mls@cce.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

William Ammentorp, Work, Community and Family Education, M2  
Fred Amran, General College, M2  
Kent R. Bales, English, M2  
Laird H. Barber, Humanities, Morris, M2  
Terrence Collins, General College, M2  
Daniel Detzner, Family Social Science, M2  
Stephen Feinstein, History, M2  
Gerald Fry, Education Policy and Administration, M2  
Jill Gidmark, General College, M2  
Maria Gini, Computer Science, M2  
Judith A. Martin, Geography, M2  
Gary Mclean, Work, Community, and Family Education, M2  
Victoria Mikelonis, Rhetoric, M2  
Randy Moore, General College, M2  
Dwight H. Purdy, Humanities, Morris, M2  
Philip Regal, Ecology, Evolution, Behavior, M2  
Karen Seashore, Education and Human Development, M2  
Patrick Starr, Mechanical Engineering, M2  
John Wallace, Philosophy, M2  
Jack Zipes, Germanic Studies, M2

### Associate Professor

Rose Brewer, Studies in Africa and the African Diaspora, M2  
C. Cryss Brunner, Educational Policy and Administration, M2  
George Green, History, M2  
Arthur M. Harkins, Educational Policy and Administration, M2  
Carol A. Miller, American Studies, M2  
Roger Miller, Geography, M2  
Lisa Norling, History, M2  
Byron Schneider, Educational Policy and Administration, M2  
Robert Silberman, Art History, M2  
Jacquelyn N. Zita, Feminist Studies, M2

### Assistant Professor

Stephen Gross, Morris, M2  
Linda Halcón, Nursing, AM2

### Other

J. Edward Anderson, AM2  
Michael M. Andregg, M2  
Barbara Crosby, M2  
Stephen L. Daniel, M2  
Sarah Dennison, M2  
William Dikel, M2  
Brenda Fiala, AM2  
Margot Galt, M2  
Isabel Gomez, M2  
Anita Gonzalez, M2  
Donna Mae J. Gustafson, M2  
John Hasselberg, M2  
Jeremy F. Iggers, M2  
Jack Johnson, M2  
Alan R. Kahn, M2  
Judith Katz, M2  
Roseann Lloyd, M2  
Peter Lock, M2  
Nora Paul, M2  
Nicholas Pease, M2  
David A. Shupe, M2  
Victor Sorell, AM2  
Roslye Ultan, M2  
Sandra Wilson, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The graduate major in liberal studies offers an interdisciplinary curriculum that includes an introductory seminar, a choice of liberal studies seminars, a choice of electives from disciplines throughout the Graduate School, and a final project seminar. Although seminars for the M.L.S. are scheduled early evenings, and some Saturday mornings, most graduate-level courses offered during the day are also open to M.L.S. students.

**Prerequisites for Admission**—In addition to a bachelor's degree, students must indicate an ability to succeed in graduate study.

**Special Application Requirements**—A statement of purpose, letters of support, an undergraduate transcript, and examples of written work should accompany the application. GRE scores may also be submitted, but are not required. International students are required to achieve a passing score on the TOEFL.

**Courses**—Please refer to Liberal Studies (LS) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Contact the M.L.S. office prior to taking a 4xxx course.

### M.L.S. Degree Requirements

The M.L.S. is a specific variation of the master's Plan B option. The program requires at least 30 credits. Required are the Introduction to Interdisciplinary Inquiry (3 credits) and the Final Project (3 credits) seminars. Students must take at least 9 credits of liberal studies seminars. The remaining 15 credits are composed of electives from disciplines throughout the Graduate School, or directed study, directed research, or additional liberal studies seminars. Courses are selected with the help of the student's graduate faculty adviser.

**Language Requirements**—None.

**Final Exam**—The final project must be prepared as part of 8002 and must be approved by at least two faculty members, and the director of graduate studies.

## Linguistics

**Contact Information**—Director of Graduate Studies, Linguistics, University of Minnesota, 215 Nolte Center, 315 Pillsbury Drive, S.E., Minneapolis, MN 55455 (612-624-3331; fax 612-624-4579; [ILES@umn.edu](mailto:ILES@umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Genevieve J. Escure, English, AM2  
Jeanette K. Gundel, SM  
Michael B. Kac, Philosophy, SM  
Michael P. Maratsos, Child Development, AM2  
John D. Nichols, American Indian Studies, AM2  
Amy L. Sheldon, Communication Studies, SM

### Associate Professor

Bruce T. Downing, SM  
Charles R. Fletcher, Psychology, AM2  
G. Lee Fullerton, German, Scandinavian, and Dutch, AM  
Betsy K. Kerr, French and Italian, AM2  
Carol A. Klee, Spanish and Portuguese Studies, AM2  
Maria D. Sera, Child Development, AM2  
Nancy J. Stenson, SM  
Polly E. Szatrowski, AM2

### Assistant Professor

Hooi Ling Soh, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Linguistics is the scientific study of human language. Investigation in phonology, syntax, and semantics/pragmatics seeks to determine general principles governing the structure and interpretation of human language and the parameters that determine degree and manner of variation across languages. These core areas of language structure constitute the foundation for other subfields of linguistics, including psycholinguistics, sociolinguistics, historical linguistics, and computational linguistics.

**Prerequisites for Admission**—There are no specific prerequisites for admission. Students admitted normally have a broad undergraduate background that includes some linguistics courses.

### Special Application Requirements

Applicants must submit a completed application, scores from the GRE, three letters of recommendation, and a supplementary questionnaire detailing background, interests, and accomplishments. Applicants wishing to be considered for financial support should apply no later than January 15 of the preceding academic year. Entry is usually in fall semester but may be permitted in other semesters in exceptional cases.

**Courses**—Please refer to Linguistics (Ling) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses in degree programs is subject to adviser and director of graduate studies approval. Students from other majors may include such courses subject to their own program's approval.

### M.A. Degree Requirements

The requirements for the M.A. degree (both Plan A and Plan B) include eight required courses in the major: six courses covering core areas of language structure (phonetics, phonology, syntax, semantics/pragmatics); one course in field methods; and one research paper course. The total number of credits, assuming no prior coursework in linguistics, is 36 (30 credits in the major and 6 credits in related fields). Subject to approval by the director of graduate studies, students who have already taken required courses or their equivalents as undergraduates (or as graduates in another program), may be able to substitute electives in the major or in

related fields, in accordance with M.A. requirements set by the Graduate School. In addition to course requirements, Plan A requires a thesis and thesis credits; Plan B requires a Plan B paper.

**Language Requirements**—The M.A. program requires knowledge of one language not native to the student. Mechanisms for demonstrating knowledge are described in the program's *Graduate Student Handbook*.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—Courses required for a master's minor in linguistics are Ling 5001 (4 cr), 4002 (3 cr), and either 5201 (3 cr) or 5301 (4 cr). Students who have had these courses or their equivalents as undergraduates can substitute other linguistics courses. The M.A. minor requires at least 9 credits.

### Ph.D. Degree Requirements

The Ph.D. program focuses on theoretical issues in core areas of language structure (phonology, syntax, semantics/pragmatics), language acquisition (first and second), and language/discourse processing (cognitive processes that underlie language use). The program especially emphasizes research that integrates core areas of theoretical linguistics with language acquisition or processing.

For the Ph.D., no minimum number of credits is required besides the 12 credits in related fields and 24 thesis credits. However, all Ph.D. students are expected to complete M.A. course requirements (30 credits or less, depending on prior coursework in linguistics), a second-semester course in field methods (3 credits), and an individualized plan of study (including at least three 8xxx courses) to be determined in consultation with the student's committee. Upon completion of required coursework, students must pass a preliminary written exam in phonology, syntax, and their primary and secondary areas of concentration. Papers judged to be of near publishable quality by the student's committee can be substituted for exam questions in any of these areas. The preliminary oral exam is a presentation and defense of a research paper-length dissertation prospectus, which introduces and motivates the student's dissertation topic and provides a detailed plan for completion of the dissertation.

**Language Requirements**—The Ph.D. degree requires knowledge of two languages not native to the student. Mechanisms for demonstrating such knowledge are described in the program's *Graduate Student Handbook*.

**Minor Requirements for Students Majoring in Other Fields**—The doctoral minor requires at least 15 credits (five courses). Students who have had no prior coursework in linguistics must take six courses approved by the director of graduate studies, including the three courses required for the M.A. minor: Ling 5001, 4002 and either 5201, and 5301. Students who have

taken 5001 or its equivalent as undergraduates do not have to substitute another course.

## Literacy and Rhetorical Studies

### Minor Only

**Contact Information**—Center for Interdisciplinary Studies of Writing, University of Minnesota, 227 Lind Hall, 207 Church Street S.E., Minneapolis, MN 55455 (612-626-7579; fax 612-626-7580; [cisw@umn.edu](mailto:cisw@umn.edu); <<http://cisw.cla.umn.edu/minor/index.html>>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### Professor

Josef L. Altholz, History, M  
Richard W. Beach, Curriculum and Instruction, M  
Lillian S. Bridwell-Bowles, English, M  
Karilyn K. Campbell, Communication Studies, M  
Andrew D. Cohen, Linguistics, English as a Second Language, M  
Terence G. Collins, General College, M  
Hazel Dicken-Garcia, Journalism and Mass Communication, M  
Edward M. Griffin, English, M  
Alan G. Gross, Rhetoric, M  
Laura J. Gurak, Rhetoric, M  
Michael Hancher, English, M  
Ruth-Ellen B. Joeres, German, Scandinavian, and Dutch, M  
Mary M. Lay, Rhetoric, M  
Earl E. McDowell, Rhetoric, M  
Nancy L. Roberts, Journalism and Mass Communication, M  
Donald J. Ross, Jr., English, M  
Edward Schiappa, Communication Studies, M  
Amy L. Sheldon, Communication Studies, M  
Elaine E. Tarone, Linguistics, ESL, Slavic Languages and Literatures, M  
Barbara M. Taylor, Curriculum and Instruction, M  
Paulus W. van den Broek, Educational Psychology, M  
Billie J. Wahlstrom, Rhetoric, M  
Arthur E. Walzer, Rhetoric, M

#### Associate Professor

Lisa Albrecht, General College, M  
Daniel Brewer, French and Italian, M  
Robert L. Brown, Jr., Cultural Studies and Comparative Literature, M  
Patricia L. Crain, English, M  
Rebecca L. Krug, English, M  
Amy M. Lee, General College, M  
Carol A. Miller, American Studies, M  
Rosemarie J. Park, Work, Community, and Family Education, M  
Geoffrey Sirc, General College, M  
Diane J. Tedick, Curriculum and Instruction, M  
Constance L. Walker, Curriculum and Instruction, M  
Susan M. Watts-Taffe, Curriculum and Instruction, M  
Kirt H. Wilson, Communication Studies, M

#### Assistant Professor

Thomas E. Augst, English, M  
Lee-Ann Kastman Breuch, Rhetoric, M  
Patrick Bruch, General College, M  
Richard J. Graff, Rhetoric, M  
Julie Kalnin, Curriculum and Instruction, M  
John Logie, Rhetoric, M  
Gwendolyn Pough, Women's Studies, M  
Thomas J. Reynolds, General College, M  
Thomas Wolfe, History, M

**Curriculum**—The minor in literacy and rhetorical studies (LRS) was created to provide a forum for students and faculty interested in various facets of writing and communication. By crafting an

individualized program of study including literacy theory and practice, research methods, and historical inquiry, students can complement their disciplinary degree and thereby open up new perspectives for their teaching and research. Students develop an interdisciplinary program of study in consultation with their major adviser (preferably one of the faculty above), the director of graduate studies in their major, and the director of graduate studies in LRS.

**Prerequisites for Admission**—Admission is contingent upon enrollment in good standing in a relevant doctoral or master's program within the Graduate School of the University.

**Special Application Requirements**—Admission is competitive and restricted to a number that will allow for a quality experience. Entrance to the minor is granted only by permission of the director of graduate studies in LRS and the faculty selection committee. Application materials include a completed application form, statement of purpose, curriculum vitae, relevant post-secondary transcripts, and two letters of recommendation. Deadlines for application materials are October 15 and March 15, although applications will be reviewed on a rolling basis.

**Courses**—Please contact the minor program office for information on relevant coursework pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses toward degree requirements is permitted with approval from the director of graduate studies.

### Minor Only Requirements

A master's minor requires three graduate courses or seminars (9 credits minimum) and one course from each of the following categories: 1) literacy theory or practice, including pedagogy; 2) research methods and practices in one of the areas of the minor; and 3) a historical topic, e.g., history of the book, or of rhetoric, or of literacy. Students must also write a substantial paper that emerges from one of the three courses.

A doctoral minor requires four graduate courses or seminars (12 credits minimum). Three courses must be in each of the categories enumerated above for the master's minor. In addition, after those three courses have been completed, students must take either a capstone writing seminar specifically offered for the minor, or a seminar that involves a substantial term paper or a completed dissertation chapter on a topic related to the minor.

In order to make the minor interdisciplinary, no more than one of the three courses at the master's level, or one of the four courses at the doctoral level may be from the student's home department.

**Language Requirements**—None.

## **Luso-Brazilian Literature**

**Contact Information**—See Hispanic and Luso-Brazilian Literatures and Linguistics.

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### **Associate Professor**

Fernando E. Arenas, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Please see Hispanic and Luso-Brazilian Literature and Linguistics for program description.

**Prerequisites for Admission**—Prospective students generally have completed an undergraduate degree or substantial coursework in the field, although individuals with other backgrounds may be admitted. The Graduate Studies Committee may require completion of background coursework, without graduate degree credit, for admitted students with insufficient preparation.

**Special Application Requirements**—Three letters of recommendation from previously attended institutions evaluating the applicant's scholarship, a sample of a writing project, and a complete set of transcripts in addition to that required by the Graduate School should be sent to the director of graduate studies. The GRE is required. The deadline for application for admission and financial aid is January 15 for fall entry. Applicants who wish to be considered for teaching assistantships or Graduate School fellowships are encouraged to apply early.

**Courses**—Please refer to Portuguese (Port), Spanish (Span), and Spanish-Portuguese (SpPt) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### **M.A. Degree Requirements**

The M.A. is offered under both Plan A and Plan B. Plan A requires at least 33 credits, including 15 credits in the major field taken from among designated 5xxx core courses, 6 credits outside the program, and 12 thesis credits. Plan B requires at least 33 course credits and two Plan B papers. Most students pursue Plan B.

**Language Requirements**—For the M.A., students must have a reading knowledge of English and at least one foreign language in addition to Spanish and Portuguese.

**Final Exam**—The final exams are written and oral.

### **Minor Requirements for Students**

**Majoring in Other Fields**—The master's minor requires at least 6 credits.

## **Management of Technology**

**Contact Information**—Management of Technology Graduate Program, Center for the Development of Technological Leadership, University of Minnesota, 510 West Bank Office Building, 1300 S. Second Street, Minneapolis, MN 55454-1082 (612-624-5747; fax 612-624-7510; [MOT@cdtl.umn.edu](mailto:MOT@cdtl.umn.edu); [www.cdtl.umn.edu](http://www.cdtl.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### **Professor**

Carl Adams, Information and Decision Sciences, M2  
Norman Bowie, Strategic Management, AM2  
Philip Bromiley, Strategic Management, AM2  
Norman L. Chervany, Information and Decision Sciences, M2

William K. Durfee, Mechanical Engineering, M2  
W. Bruce Erickson, Strategic Management, M2  
Arthur V. Hill, Operations and Management Science, M2

George John, Marketing and Logistics Management, M2

Edward J. Joyce, Accounting and Business Law, M2  
Kenneth H. Keller, Public Affairs, M2

Francis A. Kulacki, Mechanical Engineering, M2

Ian H. Maitland, Strategic Management, M2

Mary Nichols, Strategic Management, AM2

Dennis L. Polla, Electrical Engineering, M2

Kenneth J. Roering, Marketing and Logistics Management, M2

Rias J. van Wyk, M2

### **Associate Professor**

Douglas Ernie, Electrical and Computer Engineering, M2

Karl A. Smith, Civil Engineering, M2

### **Other**

Lockwood Carlson, M2

Kenneth A. Kriz, AM2

James Lenz, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The master of science in the management of technology (M.S.MOT.) program is administered by the Institute of Technology's Center for the Development of Technological Leadership in partnership with the Carlson School of Management. The two-year, executive-format program integrates the fields of technology and management and provides working engineers and scientists with management knowledge and skills needed to assume a technical leadership role within their organizations. The program focuses on management in technology-based environments in traditional and emerging industries. The curriculum includes technical and advanced management courses such as manufacturing, pivotal technologies, technology forecasting, project management, quality engineering, management of innovation, and strategic management of technology. The core management curriculum includes areas such as finance, marketing, accounting, strategic planning and decision making, and conflict management. Students enter the program in the fall and advance as a cohort, taking a prescribed

sequence of courses together. Case studies, class discussions, and study-group interaction stimulate the learning process. Students also participate in several off-campus residencies, including one in the Asia-Pacific region; complete individual and team projects; and develop final projects as part of a capstone course. Most students receive corporate financial support.

**Prerequisites for Admission**—A bachelor's degree in engineering or in a natural science discipline from an accredited program. Applicants should also have completed coursework (or show proficiency) in economics, mathematical modeling, statistics, and computer literacy.

**Special Application Requirements**—At least five years of professional experience in the applicant's technical field (in exceptional circumstances, promising candidates with less experience may be considered). Applicants must submit three letters of recommendation, a résumé, a statement of purpose, and GRE or Graduate Management Admission Test scores (if the applicant already holds a master's or Ph.D. degree, this test requirement is waived). The professional track record of the applicant weighs heavily in the admissions process. A personal interview with the director of graduate studies is required. Admission is in fall semester only.

**Use of 4xxx Courses**—4xxx courses may not be included on degree program forms.

### **M.S.MOT. Plan B Degree Requirements**

The M.S.MOT. requires 36 credits. In addition to course requirements, students must complete an oral exam and a written report for the capstone project (MOT 8234), which consists of an independent, original investigation requiring between 110 and 130 hours of effort.

**Language Requirements**—None.

**Final Exam**—An oral presentation of the capstone project is required.

## **Manufacturing Systems Engineering**

*No new students are currently being accepted to this program. Contact the Graduate School for information on the status of the program.*

**Contact Information**—Management of Technology Graduate Program, Center for the Development of Technological Leadership, University of Minnesota, 510 West Bank Office Building, 1300 S. Second Street, Minneapolis, MN 55454-1082 (612-624-5747; fax 612-624-7510; [general@cdtl.umn.edu](mailto:general@cdtl.umn.edu); [www.cdtl.umn.edu](http://www.cdtl.umn.edu)).

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—No new students are currently being accepted to this program. Contact the Graduate School for information on the status of the program.

The master of science in manufacturing systems engineering (M.S.M.S.E) program is an interdisciplinary program offered through the Institute of Technology's Center for the Development of Technological Leadership and the Department of Mechanical Engineering. Students gain familiarity with manufacturing systems and practices. The program emphasizes issues surrounding factory logistics and supply chain management, global markets and their implications for manufacturing, and manufacturing processes that are friendly to the environment.

**Courses**—Please refer to Manufacturing Systems (MS) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—4xxx courses may not be included on degree program forms.

### M.S.M.S.E. Plan B Degree Requirements

At least 30 credits, including 23 credits from the manufacturing systems program, 4 credits from the capstone project, and 3 elective credits from systems and technology themes are required. The curriculum includes six core courses, four short courses, three elective short courses, and a capstone course (Plan B final project).

**Language Requirements**—None.

**Final Exam**—The final exam is oral. An oral presentation and written report on a final project are also required.

## Mass Communication

Graduate Studies Office, School of Journalism and Mass Communication, University of Minnesota, 110 Murphy Hall, 206 Church Street S.E., Minneapolis, MN 55455; 612-625-4054; fax 612-626-8251; [sjmcgrad@tc.umn.edu](mailto:sjmcgrad@tc.umn.edu).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Hazel Dicken-Garcia, SM  
 Ronald J. Faber, SM  
 Kathleen A. Hansen, SM  
 Jane E. Kirtley, SM  
 Chin-Chuan Lee, SM  
 Nancy L. Roberts, SM  
 Daniel J. Sullivan, SM  
 Daniel B. Wackman, SM

### Associate Professor

William A. Babcock, SM  
 Tsan-Kuo Chang, SM  
 Kenneth O. Doyle, Jr., SM  
 Dona B. Schwartz, SM  
 Albert R. Tims, Jr., SM

### Assistant Professor

Linus Abraham, M2  
 Colette Gaiter, M2  
 Jisun Huh, M2  
 Linda Jean Kensicki, M2  
 Shelly L. Rodgers, M2  
 Gary Schwitzer, M2  
 Brian Southwell, M2

### Instructor

Donald Brazeal, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The mass communication M.A. emphasizes the theoretical study of mass communication and analysis of media systems. The degree is intended primarily for those who wish to pursue Ph.D. degrees or teaching and research careers, as well as those who wish to enter the communication industry. The general M.A. program does not offer professional skills training in journalism.

Individuals who have extensive professional experience in mass communication or a B.A. degree in journalism are encouraged to enter the M.A. program. Individuals with strong liberal arts backgrounds in areas such as political science, psychology, sociology, history, philosophy, and English also are encouraged to apply.

The Ph.D. offers training for academic careers primarily in communication instruction, research, or policy. Areas of specialization include media processes, influences, and effects (strategic communication); media law, ethics, and history; international communication; and media management. All programs are suffused with the study of new media communication.

**Prerequisites for Admission**—The minimum requirement for admission is a B.A. or equivalent.

### Special Application Requirements

Applicants must submit a departmental application; a clearly written statement of career interests, goals, and objectives; three letters of recommendation from persons familiar with their scholarship and research potential; a complete set of transcripts; academic work samples in English; and scores from the General Test of the GRE. Students whose native language is not English are required to submit scores from the TOEFL or IELTS (academic), but not from the GRE. In addition, such students seeking teaching assistantships are required to pass the SPEAK test of spoken-English proficiency prior to appointment. Admission is considered for fall semester only; the application deadline is December 30.

**Special Facilities**—Special facilities include the Minnesota Journalism Center for Professional Studies, the Silha Center for the Study of Media Ethics and Law, the Institute for New Media Studies, the Digital Information Resource Center (which houses the Eric Sevareid Library), and the SJMC Research Division.

**Courses**—Please refer to Journalism and Mass Communication (Jour) in the course section of this catalog for courses pertaining to this program.

### M.A. Plan A Degree Requirements

A minimum of 27 course credits and 10 thesis credits are required. Coursework must include 12 credits in required core courses and 15 other credits (6-9 credits in other journalism and mass communication seminars or courses, and 6-9 credits in other departments). All coursework must be taken A-F.

**Language Requirements**—For the master's program, foreign language study is recommended for students in international mass communication.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—Minor programs are planned in consultation with the director of graduate studies or another member of the mass communication graduate faculty. The master's minor consists of a minimum of 9 credits in a coherent area, with at least 6 credits at 8xxx.

### Ph.D. Degree Requirements

A minimum of 54 course credits and 24 thesis credits are required. Coursework must include 12 credits in required core courses, 24 credits in dissertation area courses, and a minimum of 18 credits in other departments.

**Language Requirements**—Doctoral students pursuing international study are expected to have high language proficiency, or obtain it, in the appropriate area. Doctoral students in other areas are encouraged to consult advisers regarding the appropriateness of language study for their chosen specialization.

### Minor Requirements for Students

**Majoring in Other Fields**—A Ph.D. minor program consists of a minimum of 14 credits in a coherent disciplinary area. Students completing a minor in mass communication are required to take a preliminary written exam covering their coursework.

## Materials Science and Engineering

See Chemical Engineering and Materials Science and Engineering.

## Mathematics

**Contact Information**—School of Mathematics, University of Minnesota, 127 Vincent Hall, 206 Church Street S.E., Minneapolis, MN 55455 (612-625-1306; fax 612-624-6702; [gradprog@math.umn.edu](mailto:gradprog@math.umn.edu)).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Scot Adams, SM  
 Stephen B. Agard, SM  
 Greg W. Anderson, SM  
 Douglas Arnold, SM  
 John R. Baxter, SM  
 Sergei Bobkov, SM  
 Maury D. Bramson, SM  
 Maria-Carme Calderer, SM  
 J. Bernardo Cockburn, SM

Mark F. Feshbach, SM  
Bert E. Fristedt, SM  
Paul B. Garrett, SM  
Jay R. Goldman, SM  
Lawrence F. Gray, SM  
Robert D. Gulliver II, SM  
Morton E. Harris, SM  
Dennis A. Hejhal, SM  
Naresh C. Jain, SM  
Max A. Jodeit, Jr., SM  
Donald W. Kahn, SM  
Harvey B. Keynes, SM  
Nicolai V. Krylov, SM  
Walter Littman, SM  
John S. Lowengrub, SM  
Mitchell B. Luskin, SM  
Gennady Lyubeznik, SM  
Albert Marden, SM  
Richard P. McGehee, SM  
William Messing, SM  
Norman G. Meyers, SM  
Willard Miller, Jr., SM  
Richard B. Moeckel, SM  
Claudia Neuhauser, Ecology, Evolution, and Behavior, SM  
Wei-Ming Ni, SM  
Andrew Odlyzko, SM  
Peter J. Olver, SM  
Hans Othmer, SM  
Peter Polacik, SM  
Karel L. Prikry, SM  
Victor Reiner, SM  
Fernando Reitich, SM  
Peter A. Rejto, SM  
Joel L. Roberts, SM  
Mikhail Safonov, SM  
Fadil Santosa, SM  
George R. Sell, SM  
Steven I. Sperber, SM  
Dennis W. Stanton, SM  
David A. Storvick, SM  
Vladimir Sverak, SM  
Peter J. Webb, SM  
Dennis E. White, SM  
Ofar Zeitouni, SM

### Associate Professor

Jack F. Conn, SM  
David L. Frank, SM  
Hillel H. Gershenson, SM  
Dihua Jiang, SM  
Rachel A. Kuske, SM  
Nai-Chung Leung, SM  
Chester L. Miracle, SM  
Wayne H. Richter, SM  
Arnd Scheel, SM  
Alexander A. Voronov, SM  
Jiaping Wang, SM

### Assistant Professor

Wojciech Chacholski, SM  
Ionut Ciocan-Fontanine, SM  
Marcus Keel, SM  
Tian-Jun Li, SM  
Ezra Miller, SM  
Jianhong Jackie Shen, SM  
Carlos Tolmasky, ASM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Special areas of research include ordinary and partial differential equations; probability; real, complex, harmonic, functional and numerical analysis; differential and algebraic geometry; topology; number theory; commutative algebra; group theory; logic; combinatorics; mathematical physics; and applied and

industrial mathematics. The M.S. Plan A includes an emphasis in applied and industrial mathematics. The M.S. Plan B includes an emphasis in mathematics education and an emphasis in actuarial science.

See also control science and dynamical systems, and fluid mechanics, in this catalog for Ph.D. programs that rely heavily on mathematics.

**Prerequisites for Admission**—A solid background in undergraduate-level mathematics is expected. For students whose goal is the Ph.D. degree, background should include full-year courses in analysis, abstract algebra, and a semester of topology (roughly equivalent to Math 5615H-5616H, 5285H-5286H, and 5345).

Entering students are ordinarily admitted to the master's degree program. Transfer to the Ph.D. program is made when the Ph.D. preliminary written examination is passed (and does not require earning a master's degree).

**Special Application Requirements**—All applicants are expected to submit three letters of recommendation, a score from the GRE Subject (Advanced) Test in mathematics, and a supplementary application form available from the mathematics department. Applicants desiring financial assistance should submit their applications, including the departmental form, GRE scores, and letters of recommendation, to the director of graduate studies no later than January 15 to be considered for a fellowship, and no later than February 15 to be considered for a teaching assistantship. Students normally are admitted fall semester only.

**Courses**—Please refer to Mathematics (Math) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—In exceptional cases 4xxx courses may be permitted as part of degree programs subject to director of graduate studies approval.

### M.S. Degree Requirements

The School of Mathematics offers a M.S. in mathematics. M.S. degrees are also offered with emphasis in applied and industrial mathematics, with emphasis in mathematics education, and with emphasis in actuarial science. For more information, see the *Graduate Studies in Mathematics* brochure.

The M.S. is offered under Plan A and Plan B. Plan A requires at least 20 course credits and 10 thesis credits. Plan B allows more breadth; students complete at least 30 course credits, half of which may be in areas outside of mathematics.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—The master's minor requires a two-semester 8xxx or 5xxx sequence.

### Ph.D. Degree Requirements

The School of Mathematics offers a Ph.D. in mathematics and a Ph.D. in mathematics with emphasis in applied and industrial mathematics.

Special areas of research include ordinary and partial differential equations; probability; real, complex, harmonic, functional, and numerical analysis; differential and algebraic geometry; topology; number theory; commutative algebra; group theory; logic; combinatorics; mathematical physics; and applied and industrial mathematics.

The Ph.D. preliminary written examination, given twice each year, covers real analysis, complex analysis, algebra, and manifolds and topology. Students must pass the exam by the end of their second year. After passing the exam and completing the coursework, students may take the preliminary oral exam, which they must pass by the end of their fourth year. If a supporting program is chosen, it may consist partly or entirely of mathematics courses.

The choice of courses and exams for the emphasis in applied and industrial mathematics is different from those in the general program. In particular, applications are stressed early on.

For more information, see the program's *Graduate Studies in Mathematics* brochure.

**Language Requirements**—Two foreign languages are required from among the following: French, German, Russian, and Italian.

### Minor Requirements for Students

**Majoring in Other Fields**—Two year-long sequences of 5xxx or 8xxx courses. Consult the director of graduate studies in mathematics.

## Mathematics Education

See Education, Curriculum, and Instruction.

## Mechanical Engineering

**Contact Information**—Mechanical Engineering and Industrial Engineering Graduate Programs, University of Minnesota, 1120 Mechanical Engineering, 111 Church Street S.E., Minneapolis, MN 55455 (612-625-2009; fax 612-624-2010; [gradinfo@me.umn.edu](mailto:gradinfo@me.umn.edu); [www.me.umn.edu/](http://www.me.umn.edu/)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Regents Professor

Ernst R. G. Eckert (emeritus), ASM  
Richard J. Goldstein, SM  
Benjamin Y. H. Liu, SM

### Professor

Roger E. Arndt, Civil Engineering, ASM  
Saifallah Benjaafar, SM  
John C. Bischof, SM  
Perry L. Blackshear (emeritus), ASM  
Thomas R. Chase, SM  
Jane H. Davidson, SM  
Max Donath, SM  
William K. Durfee, SM

Arthur G. Erdman, SM  
 Edward A. Fletcher (emeritus), ASM  
 Steven L. Girshick, SM  
 Joachim V. R. Heberlein, SM  
 Warren E. Ibele (emeritus), ASM  
 David B. Kittelson, SM  
 Barney E. Klamecki, SM  
 Uwe R. Kortshagen, SM  
 Thomas H. Kuehn, SM  
 Francis A. Kulacki, SM  
 Tarald O. Kvalseth, SM  
 Jack L. Lewis, Orthopaedic Surgery, ASM  
 Virgil A. Marple, SM  
 Peter H. McMurry, SM  
 Katsuhiko Ogata, SM  
 Suhas V. Patankar (emeritus), ASM  
 Emil Pfender (emeritus), ASM  
 David Y. H. Pui, SM  
 Subbiah Ramalingam, SM  
 James W. Ramsey, SM  
 Terrence W. Simon, SM  
 Ephraim M. Sparrow, SM  
 Patrick J. Starr, SM  
 Kim A. Stelson, SM  
 Paul J. Strykowski, SM  
 Kumar K. Tamma, SM  
 Robert T. Tranquillo, Biomedical Engineering, ASM  
 Michael R. Zachariah, SM

#### **Associate Professor**

Caroline C. Hayes, SM  
 Allison Hubel, SM  
 Perry Y. Li, SM  
 Susan C. Mantell, SM  
 Bradley J. Nelson, SM  
 Rajesh Rajamani, SM  
 Sridharan Ramaswamy, Wood and Paper Science, ASM

#### **Assistant Professor**

Jennifer Alexander, AM  
 Victor H. Barocas, Biomedical Engineering, ASM  
 Sean C. Garrick, SM

#### **Associate Program Director**

Craig R. Shankwitz, AM  
 Nicholas J. Ward, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Coursework and research for all graduate degrees are offered in bioengineering; biomechanics; combustion; computer-aided design; computer-aided manufacturing; computer graphics; control systems; design; energy conservation; environmental control; environmental engineering; fluid mechanics; heat and mass transfer; history of science and technology; human factors engineering; industrial engineering; innovative methodologies; integration of structural and environmental systems; lubrication; manufacturing engineering; particle technology; plasma chemistry; plasma heat transfer; power, propulsion, and applied thermodynamics; socioeconomic systems; solar energy; solar processing and thermochemistry; statistics; structures; systems dynamics; technology assessment; thermal energy storage; thermal environmental engineering; thermodynamics; transportation; tribology; vibration; and interdisciplinary finite element methodology. Additional instructional and research programs can be formulated.

**Prerequisites for Admission**—An undergraduate degree in engineering or in a closely related scientific field such as physics, chemistry, or mathematics, is required. Unusually well-qualified students may be admitted directly to the Ph.D. program with a baccalaureate degree.

**Special Application Requirements**—GRE General Test scores are required for admission and also are used in evaluating requests for financial aid. For the Ph.D. program, three letters of recommendation from faculty members at the previous educational institution are required. Students are admitted in the fall and spring semesters only, the departmental deadlines for which are December 15 and October 15, respectively.

**Courses**—Please refer to Mechanical Engineering (ME) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Selected 4xxx courses from other departments may be applied toward the degree in consultation with the student's adviser and the director of graduate studies. No 4xxx ME courses may be applied toward the degree.

#### **M.S.M.E. Degree Requirements**

The M.S.M.E. requires at least 30 credits, including at least 14 course credits in the major and 6 course credits in a minor or related field. At least 1 credit of graduate seminar and one mathematics/numerical methods course from an approved list must be included in the 30 credits. Also, of the 30 credits, Plan A (thesis) students must enroll for 10 thesis credits. For Plan B (without thesis), students must either take the Plan B course, ME 8951/8953, or must complete one to three Plan B papers, determined in consultation with the adviser.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

#### **Minor Requirements for Students**

**Majoring in Other Fields**—At least 6 credits in mechanical engineering are required for a master's minor.

#### **Ph.D. Degree Requirements**

The Ph.D. requires at least 44 course credits, including at least 12 course credits in a minor field or supporting program and at least 2 credits of graduate seminar, along with at least one mathematical/numerical methods course from an approved list; 24 thesis credits are also required.

**Language Requirements**—None.

#### **Minor Requirements for Students**

**Majoring in Other Fields**—At least 12 credits in mechanical engineering is required for a doctoral minor.

## **Mechanics**

See Aerospace Engineering and Mechanics.

## **Medical Physics**

See Biophysical Sciences and Medical Physics.

## **Medicinal Chemistry**

**Contact Information**—Department of Medicinal Chemistry, University of Minnesota, 8-101 Weaver-Densford Hall, 308 Harvard Street S.E., Minneapolis, MN 55455-0343 (612-624-9919; fax 612-624-0139; [medchem@umn.edu](mailto:medchem@umn.edu); [www.pharmacy.umn.edu/resgrad/medchem/index.htm](http://www.pharmacy.umn.edu/resgrad/medchem/index.htm)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

#### **Professor**

Yusuf J. Abul-Hajj, SM  
 Patrick E. Hanna, SM  
 Stephen S. Hecht, Laboratory Medicine and Pathology, SM  
 Thomas R. Hoye, Chemistry, SM  
 Rodney L. Johnson, SM  
 Philip S. Portoghese, SM  
 Rory P. Remmel, SM  
 David H. Sherman, Microbiology, SM  
 W. Thomas Shier, SM  
 Marilyn K. Speedie, SM  
 Robert Vince, SM

#### **Adjunct Professor**

Herbert T. Nagasawa, SM

#### **Associate Professor**

David M. Ferguson, SM  
 William B. Gleason, Laboratory Medicine and Pathology, SM  
 Lisa A. Peterson, Environmental and Occupational Health, SM  
 Carston R. Wagner, SM

#### **Assistant Professor**

Robert A. Fecik, SM  
 Natalia Y. Tretyakova, SM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The program emphasizes the application of chemical principles to research on the action of drugs on biological systems. Courses offered by the program focus on general principles of medicinal chemistry, drug design and synthesis, chemical aspects of drug metabolism, chemical mechanisms of drug toxicity and carcinogenicity, computer-assisted drug design and receptor modeling, and combinatorial chemistry.

**Prerequisites for Admission**—Applicants should have a B.S. or M.S. degree in an appropriate related science field such as pharmacy, chemistry, or biology. Students majoring in other degree programs that encompass chemical, biochemical, or biological fields of study are also encouraged to apply. All applicants should have completed undergraduate chemistry through elementary organic chemistry. Undergraduate coursework in biochemistry and physical chemistry also is a prerequisite, but under certain circumstances such coursework may be taken during the first year. Students

usually are admitted fall semester only and admissions are generally for the Ph.D. program only.

**Special Application Requirements**—Scores from the General (Aptitude) Test of the GRE, three letters of recommendation from college-level faculty, a complete set of official transcripts, and a statement of immediate and long range career objectives are required. All application materials should be submitted by mid January to ensure priority consideration for fellowship, teaching, and research assistantships awarded for the next academic year.

**Courses**—Please refer to Medicinal Chemistry (MedC) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—With the exception of BioC 4331, use of 4xxx courses is not permitted toward degree requirements.

### M.S. Plan A Degree Requirements

Students must complete a core curriculum of advanced courses in organic chemistry (4 credits) and medicinal chemistry (10 credits), and 6 credits in a minor or related field.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A minimum of 6 credits is required for a master's minor.

### Ph.D. Degree Requirements

All students must complete a core curriculum of advanced courses in organic chemistry (7 credits), biochemistry (8 credits), and medicinal chemistry (12 credits). Students must also participate in the department seminar program, successfully complete a cumulative exam requirement that serves as the preliminary written exam, and prepare and defend an original research proposal which serves as the preliminary oral exam.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—A minimum of 12 credits is required for the doctoral minor, including an introductory course (MedC 5600), advanced medicinal chemistry courses, and other courses in the medicinal chemistry core curriculum.

## Medieval Studies

### Minor Only

**Contact Information**—Center for Medieval Studies, University of Minnesota, 304 Walter Library, 117 Pleasant Street S.E., Minneapolis, MN 55455 (612-626-0805; fax 612-626-7735; [cmcdst@umn.edu](mailto:cmcdst@umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Ronald F. Akehurst, French and Italian, M  
Bernard S. Bachrach, History, M  
Caesar E. Farah, African American and African Studies, M

Evelyn S. Firchow, German, Scandinavian, and Dutch, M

Donna G. Cardamone Jackson, Music, M

Klaus P. Jankofsky, English, Duluth, M

Ruth M. Karras, History, M

Calvin B. Kendall, English, M

Anatoly Liberman, German, Scandinavian, and Dutch, M

Susan J. Noakes, French and Italian, M

James A. Parente, Jr., German, Scandinavian, and Dutch, M

William D. Phillips, Jr., History, M

Kathryn L. Reyerson, History, M

Robert P. Sankowsky, Classical and Near Eastern Studies, M

John A. Watkins, English, M

Peter Wells, Anthropology, M

### Associate Professor

G. Lee Fullerton, German, Scandinavian, and Dutch, M

Kaaren E. Grimstad, German, Scandinavian, and Dutch, M

Nita Krevans, Classical and Near Eastern Studies, M

Rebecca L. Krug, English, M

Oliver Nicholson, Classical and Near Eastern Studies, M

John W. Steyaert, Art History, M

Ray M. Wakefield, German, Scandinavian, and Dutch, M

Barbara Weissberger, Spanish and Portuguese, M

### Assistant Professor

Lianna Farber, English, M

Michael T. Lower, History, M

**Curriculum**—The medieval studies minor is available to master's (M.A. and M.F.A.) and doctoral students. The Center for Medieval Studies (CMS) encourages collegial interaction and scholarly collaboration among faculty and students in all areas of medieval studies. CMS seeks to provide an opportunity for scholars of all disciplines and at all levels to focus intensively on historical, literary, anthropological, social, economic, religious, artistic, cultural, and methodological inquiries into the medieval period, which may fall within the chronology of roughly 300 to 1500 A.D. and may include the geographical area of Europe, the Middle East, and Russia. The primary emphasis of the program is on Latin, which is the most common learned and written language of the period, and secondarily on an interdisciplinary approach to medieval culture. The minor involves the Departments of History; Art History; Theatre Arts; Music; English; French and Italian; German, Scandinavian, and Dutch; Spanish and Portuguese Studies; and Classical and Near Eastern Studies.

**Prerequisites for Admission**—Admission to a medieval studies graduate minor is contingent upon prior admission to a master's or doctoral degree-granting program in the Graduate School.

**Courses**—Please refer to Medieval Studies (MeSt) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses toward degree requirements is permitted based on director of graduate study approval.

### Minor Only Requirements

The master's minor requires 6 graduate credits: two courses in medieval studies outside the student's major department, including a Latin course (Lat 8120 or any Latin course at 5xxx or above) and either one MeSt core course (5610 or 8110) or another approved course with medieval or Latin content; if the latter option is chosen, MeSt 8010 (the medieval colloquium course) is also required.

The doctoral minor requires 12 graduate credits, comprising courses in medieval studies outside the student's major department and including an additional Latin course at 5xxx or above. Students from Classical fields using Latin to satisfy requirements in those fields must substitute an equivalent quantity of a medieval vernacular language for the medieval studies Latin requirement.

## Microbial Ecology

### Minor Only

**Contact Information**—Michael Sadowsky, Microbial Ecology Minor Program, University of Minnesota, 258 Borlaug Hall, 1991 Upper Buford Circle, St. Paul, MN 55108 (612-624-2706; [sadowsky@soils.umn.edu](mailto:sadowsky@soils.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Regents Professor

G. David Tilman, Ecology, Evolution, and Behavior, M

### Professor

Iris D. Charvat, Plant Biology, M

Linda L. Kinkel, Plant Pathology, M

Timothy J. Kurtii, Entomology, M

David J. McLaughlin, Plant Biology, M

Jean-Alex E. Molina, Soil, Water, and Climate, M

Philip J. Regal, Ecology, Evolution, and Behavior, M

Michael J. Sadowsky, Soil, Water, and Climate, M

Lawrence P. Wackett, Biochemistry, M

### Associate Professor

Randall E. Hicks, Biology, Duluth, M

**Curriculum**—This minor is available to master's (M.S.) and doctoral (Ph.D.) students. Microbial ecology is an interdisciplinary research area concerned with the relationships of microorganisms to their natural environment. The microbial ecology minor offers core coursework in microbiology, microbial physiology, microbial genetics, microbial ecology, and theoretical ecology. Additional courses and opportunities to interact with others interested in microbial ecology are also part of the minor. The microbial ecology/biotechnology seminar series allows students and faculty to interact with microbial ecologists from other universities. The curriculum encourages interdisciplinary interaction, communication, and synthesis.

**Prerequisites for Admission**—To be admitted to the minor, a student must be admitted to a master's or doctoral degree-granting program within the Graduate School, should have broad training in the

biological sciences, and must be accepted by the director of graduate studies of the microbial ecology minor program. All students are expected to have had the equivalent of introductory microbiology (MicB 3301) and general ecology, but may fulfill deficiencies in these areas by taking these courses while in the program.

**Special Application Requirements**—Consult the director of graduate studies. Students are admitted each semester.

**Courses**—Please contact the minor program office for information on relevant coursework.

**Use of 4xxx Courses**—Inclusion of more than one 4xxx course on degree program forms is subject to adviser and director of graduate study approval.

### Minor Only Requirements

The master's minor requires 6 graduate credits, all of which must be outside the student's major department and must include at least one laboratory course in microbiology (e.g., MicB 4215) and one ecology (EEB) course chosen from the list below. The remaining courses also are chosen from this list with the guidance and approval of the director of graduate studies in microbial ecology.

The doctoral minor requires 12 graduate credits, 9 credits of which must come from the core courses listed below (contact the director of graduate studies for potential alternatives to these courses). The remaining credits must come from at least two courses chosen from this list, but may not be in the student's major.

Core Courses: EEB 5053 (4 cr); MicB 4111 (3 cr); MicB 4121 (3 cr); MIMP 8002 (4 cr).

Additional Courses: CE 8541, 8542, 8551, EEB 4601, 4609, PIPa 8102, 8103, Soil 5515, 5611.

## Microbial Engineering

**Contact Information**—M.S. Program in Microbial Engineering, University of Minnesota, 1479 Gortner Avenue, Suite 140, St. Paul, MN 55108 (612-625-0212; fax 612-625-5870; <<http://cbs.umn.edu/bti/microbialms.html>>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Robert J. Brooker, Genetics and Cell Biology, M2  
Peter W. Carr, Chemistry, M2  
Paul P. Cleary, Microbiology, M2  
Gary M. Dunny, Microbiology, M2  
Lynda B. Ellis, Laboratory Medicine and Pathology, M2  
Anthony J. Faras, Microbiology, M2  
Michael C. Flickinger, Biochemistry, M2  
James A. Fuchs, Biochemistry, M2  
Richard S. Hanson, Microbiology, M2  
Alan B. Hooper, Genetics and Cell Biology, M2  
Wei-Shou Hu, Chemical Engineering and Materials Science, M2  
R. Scott McIvor, Laboratory Medicine and Pathology, M2  
Michael J. Sadowsky, Soil, Water, and Climate, M2

Janet L. Schottel, Biochemistry, M2  
David H. Sherman, Microbiology, M2  
W. Thomas Shier, Medicinal Chemistry and Pharmacognosy, M2  
Friedrich Srienc, Chemical Engineering and Materials Science, M2  
Lawrence P. Wackett, Biochemistry, M2

### Associate Professor

Daniel J. O'Sullivan, Food Science and Nutrition, M2

### Assistant Professor

Arkady Khodursky, Biochemistry, M2  
Claudia Schmidt-Dannert, Biochemistry, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Microbial engineering is an interdisciplinary program that combines an understanding of basic principles in microbiology, biochemistry, molecular biology, chemical engineering, and related sciences. Students are trained in the industrial application of microorganisms, cultured cells, and immunologic agents. Students learn both modern basic microbiology and biological engineering and can either proceed to a Ph.D. program in a related discipline or work directly with research and development staff in biotechnology industries. Supporting courses may be chosen from specific fields including biochemistry, microbiology, food science, genetics and cell biology, or pharmacognosy. The program is coordinated by the BioTechnology Institute (BTI), involving faculty from ten departments and four institutes of the University.

**Prerequisites for Admission**—A baccalaureate degree in biological sciences, microbiology, biochemistry, chemistry, or chemical engineering is preferred. Undergraduate coursework should include one year each of calculus, organic chemistry, physics, microbiology, and basic chemical engineering, as well as a background in basic biology, physical chemistry, biochemistry, and genetics. Deficiencies may be made up during the first year of graduate studies.

**Special Application Requirements**—Three letters of recommendation, scores from the General Test of the GRE, the TOEFL score for international applicants, transcripts, and an autobiographical statement including occupational goals must be submitted to the director of graduate studies. Applications are accepted at any time, but the majority of students are accepted for fall semester. To receive full consideration for financial aid, students must apply for fall semester admission by February 1.

**Courses**—Please refer to Microbial Engineering (MicE) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—A limited number of 4xxx courses are permitted toward degree requirements based on director of graduate studies approval.

## M.S. Degree Requirements

The M.S. requires 32 credits (including 10 thesis credits) for Plan A and 32 credits (including 1-4 research credits) for Plan B. The two-year program comprises coursework in a specialized program of microbiology, molecular biology, immunology, and chemical engineering. In addition, students present two seminars and teach one laboratory course in advanced microbiology, biochemistry, molecular biology, immunology, or chemical engineering. Students may choose supporting coursework (at least 6 credits) from specified fields, including biochemistry, food science, pharmacognosy, genetics, and cell biology and must demonstrate proficiency in computer programming and one computer language. Plan A students carry out a research project resulting in a thesis. Plan B students complete a summer preceptorship (about 2 1/2 months) in a private company research laboratory or at a research institute in the University, and prepare a Plan B paper based on the research project. Presentation of the original laboratory research thesis/project to the graduate faculty is required at the end of the second year.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A minor in microbial engineering is offered at the doctoral level only. Students must complete at least 12 credits, selected in consultation with the director of graduate studies for microbial engineering.

## Microbiology, Immunology, and Cancer Biology

**Contact Information**—Microbiology, Immunology, and Cancer Biology Program, University of Minnesota, MMC 196, 420 Delaware Street S.E., Minneapolis, MN 55455 (mailing address) (612-624-5947; fax 612-626-0623; [micab@mail.ahc.umn.edu](mailto:micab@mail.ahc.umn.edu)).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Regents Professor

Ashley T. Haase, Microbiology, SM

### Professor

Khalil Ahmed, Laboratory Medicine and Pathology - SM  
Timothy W. Behrens, Medicine, SM  
Judith G. Berman, Genetics, Cell Biology, and Development, SM  
Peter B. Bitterman, Medicine, SM  
Bruce R. Blazar, Pediatrics, SM  
Paul P. Cleary, Microbiology, SM  
Agustin P. Dalmasso, Surgery, SM  
Anath Das, Biochemistry, Molecular Biology, and Biophysics, SM  
Gary M. Dunny, Microbiology, SM  
Lynda B. Ellis, Laboratory Medicine and Pathology, SM  
Dale S. Gregerson, Ophthalmology, SM  
Marc K. Jenkins, Microbiology, SM  
Vivek Kapur, Veterinary Pathobiology, SM  
Tucker W. LeBien, Laboratory Medicine and Pathology, SM

Walter C. Low, Neurosurgery, SM  
Paul T. Magee, Genetics, Cell Biology, and Development, SM  
James B. McCarthy, Laboratory Medicine and Pathology, SM  
R. Scott McIvor, Laboratory Medicine and Pathology, SM  
Larry L. McKay, Food Science and Nutrition, SM  
Matthew F. Mescher, Laboratory Medicine and Pathology, SM  
Jeffrey S. Miller, Medicine, SM  
Daniel L. Mueller, Medicine, SM  
Sundaram Ramakrishnan, Pharmacology, SM  
Michael J. Sadowsky, Soil, Water, and Climate, SM  
Michel M. Sanders, Biochemistry, Molecular Biology, and Biophysics, SM  
Patrick M. Schlievert, Microbiology, SM  
Janet L. Schottel, Biochemistry, Molecular Biology, and Biophysics, SM  
Yoji Shimizu, Laboratory Medicine and Pathology, SM  
Daniel A. Valleria, Therapeutic Radiology, SM  
Brian G. Van Ness, Genetics, Cell Biology, and Development, SM  
Gregory M. Vercellotti, Medicine, SM  
Catherine M. Verfaillie, Medicine, SM  
Lawrence P. Wackett, Biochemistry, Molecular Biology, and Biophysics, SM  
Lee W. Wattenberg, Laboratory Medicine and Pathology, SM  
Carol L. Wells, Laboratory Medicine and Pathology, SM  
Douglas Yee, Medicine, SM

### Associate Professor

Mitchell S. Abrahamsen, Veterinary Pathobiology, SM  
Sandra K. Armstrong, Microbiology, SM  
Vivian J. Bardwell, Genetics, Cell Biology, and Development, SM  
Kathleen F. Conklin, Microbiology, SM  
Kristin A. Hogquist, Laboratory Medicine and Pathology, SM  
Stephen C. Jameson, Laboratory Medicine and Pathology, SM  
Ronald R. W. Jemmerson, Microbiology, SM  
David A. Largaespada, Genetics, Cell Biology, and Development, SM  
Daniel J. O'Sullivan, Food Science and Nutrition, SM  
Christopher A. Pennell, Laboratory Medicine and Pathology, SM  
Leslie A. Schiff, Microbiology, SM  
Amy P. Skubitz, Laboratory Medicine and Pathology, SM  
Peter Southern, Microbiology, SM  
Bruce K. Walcheck, Veterinary Pathobiology, SM

### Assistant Professor

Paul Bohjanen, Microbiology, SM  
Dana Davis, Microbiology, SM  
Michael A. Farrar, Laboratory Medicine and Pathology, SM  
Jennifer L. Hall, Medicine, SM  
Linda K. Hansen, Laboratory Medicine and Pathology, SM  
Elizabeth G. Ingulli, Pediatrics, SM  
Dan S. Kaufman, Medicine, SM  
Ameeta Kelekar, Laboratory Medicine and Pathology, SM  
Alexander Khoruts, Medicine, SM  
Carol A. Lange, Medicine, SM  
Christian D. Mohr, Microbiology, SM  
Erik J. Peterson, Medicine, SM  
Robert J. Sheaff, Biochemistry, Molecular Biology, and Biophysics, SM  
Wufan Tao, Medicine, SM  
Kim-Sue Tudor, Laboratory Medicine and Pathology, SM  
Jennifer J. Westendorf, Orthopedic Surgery, SM

### Senior Research Fellow

Stephen A. Rice, Microbiology, SM

### Research Associate

Brett K. Levay-Young, Surgery, SM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Students prepare for careers in biomedical research and teaching by completing broad training in molecular biology or biological sciences, and focused specialization in one of three concentrations (microbiology, immunology, or cancer biology). The program offers exceptional research opportunities for graduate training in autoimmunity, biotechnology, cancer biology and therapy, environmental microbiology, genetic engineering of microorganisms, lymphocyte activation and development, microbial pathogenesis, molecular genetics of disease, superantigens, and vascular biology and inflammation.

**Prerequisites for Admission**—College coursework should include a year of general chemistry; organic chemistry; physics; calculus; and one academic year or the equivalent of courses in the biological sciences supplemented by courses in biochemistry and genetics. A course in microbiology, immunology, or histology is highly recommended but not required.

**Special Application Requirements**—The following must be submitted to the program: three letters of recommendation; scores from the General (Aptitude) Test of the GRE; a copy of your transcripts; a copy of the Graduate School application; and a brief description of reasons for seeking an advanced degree, areas of research interest and reasons for these interests, and career objectives. A minimum TOEFL score of 600 is required of applicants whose native language is not English. Applicants are encouraged to apply for fall semester admission only because the core curriculum begins in fall. Applications should be submitted by December 15; those received after that date are considered only if space in the desired program is available.

**Courses**—Please refer to Microbiology, Immunology, and Cancer Biology (MICa) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses on degree program forms is permitted based on director of graduate study approval.

### M.S. Plan A Degree Requirements

Students are not admitted directly into the master's program; it is available only by special arrangement with the program. Students complete 14 MICa course credits, 6 credits in the minor or related field, and 10 thesis credits. Students must write and defend a thesis based on original research.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Ph.D. Degree Requirements

The Ph.D. requires a minimum of 22 course credits in the major, 12 course credits in a minor or supporting program, and 24 thesis credits.

Beginning study in the fall, students spend their first year on major coursework, identifying an adviser by doing laboratory rotations, selecting a concentration, and initiating their thesis research project. All students take courses on the structure, function, and metabolism of microorganisms; molecular immunology; and cancer biology, as well as in their chosen concentration during their first two years.

In addition to coursework and research, students have opportunities to participate in laboratory meetings, journal clubs, and student research seminars, and to assist in laboratory courses. Most students complete the Ph.D. in four to five years.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—A doctoral minor requires MICa 8001 (3 credits), MICa 8910 (1 credit), and other 8xxx MICa courses at 3 or 4 credits, totaling a minimum of 12 credits.

## Molecular, Cellular, Developmental Biology and Genetics

**Contact Information**—Director of Graduate Studies, Molecular, Cellular, Developmental Biology and Genetics, University of Minnesota, 6-160 Jackson Hall, 321 Church St. S.E., Minneapolis, MN 55455 (612-624-7470; fax 612-626-6140; [mcdbg@cbs.umn.edu](mailto:mcdbg@cbs.umn.edu); <<http://cbs.umn.edu/mcdbg/>>).

Inquiries about graduate program activities, courses, and research opportunities should be directed to the director of graduate studies at the same address and phone number.

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Regents Professor

Ronald L. Phillips, Agronomy and Plant Genetics, SM

### Professor

Timothy W. Behrens, Medicine, SM  
Judith G. Berman, SM  
Susan A. Berry, Pediatrics, SM  
Robert M. Brambl, Plant Biology, SM  
Robert J. Brooker, SM  
Robert P. Elde, Neuroscience, SM  
Stuart F. Goldstein, SM  
Perry B. Hackett, SM  
David W. Hamilton, SM  
Thomas S. Hays, SM  
Robert K. Herman, SM  
Ross G. Johnson, SM  
Richard A. King, Medicine, SM  
Ryoko Kuriyama, SM  
Paul A. Lefebvre, Plant Biology, SM  
Paul C. Letourneau, Neuroscience, SM  
Richard W. Linck, SM  
Dennis M. Livingston, Biochemistry, Molecular Biology, and Biophysics, SM  
Paul T. Magee, SM

Cary N. Mariash, Medicine, SM  
 James B. McCarthy, Laboratory Medicine and Pathology, SM  
 R. Scott McIvor, SM  
 Steven C. McLoon, Neuroscience, SM  
 Matthew F. Mescher, Laboratory Medicine and Pathology, SM  
 Michael B. O'Connor, SM  
 Neil E. Olszewski, Plant Biology, SM  
 Harry T. Orr, Laboratory Medicine and Pathology, SM  
 Laura P. W. Ranum, SM  
 Janet L. Schottel, Biochemistry, Molecular Biology, and Biophysics, SM  
 Yoji Shimizu, Laboratory Medicine and Pathology, SM  
 Carolyn D. Silflow, Plant Biology, SM  
 Michael J. Simmons, SM  
 D. Peter Snustad, Plant Biology, SM  
 Robert L. Sorenson, SM  
 Clifford J. Steer, Medicine, SM  
 Howard C. Towle, Biochemistry, Molecular Biology, and Biophysics, SM  
 Brian G. Van Ness, SM  
 Catherine M. Verfaillie, Medicine, SM  
 Chester B. Whitley, Pediatrics, SM  
 Susan M. Wick, Plant Biology, SM

#### Associate Professor

Vivian J. Bardwell, SM  
 Kathleen F. Conklin, SM  
 Stephen C. Ekker, SM  
 Betsy A. Hirsch, Laboratory Medicine and Pathology, SM  
 Kristin A. Hogquist, Laboratory Medicine and Pathology, SM  
 Victoria Iwanij, SM  
 Stephen C. Jameson, Laboratory Medicine and Pathology, SM  
 David A. Largaespada, SM  
 Bonnie S. LeRoy, SM  
 M. David Marks, Plant Biology, SM  
 Mary E. Porter, SM  
 Ann E. Rougvie, SM  
 Joceyln E. Shaw, SM  
 Jeffrey A. Simon, SM  
 Amy P. Skubitz, Laboratory Medicine and Pathology, SM  
 Margaret A. Titus, SM  
 David A. Zarkower, SM

#### Assistant Professor

Linda M. Boland, Neuroscience, SM  
 Lihsia Chen, SM  
 Duncan Clarke, SM  
 Electra C. Coucouvanis, SM  
 David T. Kirkpatrick, SM  
 Jeffrey R. Miller, SM  
 Thomas P. Neufeld, SM  
 Jennifer Roggenbuck, AM  
 William Shawlot, SM  
 Nikunj Somia, SM

#### Other

Mary J. Ahrens, AM  
 Janice Baker, AM  
 Shari R. Baldinger, AM  
 Beth Conrad, AM  
 Vicki L. Couch, AM  
 Maryann V. Fox, AM  
 Katherine A. Nelson Fuhrman, AM  
 Judy Garza, AM  
 Joy Gustin, AM  
 Bonnie A. Hatten, AM  
 Beth A. Henderson-Conrad, AM  
 Nancy J. Mendelsohn, AM  
 Karol R. Rubin, AM  
 Alysia B. Spear, AM  
 Catherine M. Walsh Vockley, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—This program provides scientific training in the basic life sciences, with emphasis on the molecular basis of genetics, development, and cell biology. Areas of specialization include membranes, receptors, and membrane transport; cell interactions; macromolecular structure; extracellular matrix; cytoskeleton and cell motility; regulation of gene expression; neuroscience; developmental mechanisms; human genetics; plant cell and molecular biology; genetic mechanisms; and genomics.

The program is interdisciplinary and involves faculty from several departments in the College of Biological Sciences, the Medical School, and the College of Agricultural, Food and Environmental Sciences. Special institutes in human genetics, plant molecular genetics, biological process technology, and a center for developmental biology provide opportunities for graduate study. The program administers a specialty in genetic counseling.

**Prerequisites for Admission**—The program is sufficiently flexible to accommodate students with a wide range of backgrounds. Students with bachelor's degrees in any of the biological, chemical, or physical sciences are encouraged to apply. Recommended academic preparation includes one year each of calculus, organic chemistry, and physics, and background in basic biology including biochemistry and genetics. Research experience is highly desirable. For students of demonstrated ability, background deficiencies can be made up during the first year of graduate study. Exceptional international applicants with TOEFL scores of 650 or better will be considered.

**Special Application Requirements**—Applicants are required to submit three letters of recommendation from persons familiar with their academic and research capabilities; scores from the General (Aptitude) Test of the GRE; and a statement of interests, goals, and research experience. The Subject (Advanced) Test (in biology; chemistry; or biochemistry, cell and molecular biology) of the GRE is not required but highly recommended. Recommended date for receipt of completed applications is December 1. Graduate studies typically begin in the fall term.

**Courses**—Please refer to Molecular, Cellular, Developmental Biology and Genetics (MCDG) and Genetics, Cell Biology, and Development (GCD) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses is not permitted toward degree requirements.

#### M.S. Degree Requirements

Students are admitted to the M.S. program only under exceptional circumstances (e.g., if they can be in the area for only two years) or if they are accepted into the genetic counseling specialization; in both cases, applicants must also be competitive for admission at the Ph.D. level.

The M.S. is offered under Plan A and Plan B. Plan A requires a minimum of 20 course credits and 10 thesis credits; Plan B requires a minimum of 30 course credits and the completion of Plan B papers. Students take a core curriculum, which is multidisciplinary and contributes to both the major and minor or related field requirements. Students may choose a concentration or specialization within the program such as cell biology, developmental biology, genetics, or human genetics. The M.S. on average takes two years to complete.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—A master's minor requires 6 credits.

#### Ph.D. Degree Requirements

The Ph.D. program is designed by the student and the adviser to meet individual interests and goals. Advanced courses in genetics, molecular biology, cell biology, developmental biology, and biochemistry are required, in addition to special courses, topical seminar courses, laboratory research rotations, thesis research, student research seminars, departmental seminars, and journal clubs. The student's core curriculum is multidisciplinary and contributes to both major and minor field requirements.

**Language Requirements**—None.

**Minor Requirements for Students Majoring in Other Fields**—A doctoral minor typically includes the genetics core (GCD 8131 and BioC 8002 or GCD 8121 or GCD 4034), cell biology (GCD 8151 or 5036), and developmental biology (GCD 8161, 4151 or 4161), as appropriate to the student's field of specialization.

## Molecular Veterinary Biosciences

**Contact Information**—See Veterinary Medicine.

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### Professor

Trevor R. Ames, Clinical and Population Sciences, SM  
 Alvin J. Beitz, Veterinary Pathobiology, SM  
 Russell F. Bey, Veterinary Pathobiology, SM  
 David R. Brown, Veterinary Pathobiology, SM  
 Agustin P. Dalmasso, Medicine, SM  
 Mohamed El Halawani, Animal Science, SM  
 Douglas N. Foster, Animal Science, SM  
 Esther M. Gallant, Veterinary Pathobiology, SM  
 Sagar Goyal, Veterinary Diagnostic Medicine, SM  
 Richard Isaacson, Veterinary Pathobiology, SM  
 Mathur S. Kannan, Veterinary Pathobiology, SM  
 Vivek Kapur, Veterinary Pathobiology, SM  
 Alice A. Larson, Veterinary Pathobiology, SM  
 Samuel K. Maheswaran, Veterinary Pathobiology, SM  
 James R. Mickelson, Veterinary Pathobiology, SM  
 Thomas W. Molitor, Clinical and Population Sciences, SM  
 Michael P. Murtaugh, Veterinary Pathobiology, SM  
 Scott M. O'Grady, Animal Science, SM  
 John W. Osborn, Animal Science, SM

F. Abel Ponce de Leon, Animal Science, SM  
Stephanie J. Valberg, Clinical and Population Sciences, SM  
Douglas J. Weiss, Veterinary Pathobiology, SM

### Associate Professor

Mitchell S. Abrahamsen, Veterinary Pathobiology, SM  
Cathy Sue Carlson, Veterinary Diagnostic Medicine, SM  
Moses Njenga, Veterinary Pathobiology, SM  
Mark S. Rutherford, Veterinary Pathobiology, SM  
Bruce K. Walcheck, Veterinary Pathobiology, SM  
Scott Wells, Clinical and Population Sciences, SM

### Assistant Professor

Leeson J. Alexander, Veterinary Pathobiology, SM  
Dori Borjesson, Veterinary Diagnostic Medicine, SM  
John Collister, Veterinary Pathobiology, SM  
Yang Da, Animal Science, SM  
Kay S. Faaberg, Veterinary Pathobiology, SM  
Scott Fahrenkrug, Animal Science, SM  
Yinduo Ji, Veterinary Pathobiology, SM  
Sagarika Kanjilal, Veterinary Pathobiology, SM  
Laura J. Mauro, Animal Science, SM  
Kent Reed, Veterinary Pathobiology, SM  
Pam Skinner, Veterinary Pathobiology, SM  
Anthony Tobias, Small Animal Clinical Science, SM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The mission of the graduate program in molecular veterinary biosciences is to educate students in basic biological mechanisms associated with or responsible for animal health and disease. This mission makes it unique among other biomedical science graduate programs at the University. Faculty research interests focus on molecular mechanisms of pathogenesis, including areas of immunobiology, microbiology, parasitology, virology, and pathology, and on comparative biomedical sciences, including areas of cellular and molecular biology, biochemistry, genetics, neuroscience, physiology, and pharmacology.

The program brings together basic and clinical scientists to provide students with biomedical research training and to apply new knowledge toward the understanding of animal disease, animal populations, comparative aspects of biology and pathology across species, and animal models of human disease. This program thus facilitates the application of basic knowledge toward the improvement of animal health and productivity, disease prevention, and diagnostic techniques.

**Prerequisites for Admission**—A bachelor's degree in biological sciences is required.

**Courses**—Please refer to Molecular Veterinary Biosciences (MVB) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses is not permitted toward degree requirements.

### M.S. Plan A Degree Requirements

The M.S. requires a core curriculum of fundamental coursework and laboratory experiences followed by one or more courses (6 credits) in the area of specialization.

Students complete 20 course credits and 10 thesis credits; the thesis is based on original laboratory research.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Ph.D. Degree Requirements

The Ph.D. requires a core curriculum of fundamental coursework and laboratory experiences followed by one or more courses in areas of special interest. Considerable flexibility is available for students to construct a program around their own interests. Students also take 12 credits in a minor or supporting program and 24 thesis credits. All students are expected to participate in two continuing series of seminars: one involving reports on current literature and research and the other involving seminars by prominent national and international scientists.

**Language Requirements**—None.

## Museum Studies

### Minor Only

**Contact Information**—Museum Studies Graduate Minor; 300 Bell Museum, 10 Church Street S.E., University of Minnesota, Minneapolis, MN 55455 (612-624-6380; fax 612-626-7704).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Regents Professor

Joanne B. Eicher, M

### Professor

Robert J. Poor, AM  
Peter S. Wells, AM  
Gayle Graham Yates, AM

### Associate Professor

Margaret K. DiBlasio, M

### Assistant Professor

David J. Rhees, AM

### Lecturer

Anita F. Cholewa, AM

### Other

Robert D. Jacobsen, AM  
Lyndel I. King, M  
Gordon R. Murdock, M  
Colleen J. Sheehy, AM

**Curriculum**—The museum studies minor offers a structured graduate curriculum for master's and doctoral students interested in museums. It provides students from a variety of disciplines with an introduction to the issues involved in museum practices (e.g., educational, curatorial, administrative, and conservation). The curriculum includes seminars and internships.

**Prerequisites for Admission**—Admission to the museum studies graduate minor is contingent upon prior admission to a master's or doctoral degree-granting program within the Graduate School. It is anticipated that no more than 15 students will be admitted to this minor each year.

**Courses**—Please refer to Museum Studies (MSt) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses towards degree requirements is permitted based on director of graduate studies approval.

### Minor Only Requirements

The master's and doctoral minors require an introductory seminar (MSt 5011, 3 credits) and the museum practices course (MSt 5012, 3 credits). An internship (MSt 5020) is also required, 1 credit for the master's minor, 6 credits for the doctoral minor.

## Music

**Contact Information**—School of Music, University of Minnesota, 100 Ferguson Hall, 2106 4th Street S., Minneapolis, MN 55455 (phone 612-624-0071; fax 612-624-8001; [mus-adm@umn.edu](mailto:mus-adm@umn.edu)).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

John E. Anderson, SM  
Lydia Artymiw, SM  
Thomas J. Ashworth, SM  
David B. Baldwin, SM  
Alexander Braginsky, SM  
Michael Cherlin, SM  
Margo Garrett, SM  
David A. Grayson, SM  
Paul A. Haack, SM  
Donna C. Jackson, SM  
Jeffrey Kimpton, SM  
Craig J. Kirchoff, SM  
Korey B. Konkol, SM  
Thomas S. Lancaster, SM  
Alex J. Lubet, SM  
Glenda Maurice, SM  
Sally O'Reilly, SM  
Tanya Remenikova, SM  
Rebecca P. Shockey, SM  
Everett L. Sutton, SM  
D. Clifton Ware, Jr., SM  
Lawrence Weller, SM  
Judith L. Zaimont, SM

### Associate Professor

Dean W. Billmeyer, SM  
Mark P. Bjork, SM  
David A. Damschroder, SM  
Jean Del Santo, SM  
Charles E. Furman, SM  
Kelley A. Harness, SM  
Young Nam Kim, SM  
Jerry Luckhardt, SM  
Peter Mercer-Taylor, SM  
Fernando A. Meza, SM  
Paul M. A. Shaw, SM

### Assistant Professor

Akosua Addo, M2  
Matthew Bribitzer-Stull, M2  
Immanuel Davis, SM  
Doug Geers, M2  
Keitha Lucas Hamann, SM  
Mirjana Lausevic, M2  
Akira Mori, SM  
Kathy S. Romey, M2  
David Teachout, M2  
David Walsh, M2

### Instructor

Rosalind L. Laskin, AM  
John W. Miller, Jr., AM  
Dean Sorenson, AM  
Ross Tolbert, AM

### Lecturer

James L. Clute, AM  
Jorja Fleezanis, AM

Brian Grivna, AM  
 Charles D. Kavalovski, AM  
 Kathy Kienzle, AM  
 Peter M. Lloyd, AM  
 Basil Reeve, AM  
 Eugene Rousseau, SM  
 John Snow, AM  
 Thomas Turner, AM  
 Charles Ullery, AM  
 Jeffrey W. Van, AM  
 Herbert E. Winslow, AM

#### Other

Julia Bogorad, AM  
 Gary A. Bordner, AM  
 Christopher Brown, AM  
 Timothy Diem, AM  
 Burt Hara, AM  
 Barbara G. Kierig, AM  
 Nancy L. Sugden, AM  
 Wendy Zaro-Mullins, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The School of Music offers a master of arts (M.A.) in music, an M.A. in music education, a master of music (M.M.), a doctor of musical arts (D.M.A.), and a doctor of philosophy (Ph.D.) degree. The School of Music also cooperates with the College of Education and Human Development in offering the master of education (M.Ed.) with

an emphasis in music education/therapy. Applications for the M.Ed. are available from Student and Professional Services in the College of Education and Human Development. Specific degree plans and emphases are listed in each degree's requirements below.

**Prerequisites for Admission**—Applicants must hold a bachelor's degree or its equivalent with a major emphasis in one of the following areas of music: musicology/ethnomusicology, theory and/or composition, performance, or music education/therapy. Applicants to the M.A. in music education also generally hold an appropriate teaching license.

**Special Application Requirements**—All applicants must submit three current letters of recommendation. Applicants to the musicology/ethnomusicology, theory, composition, or music education/therapy programs must submit GRE General Test scores; applicants to other programs are encouraged to submit GRE scores in order to be eligible for University fellowships. Applicants whose primary language is not English must score a minimum of 565 on the TOEFL test to be exempt from further English study (ESL).

The various degree programs also require the following additional application materials:

<b>Degree Objective</b>	<b>Additional Materials</b>
Theory (M.A., Ph.D.)	Original papers (tonal and post-tonal analysis)
Composition (M.A., Ph.D.)	Original scores and recordings
Musicology/Ethnomusicology (M.A., Ph.D.)	Original papers
Music Education/Therapy (Ph.D.)	Original papers (e.g., research or professional papers). Documentation of at least 3 years of teaching experience, or at least 3500 hours of clinical experience
Accompanying/Coaching (M.M., D.M.A.)	Audition/Repertoire list
Conducting (D.M.A.)	Audition/Interview
Choral Conducting (M.M.)	Audition/Interview
Church Music (M.M.)	Audition/Interview
Orchestral Conducting (M.M.)	Audition/Interview
Wind Ensemble/ Band Conducting (M.M.)	Audition/Interview
Piano Pedagogy (M.M.)	Audition/Interview
Performance (M.M., D.M.A.)	Audition/Repertoire list

For the M.M. and D.M.A. programs in performance, taped auditions may be accepted for applicants who live more than 200 miles from the Twin Cities. However, you are encouraged to perform a live audition if at all possible. For the M.M. and D.M.A. in conducting, a preliminary tape screening is required in both audio and video formats.

Although students may be admitted any semester, only students starting in fall semester will be considered for financial assistance. To receive Graduate School fellowship consideration, all materials must be received by January 10. Check with the School of Music for scholarship and assistantship application deadlines.

**Diagnostic Exams**—Music Theory and Music History Placement Exams are administered to all entering students. All graduate students in music must demonstrate proficiency in the material found in the undergraduate music theory and ear training sequences, including the form and structure of tonal music and twentieth-century music theory and ear training. Similarly, they must demonstrate proficiency in music history from the Middle Ages to the present. Individual programs may require additional diagnostic exams.

**Courses**—Please refer to Music (Mus), Music Applied (MusA), and Music Education (MuEd) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses toward degree requirements is subject to adviser and/or director of graduate studies approval.

#### M.A. Degree Requirements

The master of arts in music offers emphases in musicology or ethnomusicology (Plan A or Plan B), theory (Plan B only), and composition (Plan B only).

The M.A. in music with emphasis in musicology or ethnomusicology requires 34 credits (24 course credits and 10 thesis credits) for Plan A and 30 course credits for Plan B; the emphasis in composition (Plan B only) requires 41 course credits, and the emphasis in music theory (Plan B only) requires 30 course credits. The credit totals for all emphases include 6 credits required for courses outside the major field.

**Language Requirements**—A reading knowledge of French, German, or Italian is required for all M.A. degree emphases.

**Final Exam**—For the emphasis in musicology and ethnomusicology, the final exams are written and oral. For the emphases in theory and composition, the final exam is oral.

#### M.M. Degree Requirements

The master of music degree offers emphases in piano, organ, voice, violin, viola, cello, double bass, violin performance and Suzuki pedagogy, flute, oboe, clarinet, saxophone, bassoon, French horn, trumpet, trombone, euphonium, tuba, percussion, harp, guitar, piano pedagogy, accompanying and coaching, orchestral conducting, wind ensemble and band conducting, choral conducting, and church music (choral and organ concentrations).

The M.M. requires credit distribution among the following for each emphasis: applied music, study directly related to the emphasis (literature, pedagogy, performance practice, conducting, secondary instrument, chamber music, etc.), ensemble, and Mus 5xxx or 8xxx musicology/ethnomusicology and theory/composition, with a minimum of one 3-credit course in each area. At least one recital is required.

The minimum credit requirement for each emphasis is as follows: 30 credits are required for piano, instrumental performance, harp, guitar, piano pedagogy, orchestral conducting, wind ensemble/band conducting, and choral conducting; 31 credits for church music (choral concentration); 40 credits for church music (organ concentration); 33 credits for organ and voice; 41 credits for accompanying and coaching (two recitals are required); and 37 credits for violin performance and Suzuki pedagogy.

**Language Requirements**—None.

**Final Exam**—A final oral exam is required that covers coursework and the final project and/or recital.

### D.M.A. Degree Requirements

For the doctor of musical arts, minimum credit requirements are as follows: 89 credits for piano; 85 credits for instrumental performance, guitar, and conducting; 87 credits for organ and woodwinds; 89 credits for voice; and 93 credits for accompanying and coaching.

The School of Music offers two options for D.M.A. degrees.

The first option requires the minimum credits as outlined above, typically divided as follows: 32 credits of applied study; 12 credits in musicology/ethnomusicology and theory/composition, with at least one 3-credit course in each area; a minimum of 8 credits directly related to the emphasis (literature, pedagogy, performance practice, conducting, secondary instrument, chamber music, etc.); 9 credits in a supporting program outside of music; 20 recital credits for five recitals; and 4 thesis credits for the D.M.A. project document.

The second option allows students to choose a secondary area of concentration to become professionally prepared in an area that complements the performance major. The secondary area option requires the approval of the student's adviser and of the director of graduate studies, and is limited to secondary areas approved by the Graduate Committee of the School of Music. Under this option, students perform three doctoral recitals instead of five (12 credits total, at 4 credits each). The remaining requirements are the same as in the first option for a D.M.A. Students must also fulfill the requirements for a secondary area as described below.

### Criteria for Secondary Areas

A secondary area comprises a minimum of 15 credits in total—normally five 3-credit courses, at least two of which must be 8xxx courses. Students choosing this option apply the 8 credits that result from reducing the number of doctoral recitals from five to three toward the secondary area. The remaining credits are derived principally from the other areas of music study already built into the D.M.A.—the areas of musicology, theory, pedagogy, etc. The distribution of these credits depends upon the specific secondary area chosen.

A secondary area concentrates either on a single discipline—e.g., musicology, music theory, composition, or choral conducting—or on an interrelated body of courses—e.g., technology and music, or pedagogy. All 15 credits of a secondary area must be achieved at the University of Minnesota School of Music (i.e., no transfer credits or credits from outside of the School of Music can be used). Students who choose a secondary area are encouraged but not obligated to write their thesis in that area. A list of secondary areas and their course requirements is available upon request from the Graduate Studies Office of the School of Music.

**Language Requirements**—The D.M.A. with emphasis in accompanying and coaching requires two languages chosen from French, German, and Italian; the emphasis in conducting requires German and either French or Italian.

### Ph.D. Degree Requirements

For the doctor of philosophy in music, emphases and minimum course credit requirements are as follows: 51 credits for musicology, ethnomusicology, and theory; 65 credits for composition; and 66 credits for music education. Programs are individualized and build on the core of coursework required for the corresponding master's degrees. Coursework includes 12-18 credits outside the major. In addition, 24 thesis credits are required.

**Language Requirements**—The language requirement for each emphasis is as follows:

*Musicology, ethnomusicology, and composition*—Two languages chosen from French, German, and Italian (substitution may be made when a different language is needed for the thesis. For composition, one language may also, with approval, be replaced by a collateral field of knowledge or a special research technique).

*Theory*—German and either French or Italian (substitution may be made when a different language is needed for the thesis; with approval, the second language may also be replaced by a collateral field of knowledge or a special research technique).

## Music Education

**Contact Information**—See Music.

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Paul A. Haack, M2  
Jeffrey Kimpton, M2

### Associate Professor

Charles E. Furman, M2

### Assistant Professor

Akosua Addo, M2  
Keitha Lucas Hamann, M2  
David J. Teachout, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The M.A. in music education (Plan B only) offers two emphases: music education and music therapy. The music education emphasis involves planning, teaching, learning, and evaluating processes with musical content applied across educational settings. While knowledge of acculturation phenomena is included, applications generally are directed toward structured educational settings. The music therapy emphasis furthers the preparation of professionals who use music to accomplish therapeutic aims. The two emphases are highly compatible and mutually enhancing.

The M.A. is a research-oriented degree with coursework fairly evenly divided between scholarly skill development, musical knowledge and skills, theoretical music education and music therapy content, and applications. The School of Music also cooperates with the College of Education and Human Development in offering the master of education (M.Ed.) with an emphasis in music education/therapy. Applications for the M.Ed. are available from Student and Professional Services in the College of Education and Human Development.

**Prerequisites for Admission**—See Music.

**Special Application Requirements**—See Music.

**Courses**—Please refer to Music (Mus), Music Applied (MusA), and Music Education (MuEd) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses towards degree requirements is subject to adviser and/or director of graduate studies approval.

### M.A. Degree Requirements

The M.A. requires 30 course credits: 12 credits in music education/therapy for the major; 10 credits in music; 3 credits of electives from professional education, music, and music education/therapy; and a 5-credit research project.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

## Nanoparticle Science and Engineering

### Minor Only

**Contact Information**—Graduate Minor Program in Nanoparticle Science and Engineering, Integrative Graduate Education and Research Traineeship Program, University of Minnesota, 2101 Mechanical Engineering, 111 Church Street S.E., Minneapolis, MN 55455 (612-625-4028; fax 612-625-4344; [nanoigert@me.umn.edu](mailto:nanoigert@me.umn.edu); <[www.nanoigert.umn.edu](http://www.nanoigert.umn.edu)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Stephen A. Campbell, Electrical and Computer Engineering, M  
Robert Carr, Chemical Engineering and Materials Science, M  
C. Barry Carter, Chemical Engineering and Materials Science, M  
Jim Chelikowsky, Chemical Engineering and Materials Science, M  
William Gerberich, Chemical Engineering and Materials Science, M  
Steven L. Girshick, Mechanical Engineering, M  
Wayne L. Gladfelter, Chemistry, M  
Joachim Heberlein, Mechanical Engineering, M  
James Kakalios, Physics, M  
David Kittelson, Mechanical Engineering, M  
Uwe Kortshagen, Mechanical Engineering, M  
Alon McCormick, Chemical Engineering and Materials Science, M  
Peter H. McMurry, Mechanical Engineering, M

David Y. H. Pui, Mechanical Engineering, M  
 Jeff Roberts, Chemistry, M  
 Donald G. Truhlar, Chemistry, M  
 Randall Victoria, Electrical and Computer Engineering,  
 M  
 Michael R. Zachariah, Mechanical Engineering and  
 Chemistry, M

#### Assistant Professor

Sean Garrick, Mechanical Engineering, M  
 Heiko O. Jacobs, Electrical and Computer  
 Engineering, M  
 Richard B. McClurg, Chemical Engineering and  
 Materials Science, M  
 R. Lee Penn, Chemistry, M

**Curriculum**—The Integrative Graduate Education and Research Traineeship program offers a minor in nanoparticle science and engineering for M.S. and Ph.D. students. The curriculum is designed to allow completion of the minor without an increase in overall course load. The minor requires one or two core courses and electives relevant to nanoparticle research. The program of courses is tailored in advance consultation between the student and director of graduate studies.

**Prerequisites for Admission**—Admission to a master's or doctoral degree-granting program in the Institute of Technology and preparation of a minor program of coursework approved by the director of graduate studies is required. Students in programs outside the Institute of Technology must be approved by the director of graduate studies.

**Use of 4xxx Courses**—4xxx courses may be included on degree program forms.

#### Minor Only Requirements

M.S. students must complete NPSE 8001—Introduction to Nanoparticle Science and Engineering (3 credits) and 3 elective credits. PhD students must complete NPSE 8001 and 8002—Nanoparticle Science and Engineering Laboratory (3 credits) and 6 elective credits.

Electives must be chosen from existing courses relevant to nanoparticle research. Examples include Chem 8021—Computational Chemistry, EE 5624—Optical Electronics, ME 8361—Introduction to Plasma Technology, Phys 5701—Solid State Physics for Engineers and Scientists, ChEn 8301—Physical Rate Processes I: Transport, and MatS 8212—Solid State Reaction Kinetics.

## Natural Resources Science and Management

**Contact Information**—Kathleen Walter, College of Natural Resources, University of Minnesota, 135 Skok Hall, 2003 Upper Buford Circle, St. Paul, MN 55108-6146 (612-624-2748; fax 612-624-6282; [kwalter@umn.edu](mailto:kwalter@umn.edu); <[www.cnr.umn.edu/grad/NRSMgrad/](http://www.cnr.umn.edu/grad/NRSMgrad/)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### Professor

Dorothy H. Anderson, SM  
 Mark E. Ascerno, Jr., Entomology, SM  
 Marvin E. Bauer, SM  
 Melvin J. Baughman, SM  
 Robert A. Blanchette, Plant Pathology, SM  
 Charles R. Blinn, SM  
 James L. Bowyer, SM  
 Kenneth N. Brooks, SM  
 Thomas E. Burk, SM  
 Stephan P. Carlson, M2  
 John J. Cogan, Curriculum and Instruction, AM  
 Edward J. Cushing, Ecology, Evolution, and Behavior, SM  
 Alan R. Ek, SM  
 David T. Grimsrud, ASM  
 Gary R. Johnson, M2  
 Joseph G. Massey, SM  
 Leo H. McAvoy, Jr., Kinesiology, SM  
 Carl A. Mohn (emeritus), ASM  
 John L. Nieber, Biosystems and Agricultural Engineering, SM  
 James A. Perry, SM  
 Alan Stephen Polasky, Applied Economics, SM  
 Peter B. Reich, SM  
 C. Ford Runge, Applied Economics, ASM  
 Simo Sarkkanen, SM  
 Elmer L. Schmidt, SM  
 J. L. David Smith, Fisheries, Wildlife, and Conservation Biology, AM2  
 Susan G. Stafford, SM  
 Alfred D. Sullivan, M2  
 Karen Yin, SM

#### Adjunct Professor

William A. Befort, AM2  
 Robert G. Haight, AM  
 Randall K. Kolka, ASM  
 Ronald E. McRoberts, AM  
 Elon S. Verry, ASM  
 Jerrold E. Winandy, AM  
 Gary Worry, AM  
 John C. Zasada, ASM

#### Associate Professor

Paul V. Bolstad, SM  
 Fred N. Finley, Curriculum and Instruction, AM  
 Howard M. Hoganson, SM  
 Patrick H. Huelman, M2  
 Michael E. Ostry, AM  
 Shri Ramaswamy, SM  
 Steven J. Severtson, SM  
 Steven J. Taff, Applied Economics, AM2  
 Ulrike W. Tschirmer, SM

#### Adjunct Associate Professor

Erwin R. Berglund, AM2  
 Stephen M. Bratkovich, ASM  
 Pamela J. Jakes, AM2  
 Joseph G. O'Brien, AM  
 Brian J. Palik, AM  
 Don E. Riemenschneider, AM  
 Thomas L. Schmidt, ASM

#### Assistant Professor

David N. Bengston, ASM  
 Eileen V. Carey, SM  
 Andrew J. David, SM  
 Michael C. Demchik, M2  
 Karlyn Eckman, Institute for Global Studies, AM2  
 Daniel W. Gilmore, M2  
 Mark H. Hansen, AM2  
 Sarah E. Hobbie, Ecology, Evolution, and Behavior, AM  
 Michael A. Kilgore, SM  
 Veronica H. Long, Extension Tourism Center, AM  
 Kristine F. Miller, Landscape Architecture, AM  
 Kristen C. Nelson, SM  
 Harlan D. Petersen, M  
 Michael R. Reichenbach, Cloquet Forestry Center, M  
 Rubin Shmulsky, M2  
 Timothy M. Smith, M2  
 Eric K. Zenner, Forest Resources, M2

#### Adjunct Assistant Professor

David C. Fulton, Fisheries, Wildlife, and Conservation Biology, ASM  
 Michael J. Phillips, AM

#### Research Associate

Allen L. Lungren (emeritus), AM

#### Research Associate

Dean A. Current, M2  
 Lee E. Frelich, SM  
 Jacek Oleksyn, AM  
 Ingrid E. Schneider, SM  
 Robert T. Seavey, M  
 Robert A. Stine, Cloquet Forestry Center, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Students normally emphasize one of the following tracks: 1) Forests (biology, ecology, conservation, and management); 2) economics, policy, management, and society; 3) assessment, monitoring, and geospatial analysis; 4) recreation resources, tourism, and environmental education; 5) forest hydrology and watershed management; 6) forest products; or 7) paper science and engineering.

**Prerequisites for Admission**—Prerequisites vary by subfield. Most admitted students have earned degrees in natural resource related majors. Applicants with exceptional academic records but no related background are eligible; if admitted, they may complete the prerequisites for advanced courses during the early stages of their graduate program. Applicants for the doctoral program should demonstrate a capacity for advanced study and independent research.

**Special Application Requirements**—Applications are processed continually, and students are admitted each semester. However, submission of application materials by January 7 (for fall admission) is encouraged to ensure consideration for fellowships and assistantships. General GRE scores are required. Letters of recommendation are highly recommended. Applicants for the doctoral program should supply the names and addresses of three people who can provide evaluations of their capacity for advanced study and independent research.

**Courses**—Please refer to Natural Resources Science and Management (NR), Forest Resources (FR), Natural Resources and Environmental Studies (NRES), and Wood and Paper Science (WPS) in the course section of this catalog.

**Use of 4xxx Courses**—Inclusion of 4xxx Forest Resources (FR), Natural Resources and Environmental Studies (NRES), and Wood and Paper Science (WPS) courses on degree program forms of natural resources science and management majors or minors for the M.S. or Ph.D. degree is subject to adviser and director of graduate studies approval. Students from other majors may use these 4xxx courses subject to their own program's approval.

The Natural Resources Science and Management Graduate Studies Committee reviews and must approve all graduate degree programs. Although there is no set maximum number of 4xxx credits, programs with insufficient 5xxx and 8xxx coursework will not be approved.

### M.S. Degree Requirements

The M.S. is offered under Plan A (with thesis) and Plan B (without thesis). Plan A requires at least 20 credits and Plan B requires at least 30 credits; Plan A students also register for 10 thesis credits. Plan A students usually design a program to support their specific thesis project. Plan B students design a program, in consultation with faculty members, that develops competence in at least one subfield. Students present a seminar on the thesis, the Plan B project, or a topic selected in consultation with the graduate adviser. Specific requirements vary by subfield; prospective students should contact the director of graduate studies or a prospective faculty adviser for specific information.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—Students should contact the director of graduate studies. The selection of courses is influenced by the student's background and educational objective. Minor field competence is evaluated in the oral exam.

### Ph.D. Degree Requirements

The doctoral program varies from 30 to 60 credits, not including 24 thesis credits. Course selection and thesis proposals are developed by each student in consultation with the faculty adviser and are approved by the Natural Resources Science and Management Graduate Studies Committee.

**Language Requirements**—None.

**Minor Requirements for Students Majoring in Other Fields**—Students should contact the director of graduate studies. The selection of courses is influenced by the student's background and educational objective. Minor field competence is evaluated in the oral exam.

## Neuroscience

**Contact Information**—Neuroscience Program, University of Minnesota, D-610 Mayo Building, MMC 265, 420 Delaware St. S.E., Minneapolis, MN 55455 (612-626-5898; fax 612-626-6460; [neurosci@umn.edu](mailto:neurosci@umn.edu); [www.neuroscience.umn.edu](http://www.neuroscience.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Karen Hsiao Ashe, Neurology, SM  
Alvin J. Beitz, Veterinary Pathobiology, SM  
David R. Brown, Veterinary Pathobiology, SM  
Dwight A. Burkhardt, Psychology, SM  
Marilyn E. Carroll, Psychiatry, SM  
H. Brent Clark, Laboratory Medicine and Pathology, SM

Bianca M. Conti-Fine, Biochemistry, SM  
John W. Day, Neurology, SM  
Richard Di Fabio, Physical Therapy, SM  
Janet M. Dubinsky, Neuroscience, SM  
Timothy J. Ebner, Neuroscience, SM  
S. Mbuja Ngale Efange, Radiology, SM  
Robert P. Elde, Biological Sciences, SM  
Esam E. El-Fakahany, Psychiatry, SM  
William C. Engeland, Surgery, SM  
Martha Flanders, Neuroscience, SM  
William H. Frey, Pharmacy, SM  
Michael K. Georgieff, Pediatrics, SM  
Apostolos P. Georgopoulos, Neuroscience, SM  
Glenn J. Giesler, Jr., Neuroscience, SM  
Christopher M. Gomez, Neurology, SM  
Rolf Gruetter, Radiology, SM  
Boyd K. Hartman, Psychiatry, SM  
William G. Iacono, Psychology, SM  
Paul A. Iainzo, Anesthesiology, SM  
William R. Kennedy, Neurology, SM  
Daniel J. Kersten, Psychology, SM  
Alice A. Larson, Veterinary Pathobiology, SM  
Ping-Yee Law, Pharmacology, SM  
Gordon E. Legge, Neurology, SM  
Paul C. Letourneau, Neuroscience, SM  
Allen S. Levine, Psychiatry, SM  
Kelvin O. Lim, Psychiatry, SM  
Walter C. Low, Neurosurgery, SM  
Patrick W. Mantyh, Preventive Sciences, SM  
Steven C. McLoon, Neuroscience, SM  
Karen A. Mesce, Entomology, SM  
Robert F. Miller, Neuroscience, SM  
Charles A. Nelson, Child Development, SM  
Eric A. Newman, Neuroscience, SM  
Michael B. O'Connor, Genetics, Cell Biology, and Development, SM  
Harry T. Orr, Laboratory Medicine and Pathology, SM  
John W. Osborn, Physiology, SM  
Hans G. Othmer, Mathematics, SM  
J. Bruce Overmier, Psychology, SM  
Richard E. Poppele, Neuroscience, SM  
Philip S. Portoghese, Pharmacy, SM  
Laura P. Ranum, Genetics, Cell Biology, and Development, SM  
David A. Rottenberg, Neurology, SM  
Peter A. Santi, Otolaryngology, SM  
Ronald J. Sawchuk, Pharmaceuticals, SM  
Scott Selleck, Pediatrics, Genetics, Cell Biology, and Development, SM  
Virginia S. Seybold, Neuroscience, SM  
John F. Soechting, Neuroscience, SM  
Peter W. Sorensen, Fisheries and Wildlife, SM  
Sheldon B. Sparber, Pharmacology, SM  
Stanley A. Thayer, Pharmacology, SM  
David D. Thomas, Biochemistry, SM  
Kamil Ugurbil, Radiology, SM  
Catherine Verfaillie, Medicine, SM  
Neal F. Viemeister, Psychology, SM  
George L. Wilcox, Pharmacology, SM

### Associate Professor

John H. Anderson, Otolaryngology, SM  
James Ashe, Neuroscience, SM  
W. Dale Branton, Neuroscience, M2  
Patricia L. Farris, Psychiatry, SM  
S. Hossein Fatemi, Psychiatry, SM  
Janet L. Fitzakerley, Pharmacology Duluth, SM  
Jurgen F. Fohlmeister, Physiology, SM  
Sheng He, Psychology, SM  
Christopher N. Honda, Neuroscience, SM  
Eric Javel, Otolaryngology, SM  
Juergen Konczak, Kinesiology, SM  
Linda K. McLoon, Ophthalmology, SM  
Moses K. Njenga, Veterinary Pathobiology, SM  
Jose V. Pardo, Psychiatry, SM  
Giuseppe Pellizzer, Neuroscience, SM  
Donald A. Simone, Oral Sciences, SM  
Govind T. Vatasery, Psychiatry, SM  
Martin W. Wessendorf, Neuroscience, SM

### Adjunct Associate Professor

Catherine M. Kotz, Food Science and Nutrition, SM

### Assistant Professor

Bagrat Amirikian, Neuroscience, M2  
Vincent A. Barnett, Physiology, SM  
Linda M. Boland, Neuroscience, SM

Frank H. Burton, Pharmacology, SM  
Jian M. Ding, Medicine, SM  
Carolyn Fairbanks, Pharmaceuticals, Pharmacology, and Neuroscience, SM  
Rod M. Feddersen, Veterinary Pathobiology, SM  
Jonathan Gewirtz, Psychology, SM  
Dae-Shik Kim, Radiology, SM  
Paulo Kofuji, Neuroscience, SM  
Michael Koob, Neurology, SM  
Lorene Lanier, Neuroscience, SM  
Scott M. Lewis, Neurology, M2  
Dezhi Liao, Neuroscience, SM  
Paul G. Mermelstein, Neuroscience, SM  
A. David Redish, Neuroscience, SM  
Kevin D. Wickman, Pharmacology, SM  
Lance Zirpel, Neuroscience, SM

### Research Associate

Jon Gottesman, Neuroscience, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Neuroscience is an interdisciplinary field of inquiry. The objects of this inquiry, the brain and nervous system, are sufficiently complex and unique among biological systems to require experimental and analytical approaches that cross the traditional boundaries of molecular and cell biology, behavioral biology, biochemistry, genetics, pharmacology, physiology, and psychology. In some instances, neuroscientific inquiry may also encompass computer science, information processing, engineering, physics, and mathematics.

The neuroscience Ph.D. curriculum begins in the summer session with the intensive laboratory course in cellular and molecular neurobiology (NSc 5551), held at the Lake Itasca Biological Station. The core curriculum continues on the Twin Cities campus with NSc 5461, 5481, 5561, 5661, and 8211. While taking these courses, students explore research opportunities in the faculty's laboratories (NSc 8334) and thereby select a thesis adviser. Most students take a course in cell biology (such as Biol 4004) in the first semester. Because thesis research is expected to include statistical analysis of data, a course in statistics (such as Stat 5021) is required.

Elective courses and at least 12 credits in a minor or supporting program are selected in consultation with the adviser (typical minors include cell biology, physiology, statistics, psychology, and medicine; medicine is primarily for students in the M.D./Ph.D. program). Students with sufficient background and previous course experience may apply for a waiver of specific requirements. Proficiency in at least one computer programming language is highly recommended.

Students are also expected to participate in teaching neuroscience and to attend the weekly colloquium as well as neuroscience seminars and sessions devoted to professional development. Students are strongly encouraged to attend seminars in other areas and departments that may interest them.

**Prerequisites for Admission**—Applicants to the Ph.D. program must have a bachelor's degree or its foreign equivalent from a recognized college or university. Undergraduate coursework should include instruction in several of the following disciplines: biology, neuroscience, mathematics, physics, chemistry, and psychology.

**Special Application Requirements**—Applicants are required to take the GRE General Test. The Subject Test appropriate to their field of emphasis is optional. Foreign students must take the TOEFL and obtain a minimum score of 550.

**Courses**—Please refer to Neuroscience (NSc) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses toward degree requirements is permitted based on director of graduate studies approval.

### M.S. Plan A Degree Requirements

The course requirements for a master's are the same as those for a Ph.D. degree. They are described under Curriculum (above).

### Ph.D. Degree Requirements

The course requirements for a Ph.D. degree are described under Curriculum above. More detailed information may be found in the *Neuroscience Student Handbook* <[www.neuroscience.umn.edu/CurStu/studHand.html](http://www.neuroscience.umn.edu/CurStu/studHand.html)>.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—A doctoral minor program is developed in consultation with the director of graduate studies for neuroscience. Students must take one of NSc 5461, 5561, or 6111 and elective courses in neuroscience, for a minimum of 12 credits (including core courses).

## Nursing

**Contact Information**—Jennifer Rosand, Recruiter, School of Nursing, University of Minnesota, 5-160 Weaver Densford Hall, 308 Harvard Street S.E., Minneapolis, MN 55455 (612-624-4454; fax 612-624-3174; [urseoss@umn.edu](mailto:urseoss@umn.edu) <[www.nursing.umn.edu](http://www.nursing.umn.edu)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rovers/step1.asp](http://www.grad.umn.edu/faculty_rovers/step1.asp)>.

### Professor

Lyn Bearinger, SM  
Joanne Disch, AM  
Sandra Edwardson, SM  
Cynthia Gross, SM  
Felicia Hodge, SM  
Barbara Leonard, SM  
Mariah Snyder (emeritus), ASM  
Jean Wyman, SM

### Associate Professor

Melissa Avery, SM  
Donna Bliss, SM  
Laura Duckett, SM  
Karen Feldt, SM  
Ann Garwick, SM

Helen Hansen, SM  
Susan Henly, SM  
Ann Jones, AM  
Merrie Kaas, SM  
Madeleine Kerr, SM  
Kathie Krichbaum, SM  
Marsha Lewis, SM  
Betty Lia-Hoagberg, SM  
Joan Liaschenko, SM  
Linda Lindeke, SM  
Ruth Lindquist, SM  
Marilee Miller, AM  
Christine Mueller, SM  
Cynthia J. Peden-McAlpine, SM  
Janice Post-White, SM

### Assistant Professor

Diane Bohn, M2  
Linda Chlan, M2  
Kathleen Fagerlund, AM  
Linda Gerdner, M2  
Laila Gulzar, M2  
Linda Halcon, SM  
Elizabeth Kraatz, M2  
Mary Jo Kreitzer, AM  
Martha Kubik, AM  
Margaret Moss, M2  
Carol O'Boyle, M2  
Cheryl Robertson, M2  
Elizabeth Saewyc, M2  
Renee Sieving, AM  
Roxanne Struthers, M2  
Diane Treat-Jacobsen, M2  
Gretchen Zunkel, M2

### Other

Karen Alaniz, AM  
Linda Herrick, AM  
Catherine Juve, M2  
Jennifer Peters, AM  
Mary Rowan, M2  
Kay Savik, AM  
Lynn Sprayberry, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The School of Nursing prepares advanced practice nurses, leaders, and scholars in nursing, and provides coursework to prepare postbaccalaureate students from other disciplines to become licensed nurses. The M.S. program includes the following areas of study: adult health clinical nurse specialist, children with special health care needs, family nurse practitioner, generalist, gerontological clinical nurse specialist, gerontological nurse practitioner, nurse midwifery, nursing and healthcare systems administration, nursing education, oncology nursing, pediatric clinical nurse specialist, pediatric nurse practitioner, pediatric nurse practitioner/children with special health care needs, psychiatric-mental health clinical nurse specialist, public health nursing, public health nursing/adolescent nursing, public health nursing/school nursing, and women's health care nurse practitioner. The area of study the student chooses in the Plan B option is identified as a subprogram on the official transcript.

The Ph.D. program prepares creative and productive scholars in nursing. The postbaccalaureate certificate program is designed for students who wish to become registered nurses and currently hold a baccalaureate (or higher) degree in a field other than nursing. After successful

completion of the certificate program, graduates will be eligible to sit for the registered nurse licensure examination. Completion of the graduate coursework included in the certificate program positions students for entry into a graduate degree program in nursing.

**Prerequisites for Admission**—Applicants must meet the stated requirements of the Graduate School, including a minimum undergraduate GPA of 3.00 and a minimum TOEFL score of 586 (240 for computer-based TOEFL). In the M.S. program, licensure as a registered nurse and a bachelor's degree with a major in nursing is required. Applications from students with a bachelor's degree in another field will be considered if there is sufficient evidence of ability in health promotion, community health nursing, leadership/management, teaching/counseling, and systematic investigation. For the Ph.D. program, a master's degree with a strong background in the physical and/or behavioral sciences or a bachelor's degree with an exceptionally strong background are required. For the postbaccalaureate certificate program, a bachelor's degree in a field other than nursing is required. Seven of the prerequisites for admission must be completed by December 31, with the ability to complete the remaining prerequisites by the time the program starts the following fall. Prerequisite course information is available online at <[www.nursing.umn.edu](http://www.nursing.umn.edu)>.

**Special Application Requirements**—For the postbaccalaureate certificate program, two letters of recommendation are required. The GRE is not required. Selected applicants will be invited for an interview. Admission to the program is competitive and class size is limited to 24 students. The application deadline for the postbaccalaureate program is December 15. Students may apply to the M.S. after successful completion of the postbaccalaureate certificate and the registered nurse licensure examination. Acceptance to the postbaccalaureate certificate program does not guarantee admittance to the M.S. program in nursing.

For the M.S. degree, two letters of reference and a goal statement are required. GRE General Test scores are required for applicants with narrative transcripts from previous college work. The application deadlines for the M.S. program are August 15 (spring semester), December 15 (summer), and February 15 (fall semester). A complete application includes a School of Nursing application and a Graduate School application. For competitive nurse practitioner, clinical nurse specialist, and nurse midwifery areas of study, priority is given to applicants who submit application materials by the December 15 deadline.

For the Ph.D. degree, GRE General scores, two letters of reference, and a statement of goals, objectives, and research interest are required. The application deadline for the Ph.D. program is December 1 for the following fall semester.

**Courses**—Please refer to Nursing (Nurs) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—4xxx courses are not routinely accepted on degree program forms. However, CPsy 4303—Adolescent Psychology is used on M.S. programs for public health/adolescent nursing.

### Postbaccalaureate Certificate Requirements

This is a 16-month full-time program with no options for part-time study. The curriculum includes 5 courses (14 credits) that can be applied to the master's degree in nursing and 6 courses specifically designed for the postbaccalaureate program. After completion of the certificate program, students are eligible to take the National Council Licensing Examinations (NCLEX) for registered nurses. Graduates of the program are encouraged to apply for the M.S. in nursing (RN licensure is a requirement for entry in to the M.S. degree program). Please note that some areas of study in the M.S. program require one or more years of clinical experience prior to admission.

**Language requirements**—None

### M.S. Degree Requirements

The M.S. program prepares students for advanced practice nursing roles that address complex health and illness issues. The program is offered under Plan A and Plan B. Plan A emphasizes research; Plan B prepares students to integrate research into advanced practice roles or leadership positions.

Plan A requires 30 credits: 14 credits in the major, including Nurs 8170—Research in Nursing (3 cr); Nurs 8100—The Discipline of Nursing (3 cr); Nurs 8140—Moral and Ethical Positions in Nursing (3 cr); 6 credits in a minor or related fields; and 10 thesis credits.

Plan B requires a minimum of 30 credits with at least 9 credits of disciplinary core courses; 12 credits of advanced nursing core courses, including Nurse 8194—Problems in Nursing (3 cr); 6 credits of specialty core courses; and 6 credits in related fields. See individual area of study information at [www.nursing.umn.edu](http://www.nursing.umn.edu) for specific course and credit requirements.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Ph.D. Degree Requirements

Students are required to take a minimum of 37 credits in required nursing courses in three areas: scholarly processes, nursing science, and area of concentration. The Ph.D. also requires a minimum of 12 credits in a minor or supporting field and 24 thesis credits. Students who do not have an M.S. in nursing will be required to take additional credits.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—A doctoral minor requires 12 credits in nursing with at least 8 credits of 8xxx courses.

## Nutrition

**Contact Information**—Nutrition Graduate Program, Department of Food Science and Nutrition, University of Minnesota, 1334 Eckles Avenue, St. Paul, MN 55108 (612-624-1290; fax 612-625-5272; [nutrgrad@umn.edu](mailto:nutrgrad@umn.edu); <http://fscn.che.umn.edu/nutrgrad/>).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Paul B. Addis, Food Science and Nutrition, SM  
Linda J. Brady, Food Science and Nutrition, SM  
Judith E. Brown, Epidemiology, SM  
Frank B. Cerra, Surgery, ASM  
Agnes S. Csallany, Food Science and Nutrition, SM  
Daniel D. Gallaher, Food Science and Nutrition, SM  
John H. Himes, Epidemiology, SM  
Joseph M. Keenan, Family Practice and Community Health, ASM  
Mindy S. Kurzer, Food Science and Nutrition, SM  
Theodore P. Labuza, Food Science and Nutrition, M2  
Arthur S. Leon, Kinesiology, SM  
Allen S. Levine, Psychiatry, SM  
Mark Lyte, Surgery, SM  
Joseph R. Prohaska, Biochemistry and Molecular Biology, Duluth, SM  
Marla M. Reicks, Food Science and Nutrition, SM  
Joanne L. Slavin, Food Science and Nutrition, SM  
Mary T. Story, Epidemiology, SM

### Adjunct Professor

Mary C. Gannon, SM  
Julie M. Jones, AM

### Associate Professor

Margot P. Cleary, Hormel Institute, ASM  
Lisa J. Harnack, Epidemiology, SM  
Craig A. Hassel, Food Science and Nutrition, SM  
Diane R. Neumark-Sztainer, Epidemiology, SM  
Daniel J. O'Sullivan, Food Science and Nutrition, SM  
Cheryl F. Smith, Food Science and Nutrition, SM

### Adjunct Associate Professor

Darlene G. Kelly, Food Science and Nutrition, ASM  
Catherine M. Kotz, Food Science and Nutrition, SM  
Patricia L. Splett, Food Science and Nutrition, AM2

### Assistant Professor

Leonard F. Marquart, Food Science and Nutrition, SM  
Elizabeth J. Parks, Food Science and Nutrition, SM  
M. Kathryn Schmitz, Epidemiology, SM  
Lyn M. Steffen, Epidemiology, SM

### Adjunct Assistant Professor

Mary K. Schmidl, Food Science and Nutrition, AM2  
Alice C. Shapiro, Epidemiology, M2

### Senior Research Associate

Susan K. Raatz, Medical School, SM

### Other

Jamie S. Stang, Epidemiology, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Nutrition is the study of how nutrients, both essential and non-essential, affect health and all life processes. Consequently, nutrition is an extremely broad field that encompasses physiology, biochemistry, education, public health, and

public policy. The nutrition graduate program is interdisciplinary. Advisers and financial support may come from any of the departments or schools in which nutrition graduate faculty reside, including the Department of Food Science and Nutrition (Colleges of Human Ecology and Agricultural, Food and Environmental Sciences), Division of Epidemiology (School of Public Health), Department of Family Practice and Community Health and the Department of Surgery (Medical School), School of Kinesiology (College of Education and Human Development), Hormel Institute (Austin, MN), and Veterans Administration Hospital (Minneapolis, MN).

Three subspecialty areas are offered in the doctoral degree program: human nutrition, nutritional biochemistry, and public health nutrition. Thesis work can be conducted in the laboratory, clinic, or field, locally or internationally.

**Prerequisites for Admission**—A strong foundation in the biological and physical sciences is required. This background includes college mathematics, the equivalent of one year of general chemistry, one semester of organic chemistry, general biology, biochemistry, physiology, and statistics. For the doctoral program, additional prerequisite courses include calculus and physics. If there is evidence that the applicant has a good background in the sciences, some of the prerequisites can be met after admission.

**Special Application Requirements**—GRE scores and three letters of recommendation evaluating the applicant's scholarship must be submitted. At least two letters should be from professorial-rank faculty. The GRE Writing Assessment Test is recommended.

**Courses**—Please refer to Nutrition (Nutr) and Food Science and Nutrition (FScN) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses toward degree requirements is subject to adviser and director of graduate studies approval.

### M.S. Degree Requirements

The M.S. is offered under both Plan A (thesis) and Plan B (non-thesis). Plan A requires a minimum of 20 course credits and 10 thesis credits; Plan B requires a minimum of 30 course credits, including a Plan B project. General requirements include the graduate nutrition core series (three courses), an orientation and presentation skills class, graduate courses in biochemistry, physiology, statistics, an advanced topics course, and presentation of the thesis or project work. All students also are expected to obtain teaching experience, subject to the policies of the adviser's department or division.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor requires a minimum of 6 course credits in nutrition, including FScN 5621 (4 cr).

**Ph.D. Degree Requirements**

The Ph.D. offers three areas of specialization: human nutrition, nutritional biochemistry, and public health nutrition. Thesis work may be conducted in the laboratory, clinic, or field, either locally or internationally.

The Ph.D. requires the graduate nutrition core series (three courses), an orientation and presentation skills class, graduate level courses in biochemistry, physiology, statistics, two advanced topics courses, and presentation of the thesis. All students also are expected to obtain teaching experience, subject to the policies of the adviser's department or division.

**Language Requirements**—None.

**Minor Requirements for Students**

**Majoring in Other Fields**—A doctoral minor may be completed by taking FScN 5621, 5622, 5623, and three additional credits in nutrition, including at least one 8xxx course.

**Occupational Therapy**

**Contact Information**—Program in Occupational Therapy, University of Minnesota, 388 MMC, 420 Delaware St. S.E., Minneapolis, MN 55455 (612-626-5887; fax 612-625-7192; [otprog@umn.edu](mailto:otprog@umn.edu); <http://www.ot.umn.edu/>). Program office is in 271 Children's Rehabilitation Center, 426 Church St. S.E., Minneapolis MN, 55455.

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

**Associate Professor**

James R. Carey, AM  
Virgil G. Mathiowetz, M2  
Erica B. Stern, M2

**Assistant Professor**

Diane R. Anderson, M2  
Cheryl A. Meyers, M2  
Michael Potegal, AM  
Deborah D. Roman, AM

**Assistant Clinical Specialist**

Nancy Jo Callinan, AM  
Rebecca B. Catterton, AM  
Margaret A. Christenson, AM  
Elin Schold Davis, AM  
Katherine (Kay) N. Dole, AM  
Vickie I. Lange, AM  
Barbara A. Larson, AM  
Susan A. Lasoff, AM  
Kathleen M. Matuska, AM  
Julie A. Mehr, AM  
Denise M. Melander, AM  
Peggy Mueller, AM  
Virginia H. O'Brien, AM  
Jennifer Rosenstiel, AM  
Marcia A. Sitz, AM  
Margaret VanEeckhout, AM  
Deborah J. Voydetich, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The program provides a combination of academic and clinical education that prepares students to be occupational therapy clinicians and

researchers. Emphasis is on application of the critical thinking model to diverse areas of practice and to diagnostic groups in both clinic and community settings. Clinical education includes fieldwork in such areas as physical, psychosocial, and developmental disabilities. Research and scholarly projects emphasize investigation of treatment effectiveness.

The program is accredited by the Accreditation Council for Occupational Therapy Education (ACOTE) of the American Occupational Therapy Association (P.O. Box 31220, Bethesda, MD, 20824-1220; 301-652-AOTA). Graduates of the program may sit for the national certification exam administered by the National Board for Certification of Occupational Therapists. Most states require licensure in order to practice; however, state licenses are usually based on the results of this certification exam.

**Prerequisites for Admission**—Individuals with a bachelor's degree in any field other than occupational therapy, or those who will have completed their bachelor's degree before entering the program, may apply. Students may be admitted pending successful completion of outstanding prerequisite coursework with the understanding that the missing course(s) will be completed before beginning the program. Occasionally, under extenuating circumstances, an individual may be admitted who does not meet all of the admissions requirements.

**Special Application Requirements**—

Applicants must submit a program application, including one to three references, and evidence of work or volunteer experience in occupational therapy. Prerequisite coursework in statistics, the biological sciences, developmental and abnormal psychology, and related areas is required. International students must submit evidence of English proficiency; TOEFL scores (550 minimum paper version, 213 minimum computer version), MELAB score of 80, or IELTS score of 6.5. Applications are accepted and reviewed beginning September 15th, and continue until the class is filled (rolling admissions).

**Courses**—Please refer to Occupational Therapy (OT) and Physical Medicine and Rehabilitation (PMed) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—4xxx courses cannot be used toward degree requirements.

**M.S. Plan B Degree Requirements**

Students take 56 credits of predetermined academic coursework, 6 project credits (Plan B), and a minimum of 12 credits of fieldwork education. Optional fieldwork education is available in several specialty areas. Required fieldwork must be completed within 24 months of finishing academic coursework. Plan B projects must be completed within three months following fieldwork. There is no minor or related field requirement.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Oral Biology**

**Contact Information**—Oral Biology Graduate Program, University of Minnesota, 17-252 Moos Health Sciences Tower, 515 Delaware Street S.E., Minneapolis, MN 55455 (612-624-9123).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

**Professor**

Alvin J. Beitz, Veterinary Pathobiology, SM  
Edward C. Combe, Oral Sciences, SM  
Ralph DeLong, Oral Sciences, SM  
William H. Douglas, Oral Sciences, SM  
James Ryan Fricton, Diagnostic/Surgical Science, M2  
Gregory R. Germaine, Oral Sciences, SM  
Mark C. Herzberg, Oral Sciences, SM  
William F. Liljemark, Diagnostic/Surgical Sciences, SM  
Patrick W. Mantyh, Preventive Sciences, SM  
Joel D. Rudney, Oral Sciences, SM  
Charles F. Schachtele, Oral Sciences, SM  
Burton L. Shapiro, Oral Sciences, SM  
Larry F. Wolff, Preventive Sciences, SM

**Associate Professor**

Pamela R. Erickson, Preventive Sciences, SM  
Robert H. Ophaug, Oral Sciences, SM  
Donald A. Simone, Oral Sciences, SM

**Assistant Professor**

Darryl T. Hammamoto, Diagnostic/Surgical Science, M2  
Lois Jean Kehl, Anesthesiology, SM  
Ching-Chang Ko, Oral Sciences, SM  
Kathy Moser, Medicine, SM  
Antheunis Versluis, Oral Sciences, SM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—This program is offered by the Department of Oral Science in the School of Dentistry and gives students a broad understanding of the development, structure, function, and pathology of the orofacial region. Advanced coursework and research emphasize specialized areas of interest, including salivary glands and secretions, oral microbial ecology and physiology, immunobiology, neurobiology, mineral metabolism and nutrition, pathobiology of oral structures, physical biology of the masticatory system, and development and evaluation of dental materials. Considerable flexibility is encouraged in planning individual programs to accommodate the student's specific areas of interest, and courses from other disciplines may be included as part of the major.

**Prerequisites for Admission**—Applicants should have completed requirements for graduation with high standing from dental or medical schools and have a desire to undertake advanced studies in oral biology. In some cases, those who have not obtained the D.D.S. (D.M.D.) or M.D. degree, but who have demonstrated exceptional potential for graduate study, may be admitted for a combined program. Individuals with a

bachelor's or master's degree who can demonstrate an appropriate background and an interest in oral biology are considered.

### Special Application Requirements—

Applicants must submit three letters of recommendation from persons familiar with their academic and research experience and a statement describing how training in oral biology will help them attain their professional objectives. Students may enter the program in any semester, but fall semester is recommended.

**Courses**—Please refer to Oral Biology (OBio) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses is not permitted toward degree requirements.

### M.S. Degree Requirements

The M.S. generally requires a minimum of two years, and may be taken as Plan A (with thesis) or Plan B (without thesis); both plans require a total of 30 credits. Students in both plans must complete a minimum of 14 credits in the major, including 4 credits of oral biology topics courses (8021-8028). Courses in the major may be taken from other disciplines with the approval of the adviser and the director of graduate studies. Registration and participation in the oral biology student seminar series (8030) is required each semester. Students must also complete a minor or related field program in a related nonclinical discipline (minimum 6 credits). Plan A requires 10 thesis credits and Plan B requires 10 credits of additional coursework and three Plan B papers. The Plan B papers consist primarily of critical reviews of the literature, but at least one must include a laboratory study. Students must maintain a GPA of at least 3.00 in both the major and minor. Only grades of A or B are acceptable in the core courses.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor in oral biology consists of 6 credits, at least two advanced courses in oral biology, and other coursework determined in consultation with the director of graduate studies.

### Ph.D. Degree Requirements

Coursework for the Ph.D. is selected to give students a broad background in oral biology plus advanced coursework directly related to students' research interests. Although there is no Graduate School minimum credit requirement for the degree, most students are expected to complete a core curriculum of 23-25 credits; all students must satisfactorily complete 8 credits of oral biology topics courses (8021-8028) and participate in the oral biology student seminar series (8030) each semester. The remaining coursework is tailored to the student's research interests and may be selected from departments and programs outside the oral biology program

with the approval of the adviser and director of graduate studies. A minor (minimum 12 credits) in a nonclinical discipline is also required. A cumulative GPA of at least 3.00 in both the major and minor is required. Only grades of A or B are acceptable in the core courses. The preliminary written exam consists of two research proposals, one representing the student's anticipated thesis research and the other on a topic assigned by the graduate faculty. The preliminary oral exam consists primarily of a defense of the two research proposals described above. Students must also present a seminar describing their thesis research (which is attended by the final oral exam committee) no later than six months before defense of the thesis.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—A Ph.D. minor in oral biology consists of 12 credits, at least two advanced courses in oral biology, and other coursework in consultation with the director of graduate studies.

## Otolaryngology

**Contact Information**—Department of Otolaryngology, University of Minnesota, MMC 396, 420 Delaware Street S.E., Minneapolis, MN 55455 (mailing address) (612-625-3200; fax 612-625-2101; <[www.med.umn.edu/otol/](http://www.med.umn.edu/otol/)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

George L. Adams, SM  
Khalil Ahmed, ASM  
G. Scott Giebink, AM2  
Sung K. Juhn, SM  
Frank M. Lassman (emeritus), ASM  
Robert H. Maisel, SM  
Robert H. Margolis, SM  
David A. Nelson, SM  
Peter A. Santi, SM

### Clinical Professor

Michael M. Paparella, ASM

### Associate Professor

John H. Anderson, SM  
Lawrence R. Boies, Jr., AM2  
Kathleen Ann Daly, M2  
Markus Gapany, M2  
George S. Goding, Jr., M2  
Peter A. Hilger, M2  
David B. Hom, M2  
Eric Javel, SM  
Samuel C. Levine, M2

### Clinical Associate Professor

Barry P. Kimberley, AM2  
Stephen L. Liston, AM  
James D. Sidman, AM2

### Assistant Professor

Gail S. Donaldson, M2  
David D. Hamlar, M2  
Jizhen Lin, M2  
Rick M. Odland, M2  
Frank G. Ondrey, SM  
Franklin L. Rimell, M2

### Assistant Clinical Specialist

Deirdre Michaelmechelke, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—This program prepares students in both clinical and experimental aspects of otolaryngology. The M.S., M.S.Otol., and Ph.D. degrees require a publishable thesis. Rotations at Fairview-University Medical Center, Minneapolis Veterans Administration Medical Center, Regions Hospital, and Hennepin County Medical Center provide a wide range of opportunity for clinical education and surgical experience. Opportunities for independent research are provided in the research laboratories of audiology, auditory electrophysiology, auditory neurophysiology, biochemistry, cancer biology, cell biology and genetics, electronmicroscopy, electrophysiology, histochemistry, morphometry, psychoacoustics, temporal bone pathology, tumor immunology, skin-flap physiology, laryngeal physiology, mandibular bone physiology, microvascular tissue transfer, and vestibular physiology. Each student selects an adviser and prepares a preliminary research proposal by February 1 of the first year. A full proposal in NIH style is expected by June 1. Both proposals must be reviewed by the graduate research committee. A minimum of six months in basic research begins in the second year. Graduates of the program have careers in teaching, research, and professional practice.

**Prerequisites for Admission**—The M.S. requires a bachelor's degree from an accredited university or equivalent. The M.S.Otol. requires an M.D. degree and is usually pursued in conjunction with a residency in otolaryngology. The Ph.D.Otol. requires a bachelor's or master's degree, preferably in an area related to otolaryngology or, for those pursuing the degree in conjunction with a residency in otolaryngology, an M.D. degree. The admissions committee reviews previous academic records, letters of recommendation, etc.

**Courses**—Please refer to Otolaryngology (Otol) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Otolaryngology does not offer 4xxx courses. Use of 4xxx courses from other departments is permitted toward degree requirements with the permission of the director of graduate studies.

### M.S. Plan A Degree Requirements

The M.S. (Plan A only) requires a minimum of 30 credits: 20 course credits (14 in the major and 6 in the minor or related fields) and 10 thesis credits. Understanding and application of basic statistics and experimental methodology are expected. Statistics coursework is usually necessary. Choice of statistics courses is made with the guidance of the director of graduate studies. Students are expected to complete and

publish a research paper in a peer-reviewed journal or a presentation/poster at a national scientific meeting.

**Language Requirements**—None.

**Final Exam**—The final exams are both written and oral. A grade of 70 percent or higher is expected on a national written exam.

### M.S.Otol. Plan A Degree Requirements

The M.S.Otol. (Plan A only) requires a minimum of 35 credits, including 25 course credits (19 in the major and 6 in the minor or related fields) and 10 thesis credits.

Understanding and application of basic statistics and experimental methodology are expected. Statistics coursework is usually necessary. Choice of statistics courses is made with the guidance of the director of graduate studies. Some courses for the M.S.Otol. are more clinical than those for the M.S., and four years of academic preparation are expected. Students are expected to complete and publish a research paper in a peer-reviewed journal or a presentation/poster at a national scientific meeting.

**Language Requirements**—None.

**Final Exam**—The final exams are both written and oral. A grade of 70 percent or higher is expected on a national written exam.

### Ph.D.Otol. Degree Requirements

The number of credits required will vary depending on preparation and the research undertaken. Most students take a total of about 55 credits. A minimum of 12 credits in the minor or supporting program, plus 24 doctoral thesis credits, are required. An advisory committee including the student, the adviser, and the director of graduate studies determines coursework in the major. At least one seminar is selected from seminars such as Otol 8247, 8248, 8249, and 8250. Understanding and application of basic statistics and experimental methodology are expected. Statistics coursework is usually necessary. Choice of statistics courses is made with the guidance of the director of graduate studies. All students are expected to publish a research paper in a peer-reviewed journal. Students concurrently in an otolaryngology residency usually take five to six years to complete research, course, and dissertation requirements.

**Language Requirements**—None.

**Minor Requirements for Students**

**Majoring in Other Fields**—A minor is not available, but otolaryngology courses may be taken for related fields or supporting program credits.

## Pharmaceutics

**Contact Information**—Department of Pharmaceutics, College of Pharmacy, University of Minnesota, 9-177 Weaver-Densford Hall, 308 Harvard Street S.E., Minneapolis, MN 55455 (612-624-5151; fax 612-626-2125; [pceuts@umn.edu](mailto:pceuts@umn.edu); [www.pharmacy.umn.edu/pharmaceutics](http://www.pharmacy.umn.edu/pharmaceutics)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Janet M. Dubinsky, ASM  
David J. W. Grant, SM  
Ronald J. Sawchuk, SM  
Ronald A. Siegel, SM  
Raj G. Suryanarayanan, SM  
Cheryl L. Zimmerman, SM

### Adjunct Professor

Rene A. Braeckman, ASM  
William H. Frey II, Pharmacy, ASM  
Aldo Rescigno, Pharmacy, ASM

### Associate Professor

William F. Elmquist, SM  
Timothy S. Wiedmann, SM

### Adjunct Associate Professor

Walid M. Awni, ASM  
Keith K. Chan, ASM  
Michael D. Karol, ASM  
Evgeniy Y. Shalaev, ASM  
Ray Skwierczynski, ASM  
Lian Yu, ASM

### Assistant Professor

Belinda Cheung, ASM  
Carolyn A. Fairbanks, SM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Emphases are available in physical pharmacy, biopharmaceutics and pharmacokinetics. Minor fields of particular value include biochemistry, biometry, chemistry, biomedical engineering, chemical engineering, mechanical engineering, pharmacology, and statistics.

**Prerequisites for Admission**—The pharmaceutics program considers students who possess a B.S. degree and an exceptional scholastic record from recognized colleges of pharmacy as well as from a relatively wide range of academic fields. For those individuals with a degree other than pharmacy, the program adviser may recommend additional coursework to provide the necessary background in pharmacy.

**Special Application Requirements**—In addition to undergraduate scholastic records, recent GRE scores, a statement of career goals, and three letters of recommendation are used to determine each candidate's admissibility. Minimum GRE scores of 80 percentile are required for the quantitative and analytical sections, as well as a minimum GPA of 3.20 from U.S. schools, and "First Class" or the equivalent on transcripts from foreign institutions. A TOEFL score of 600 or higher is required for applicants whose native language is not English. Fall admission is preferred, although admission in the spring semester may be considered. The deadline to apply for fall admission is December 31. *(Students who want to know their chances for admission before paying the application fee can use a pre-evaluation feature on the pharmaceutics Web site at [www.pharmacy.umn.edu/pharmaceutics](http://www.pharmacy.umn.edu/pharmaceutics) to determine if their credentials are competitive.)*

**Courses**—Please refer to Pharmaceutics (Phm) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses towards degree requirements is permitted based on the approval of the graduate faculty and director of graduate studies.

### M.S. Degree Requirements

Students are not admitted directly into the M.S. program. Ph.D. pharmaceutics students may pursue an M.S. through a change of status request. Students take core courses in pharmaceutics and chemistry. In addition to the coursework, a preliminary written exam and preparation of a thesis and its defense are required. Coursework for the M.S. (Plan A only) includes 14 credits in 5xxx or 8xxx courses in the major and 6 credits in one or more related fields outside the major to comprise a minimum of 20 credits for the degree. A complete list of degree program requirements can be obtained from the director of graduate studies. Additional courses are selected in consultation with the major adviser.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Ph.D. Degree Requirements

The Ph.D. requires a minimum of 29 course credits in upper division or 5xxx or 8xxx courses, including 12 credits in a minor or supporting program, and language requirement (or alternatively a collateral field with a minimum of 6 credits). Students must take advanced courses in pharmaceutics, chemistry, mathematics, statistics, and pharmacology. A complete list of degree program requirements may be obtained from the director of graduate studies. In addition, students complete a preliminary written exam, a written research proposal based on thesis research, a preliminary oral exam, and finally a thesis and its defense.

**Language Requirements**—One foreign language or a collateral field of knowledge chosen with the consent of the director of graduate studies is required. The choice of option must have the approval of the major adviser.

## Pharmacology

**Contact Information**—Graduate Program in Pharmacology, University of Minnesota, 6-120 Jackson Hall, 321 Church Street, S.E., Minneapolis, MN 55455 (612-625-9997; fax 612-625-8408; [fider@lenti.med.umn.edu](mailto:fider@lenti.med.umn.edu); [www.pharmacology.med.umn.edu](http://www.pharmacology.med.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Bianca M. Conti-Fine, SM  
Richard M. Eisenberg, Duluth, SM  
Robert P. Elde, SM  
Esam E. El-Fakahany, SM  
Patrick E. Hanna, SM  
Stephen S. Hecht, SM  
Jordan L. Holtzman, SM  
Donald B. Hunninghake, SM

Ping-Yee Law, SM  
Hon Cheung Lee, SM  
Horace H. Loh, SM  
Paul R. Pentel, SM  
Philip S. Portoghesi, SM  
Jean F. Regal, Duluth, SM  
Virginia S. Seybold, SM  
Alan R. Sinaiko, M2  
Norman E. Sladek, SM  
Sheldon B. Sparber, SM  
Sundaram Ramakrishnan, SM  
Stanley A. Thayer, SM  
George J. Trachte, Duluth, SM  
Kendall B. Wallace, Duluth, SM  
Timothy F. Walseth, SM  
Li-Na Wei, SM  
George L. Wilcox, SM  
Wellington G. Wood III, SM  
Douglas Yee, SM

### Associate Professor

Colin R. Campbell, SM  
Gregory J. Connell, SM  
Earl W. Dunham, SM  
Janet Lyn Fitzakerley, SM  
Edward T. Knych, Duluth, M2  
Rita B. Messing, M2  
Duanqing Pei, SM  
Daniel P. Romero, SM  
Sabita Roy, SM  
Ronald John Shebuski, SM  
Elizabeth V. Wattenberg, AM

### Assistant Professor

Frank H. Burton, SM  
Carolyn Ann Fairbanks, SM  
Jonathan C. Gerwitz, SM  
Hiroschi Hiasa, SM  
Carol A. Lange, SM  
Jonathan S. Marchant, SM  
Lisa Schrott, ASM  
Kevin D. Wickman, SM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Pharmacology is the study of the interactions of chemicals with biological systems. Courses and research training in biochemistry, biophysics, genetics, and molecular biology provide a solid foundation for performing original research in pharmacology, neuropharmacology, and cancer chemotherapy.

**Prerequisites for Admission**—A four-year B.A. or B.S. degree (or its equivalent) in a basic science program is generally required. Candidates for admission are evaluated on the basis of undergraduate record, GRE score, previous research experience, and letters of recommendation.

**Special Application Requirements**—Applicants must submit scores from the General Test of the GRE, three letters of recommendation from persons familiar with their scholarship and research potential, a complete set of official transcripts, and a clearly written statement of career interests, goals, and objectives. Students may apply at any time; however, submission of all application materials by January 15 is strongly encouraged to ensure priority consideration for fellowships and research assistantships awarded for the next academic year. Students can be admitted any term.

**Research Facilities**—Graduate faculty members in the pharmacology program have state-of-the-art laboratories located in the Basic Sciences and Biomedical Engineering Building, Moos Tower, Molecular and Cellular Biology, and Jackson Hall. The Basic Research Center on Molecular and Cell Biology of Drug Abuse is comprised of pharmacology program graduate faculty.

**Courses**—Please refer to Pharmacology (Phcl) in the course section of this catalog for courses pertaining to this program.

**Use of 4xxx Courses**—Use of 4xxx courses on degree program forms is subject to adviser and/or director of graduate studies approval.

### M.S. Degree Requirements

Plan A requires a minimum of 20 course credits (14 in pharmacology, and 6 in biochemistry and physiology) and 10 thesis credits. Plan B requires a minimum of 30 course credits (14 in pharmacology, and 16 in biochemistry, physiology, and/or other related areas) and a Plan B project.

Students are expected to maintain a GPA of 3.00. Students who fail to maintain this standard must petition the director of graduate studies for permission to remain in the program.

For more detailed information, contact the director of graduate studies in pharmacology.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor requires a minimum of 9 credits in pharmacology approved by the director of graduate studies in pharmacology.

### Ph.D. Degree Requirements

The Ph.D. requires a minimum of 21 course credits in the major (excluding the required 24 thesis credits).

Students are expected to maintain a GPA of 3.00. Students who fail to maintain this standard must petition the director of graduate studies for permission to remain in the program.

For more detailed information, contact the director of graduate studies in pharmacology.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—A doctoral minor requires a minimum of 12 credits in pharmacology approved by the director of graduate studies in pharmacology. There are no special requirements (e.g., specific courses, written examination).

## Philosophy

**Contact Information**—Further details about the program are on the department's Web site at <[www.philosophy.umn.edu](http://www.philosophy.umn.edu)>, and in two publications, *Graduate Studies: Philosophy* and *Department Degree Programs: M.A. and Ph.D.*, available from the Department of Philosophy, University of Minnesota, 831

Walter Heller Hall, 271 19th Avenue South, Minneapolis, MN 55455-0310 (612-625-6563; fax 612-626-8380; [umphil@umn.edu](mailto:umphil@umn.edu)).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

John H. Beatty, Ecology, Evolution, and Behavior, ASM  
Elizabeth S. Belfiore, Classical and Near Eastern Studies, ASM  
Brian Bix, Law, SM  
Norman E. Bowie, Strategic Management and Organization, SM  
Norman O. Dahl, SM  
Marcia M. Eaton, SM  
Eugene Garver, ASM  
Ronald N. Giere, SM  
Jeanette K. Gundel, Linguistics, ESL, and Slavic Languages and Literatures, AM2  
Keith Gunderson, SM  
William H. Hanson, SM  
Geoffrey Hellman, SM  
Jasper S. Hopkins, SM  
Michael B. Kac, SM  
Jeffrey P. Kahn, Public Health, ASM  
Douglas E. Lewis, SM  
Helen E. Longino, Women's Studies, SM  
H. E. Mason (emeritus), ASM  
Joseph I. Owens, SM  
Sandra L. Peterson, SM  
C. Wade Savage, SM  
Naomi B. Scheman, SM  
John R. Wallace, SM

### Associate Professor

John M. Dolan, SM  
Carl Elliott, Public Health, ASM  
Sarah W. Holtman, SM  
Michael D. Root, SM  
C. Kenneth Waters, SM

### Assistant Professor

David Martinez, American Indian Studies, AM2  
Michelle Mason, M2  
Valerie Tiberius, M2  
Byeong-Uk Yi, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The Department of Philosophy offers both Ph.D. and M.A. degrees. Students are generally admitted to the Ph.D. program, while admission to the M.A. is generally intended for those with professional goals in other fields.

Philosophy is noteworthy for its emphasis on the individual student's research interests. With the help of an adviser, students design their own program of study, which consists of the philosophy major and either a supporting program or a minor. The minor or supporting program, drawn at least in part from a department or departments other than philosophy, complements the student's research focus. Students gain a broad base of knowledge through required coursework. Ph.D. students take courses in four main areas: history of philosophy, logic, ELMS (epistemology, philosophy of language, metaphysics, philosophy of science), and value theory. These areas provide a firm foundation for research and teaching beyond the Ph.D. program.

**Prerequisites for Admission**—Recognizing that evidence of ability to pursue graduate study in philosophy is diverse, the department does not specify prerequisites for admission. Normally, those admitted have a broad undergraduate background that includes some courses in philosophy.

**Special Application Requirements**—Students must apply to both the Graduate School and the Department of Philosophy. The Graduate School application is available online from the Graduate School Web site. The departmental application for admissions and aid is available from the Committee on Admissions and Aid at the address listed above or may be downloaded from the philosophy Web site.

Department applications should include a completed application form, personal statement, transcripts, scores from the GRE General Test, three letters of recommendation, and a writing sample. Students interested in Opportunity or MacArthur Fellowships should include a statement expressing their interest. Students interested in the MacArthur Fellowship should also contact the MacArthur Program.

Applications, together with all supporting materials, must be received by January 7. The philosophy department generally admits students only for fall semester.

**Courses**—Please refer to Philosophy (Phil) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—All philosophy 4xxx courses are available for graduate credit. Philosophy students may use any 4xxx philosophy course on their graduate degree program, but must register concurrently for a related 1 credit 8xxx workshop to receive graduate credit for the 4xxx course. Students from other majors may register for the related workshop with the permission of the instructor of the 4xxx course.

### M.A. Degree Requirements

The M.A. is offered under two plans. Plan A requires 14 course credits in philosophy, 6 course credits outside the department, and 10 thesis credits. Plan B requires 24 course credits in philosophy, 6 course credits outside the department, and three Plan B papers.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—A master's minor requires 6 course credits in philosophy approved by the director of graduate studies in philosophy. Programs are tailored to meet the interests and needs of the student.

### Ph.D. Degree Requirements

No minimum credits are required for the Ph.D., though specific philosophy courses are required that total 26-28 credits; 24 thesis credits are also required. After a student has satisfied the logic and history course requirements and passed the three-paper exam, the student's entire record is reviewed

by the faculty. Successful review represents passing the preliminary written exam. Students then write a dissertation proposal, successful defense of which constitutes passing the preliminary oral exam.

**Language Requirements**—None.

**Minor Requirements for Students Majoring in Other Fields**—A doctoral minor requires 12 course credits in philosophy approved by the director of graduate studies in philosophy. Programs are tailored to meet the interests and needs of the student.

## Physical Education and Recreation

See Kinesiology.

## Physical Therapy

**Contact Information**—Physical Therapy Program Office, MMC 388, University of Minnesota, Minneapolis, MN 55455 (612-624-2262; fax 612-625-7192; [ptquest@umn.edu](mailto:ptquest@umn.edu); [www.phyther.med.umn.edu](http://www.phyther.med.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Richard P. DiFabio, SM

### Associate Professor

James R. Carey, SM  
Glenn N. Scudder, SM  
LaDora V. Thompson, SM

### Assistant Professor

Paula M. Ludewig, SM

### Adjunct Faculty

Scott M. Lewis, AM  
Dawn A. Lowe, AM  
Robert P. Patterson, AM  
Fred A. Wentorf, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The physical therapy program, a division within the Department of Physical Medicine and Rehabilitation, offers a professional doctoral degree in physical therapy (D.P.T.). Physical therapy is a health-care discipline involved with the study and rehabilitation of movement impairments such as muscular weakness, joint stiffness, and pain, which can lead to functional problems affecting self care, employment, ambulation, etc. Graduates are prepared to promote proper health care and quality of living by maximizing human movement following disease or injury or by preventing its loss. The program requires three years of year-round graduate study. Academic coursework and research activity are completed during the first seven semesters. The final two semesters are devoted to clinical internships.

**Didactic Curriculum**—During the first year of the program the curriculum involves the basic sciences, physical agents, biomechanical principles, and clerkship clinical experiences. The second year advances and integrates first-year coursework into evaluation skills, treatment techniques, and critical thinking. These tools are utilized during second-year clerkships in orthopedics, rehabilitation, and wellness.

**Clinical Curriculum**—Students complete up to 40 weeks of clinical internships in addition to clinical clerkships imbedded in the academic curriculum. The full-time internships occur during the third year of the program. Each student completes clinical affiliations in the following areas: acute hospital, outpatient, rehabilitation, and specialty area. These are under direct supervision of experienced clinical faculty and give each student the opportunity to combine theoretical skills with practical experience. Beyond direct patient care, students also develop skills and knowledge related to administration, management and supervision, education, and consultation. Graduates of the program are eligible to apply for state registration or licensure according to the laws of individual states.

**Prerequisites for Admission**—To be considered for admission, the student must complete a baccalaureate degree by June 1 of the year of application (no preferred major) and have a minimum overall GPA of 3.00 as well as a GPA of 3.00 in all physical therapy prerequisite coursework. Applications received after June 1 will be considered for the following year. Information and applications, including a list of prerequisite coursework, are available at [www.phyther.med.umn.edu](http://www.phyther.med.umn.edu).

**Special Application Requirements**—Submission of GRE scores is required. For international students, a TOEFL score of at least 550 is required and the TSE is highly recommended (score of at least 50). The D.P.T. program accepts only applications completed online at [www.phyther.med.umn.edu](http://www.phyther.med.umn.edu).

**Courses**—Please refer to Physical Therapy (PT) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses towards degree requirements is subject to adviser and director of graduate studies approval.

### D.P.T. Degree Requirements

The program requires 140 major field credits, of which 94 are core academic credits and 46 are clinical internship credits; 9 credits of research are included and an oral presentation based on this research culminates the project. No minor or related field is required. Students must maintain a cumulative GPA of 2.80 while in the program.

**Language Requirements**—None.

## Physics

**Contact Information**—Physics Program, School of Physics and Astronomy, University of Minnesota, 145 Tate Laboratory of Physics, 116 Church Street S.E., Minneapolis, MN 55455 612-624-6366; fax 612-624-4578; [grad@physics.umn.edu](mailto:grad@physics.umn.edu); <[www.physics.umn.edu](http://www.physics.umn.edu)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Benjamin F. Bayman (emeritus), ASM  
John H. Broadhurst, SM  
Charles E. Campbell, SM  
Cynthia A. Cattell, SM  
James R. Chelikowsky, Chemical Engineering and Materials Science, SM  
Hans W. Courant (emeritus), ASM  
Priscilla B. Cushman, SM  
E. Dan Dahlberg, SM  
Kris Davidson, Astronomy, SM  
Dietrich K. Dehnhard (emeritus), ASM  
Paul J. Ellis, SM  
Robert D. Gehrz, Astronomy, SM  
Clayton F. Giese (emeritus), ASM  
Leonid Glazman, SM  
Allen M. Goldman, SM  
Anand Gopinath, Electrical and Computer Engineering, ASM  
Alexander Grosberg, SM  
J. Woods Halley, SM  
Kenneth Heller, SM  
Cheng-Cher Huang, SM  
Roberta Humphreys, Astronomy, ASM  
Thomas W. Jones, Astronomy, SM  
James Kakalios, SM  
Joseph I. Kapusta, SM  
Uwe R. Kortshagen, Mechanical Engineering, ASM  
Yuichi Kubota, SM  
Anatoly Larkin, SM  
Robert L. Lysak, SM  
Marvin Marshak, SM  
Keith A. Olive, SM  
Robert O. Pepin, SM  
Earl A. Peterson, SM  
Ronald A. Poling, SM  
Serge Rudaz, SM  
Keith Ruddick, SM  
Roger W. Rusack, SM  
Mikhail Shifman, SM  
Boris Shklovskii, SM  
Roger H. Stuewer (emeritus), AM  
Arkady Vainshtein, SM  
Oriol T. Valls, SM  
Randall H. Victora, Electrical and Computer Engineering, ASM  
Mikhail Voloshin, SM  
Thomas F. Walsh, SM  
Walter Weyhmann (emeritus), ASM  
William Zimmermann, Jr. (emeritus), ASM

### Associate Professor

Paul A. Crowell, SM  
Eric Ganz, SM  
Shaul Hanany, SM  
Alex Kamenev, SM  
Yong-Zhong Qian, SM  
John R. Wygant, SM

### Adjunct Associate Professor

Daniel M. Kroll, Medicinal Chemistry, M

### Assistant Professor

Michael DuVernois, SM  
Tony Gherghetta, SM  
Joachim Mueller, SM  
Jon Urheim, SM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Physics is the study of the fundamental structure and interactions of matter. Research areas in the program include experimental and theoretical studies in astrophysics and cosmology, biological physics, condensed matter physics, elementary particle physics, nuclear physics, space and planetary physics, and physics education research. Interdisciplinary study is also available with the programs in astrophysics, biological sciences, chemical engineering and materials science, electrical and computer engineering, mechanical engineering and the history of science and technology.

**Prerequisites for Admission**—For major work, an undergraduate major in physics or a strong undergraduate minor in physics is required.

**Special Application Requirements**—Teaching assistantships and a few fellowships are available on application to the School of Physics and Astronomy; three letters of recommendation are required. Submission of GRE scores is strongly recommended. Fall semester entry is strongly recommended for all students.

**Special Examination**—During the two weeks before the beginning of fall semester, new graduate students are expected to participate in the department orientation program.

**Courses**—Please refer to Physics (Phys) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx physics courses is permitted for either major or minor degree requirements.

### M.S. Degree Requirements

The M.S. requires a minimum of 20 course credits (Plan A) or 30 course credits (Plan B), including classical physics (Phys 5011-5012) or quantum mechanics (Phys 5001-5002) and a minimum of 6 credits in a minor or related field; Plan A also requires 10 thesis credits. The minor or related field requirement may be satisfied by completion of courses in one or two areas outside the specialization; some or all of these courses may be in physics.

**Language Requirements**—There is no language requirement. However, in some instances the thesis adviser may require a reading knowledge of one or more foreign languages if justified by the nature of the topic.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A physics minor requires a background in differential and integral calculus and one year of calculus-level college physics. For the master's minor, students must complete a minimum of 6 credits in physics.

### Ph.D. Degree Requirements

The Ph.D. requires a minimum of 40 credits, including classical physics (Phys 5011-5012), quantum mechanics (Phys 5001-5002), and two semesters of a seminar in the student's research area. The minor or supporting program requirement may be satisfied by completion of courses in one or two areas outside the specialization; some or all of these courses may be in physics.

**Language Requirements**—There is no language requirement. However, in some instances the thesis adviser may require a reading knowledge of one or more foreign languages if justified by the nature of the topic.

### Minor Requirements for Students

**Majoring in Other Fields**—A physics minor requires a background in differential and integral calculus and one year of calculus-level college physics. For the doctoral minor, students must complete a minimum of 12 credits in physics, including either the classical physics sequence (Phys 5011-5012) or the quantum mechanics sequence (Phys 5001-5002).

## Physiology

See Cellular and Integrative Physiology.

## Planning

See Urban and Regional Planning.

## Plant Biological Sciences

**Contact Information**—Plant Biological Sciences Graduate Program, University of Minnesota, 250 Biological Sciences Center, 1445 Gortner Avenue, St. Paul, MN 55108-1095 (612-625-4222; fax 612-625-1738; [pbiogp@cbs.umn.edu](mailto:pbiogp@cbs.umn.edu); <[www.cbs.umn.edu/plantbio/gradprog](http://www.cbs.umn.edu/plantbio/gradprog)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Regents Professor

Ronald L. Phillips, Agronomy and Plant Genetics, SM

### Professor

Deborah L. Allan, Soil, Water, and Climate, SM  
Bridgette A. Barry, Biochemistry, Molecular Biology, and Biophysics, SM  
Judith G. Berman, Genetics, Cell Biology, and Development, SM  
David D. Biesboer, Plant Biology, SM  
Robert M. Brambl, Plant Biology, SM  
Iris D. Charvat, Plant Biology, SM  
Jerry D. Cohen, Horticultural Science, SM  
Edward J. Cushing, Ecology, Evolution, and Behavior, SM  
Anath Das, Biochemistry, Molecular Biology, and Biophysics, SM  
Gary M. Gardner, Horticultural Science, SM  
Burle G. Gengenbach, Agronomy and Plant Genetics, SM  
Florence K. Gleason, Plant Biology, SM  
Peter H. Graham, Soil, Water, and Climate, SM  
Robert J. Jones, Agronomy and Plant Genetics, SM  
Willard L. Koukkari, Plant Biology, SM  
Paul A. Lefebvre, Plant Biology, SM  
Pen Hsiang Li, Horticultural Science, SM  
Albert H. Markhart III, Horticultural Science, SM  
David J. McLaughlin, Plant Biology, SM

Neil E. Olszewski, Plant Biology, SM  
 James A. Perry, Forest Resources, SM  
 Peter B. Reich, Forest Resources, SM  
 Michael J. Sadowsky, Soil, Water, and Climate, SM  
 Ruth G. Shaw, Ecology, Evolution, and Behavior, SM  
 Carolyn D. Silflow, Plant Biology, SM  
 D. Peter Snustad, Plant Biology, SM  
 David A. Somers, Agronomy and Plant Genetics, SM  
 Joseph R. Sowokinos, Horticultural Science, SM  
 Kate VandenBosch, Plant Biology, SM  
 Clifford M. Wetmore, Plant Biology, SM  
 Susan M. Wick, Plant Biology, SM  
 Nevin D. Young, Plant Pathology, SM

#### **Adjunct Professor**

John W. Gronwald, Agronomy and Plant Genetics, SM  
 Deborah A. Samac, Plant Pathology, SM  
 Carroll P. Vance, Agronomy and Plant Genetics, SM

#### **Associate Professor**

J. Stephen Gantt, Plant Biology, SM  
 Susan I. Gibson, Plant Biology, SM  
 Michael D. Marks, Plant Biology, SM  
 Georgiana May, Plant Biology, SM  
 Gary J. Muehlbauer, Agronomy and Plant Genetics, SM  
 Alan G. Smith, Horticultural Science, SM  
 Cindy B. Tong, Horticultural Science, SM

#### **Adjunct Associate Professor**

Les J. Szabo, Plant Pathology, SM

#### **Assistant Professor**

James A. Bradeen, Plant Pathology, SM  
 Min Ni, SM  
 Anton A. Sanderfoot, Plant Biology, SM  
 Peter Tiffin, Plant Biology, SM  
 John M. Ward, Plant Biology, SM  
 George Weiblen, Plant Biology, SM  
 Cynthia Weinig, Plant Biology, SM

#### **Lecturer**

Anita F. Cholewa, College of Continuing Education, AM

#### **Other**

Thomas K. Soulen, Plant Biology, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Plant biological sciences encompasses all aspects of the basic biology of both higher and lower plants. Major emphases include molecular and physiological approaches to development; physiological, structural, and functional studies at the cellular and organismal levels; systematic and evolutionary biology; and molecular genetics and applied biotechnology. Students study plants from the subcellular and molecular to the whole plant and community levels of biological organization. They also have opportunities for laboratory and field research at state, national, and international levels. Each student's program is planned to meet individual requirements within the framework of a multidisciplinary core of coursework. Seminars are an integral part of the program.

**Prerequisites for Admission**—Prospective students are expected to have completed a year of coursework in at least three of the following four areas: differential and integral calculus; organic and inorganic chemistry; biology; and physics. For students with demonstrated ability, background

deficiencies, as determined by the admissions committee, can be made up during the first year of graduate studies. All admitted students are assigned to an adviser in the graduate program before they begin their studies.

#### **Special Application Requirements**—

Applicants must submit scores from the General Test of the GRE, three letters of recommendation from persons familiar with their scholarship and research potential, a complete set of official transcripts, and a clearly written statement of career interests, goals, and objectives. Students may apply at any time; however, submission of all application materials by January 15 is strongly encouraged to ensure priority consideration for fellowships and teaching and research assistantships awarded for the next academic year. Students can be admitted any semester.

**Courses**—Please refer to Plant Biology (PBio) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

#### **M.S. Degree Requirements**

Course programs are planned in consultation with an advisory committee. Students are expected to take a minimum of four courses in the major in addition to the two 1-credit current topics courses taken during their first year.

Students participate in a teacher-training program and then serve as a teaching assistant for one semester. Regular attendance at the weekly Plant Biological Sciences Colloquium seminars is expected.

Plan A students write a thesis proposal and present the results of their research at a colloquium seminar. Plan B students develop a thesis proposal.

**Language Requirements**—None, except as specified by a faculty adviser in consultation with the student.

**Final Exam**—The final exam is oral.

#### **Minor Requirements for Students**

**Majoring in Other Fields**—A master's minor requires a minimum of 6 credits approved by the director of graduate studies.

#### **Ph.D. Degree Requirements**

Doctoral requirements are the same as those for a master's degree. In addition, a dissertation proposal and the presentation of two noncredit seminars are required.

**Language Requirements**—None, except as specified by a faculty adviser in consultation with the student.

#### **Minor Requirements for Students**

**Majoring in Other Fields**—A doctoral minor requires a minimum of 12 credits approved by the director of graduate studies.

## **Plant Pathology**

**Contact Information**—Department of Plant Pathology, University of Minnesota, 495 Borlaug Hall, 1991 Buford Circle, St. Paul, MN 55108 (612-625-8200; [anna@umn.edu](mailto:anna@umn.edu); [www.plpa.agri.umn.edu](http://www.plpa.agri.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

#### **Professor**

Robert A. Blanchette, SM  
 Robert Morgan Brambl, SM  
 William R. Bushnell, SM  
 James V. Groth, SM  
 Roger K. Jones, SM  
 Linda L. Kinkel, SM  
 Sagar V. Krupa, SM  
 Philip O. Larsen, SM  
 Benham E. L. Lockhart, SM  
 David H. MacDonald, SM  
 James A. Percich, SM  
 Francis L. Pfleger, SM  
 Brian J. Steffenson, SM  
 Carol E. Windels, SM  
 Nevin D. Young, SM  
 Richard J. Zeyen, SM

#### **Adjunct Professor**

Martin Carson, SM  
 H. Corby Kistler, SM  
 Deborah A. Samac, SM

#### **Associate Professor**

Senyu Chen, M2  
 Ruth Dill-Macky, SM

#### **Adjunct Associate Professor**

James Kolmer, M2  
 Les J. Szabo, M2

#### **Assistant Professor**

James M. Bradeen, M2  
 James E. Kurle, M2  
 Charla Hollingsworth, M2  
 Salliana R. Stetina, M2

#### **Adjunct Assistant Professor**

Jennifer Juzwik, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Plant pathology focuses on the biology of plant-microbe interactions, and incorporates research spanning the biochemical, molecular, genetic, physiological, whole organism, population, and community levels of biological organization. Plant pathology interfaces with all plant science disciplines, and with food sciences, veterinary medicine, and ecology. Areas of concentration include molecular plant pathology (offered as a special emphasis), plant disease management, biological control of plant disease, forest pathology and microbial degradation of wood, microbial ecology, population biology, plant-microbe interactions, disease resistance, host-parasite coevolution, environmental pollution and climate change, plant-microbe mutualisms, and virology. Students have opportunities for laboratory and field research locally as well as nationally and internationally. The course of study varies with the requirements of the area of concentration and interests of the student.

Students who choose the emphasis in molecular plant pathology enhance their ability to design and use molecular approaches to investigate plant disease, increase basic knowledge, and develop new strategies for disease control.

**Prerequisites for Admission**—Master's degree applicants must have a sound college background in the basic biological and physical sciences and mathematics, including 35 semester credits in biology with at least one course in each of the following areas: botany, zoology, genetics, plant physiology, and microbiology. Applicants must also have completed at least one course each in inorganic chemistry, organic chemistry, biochemistry, and physics. If deficiencies exist in the prerequisites, they must be corrected during the first year of the graduate program. All students accepted into the department with a B.S. degree are admitted into the M.S. degree program. After a minimum of two semesters, students who qualify may elect to change their degree status to a Ph.D. program. Criteria for the change include scholastic standing, potential for success in completing a Ph.D., and writing competency. Such a change in status must be approved by the student's advisory committee and the director of graduate studies after consultation with the Graduate Studies Committee. Ph.D. applicants must satisfy all the prerequisites for the master's degree program in plant pathology or have a master's degree in plant pathology or in a field of natural science.

**Special Application Requirements**—GRE scores are required for all students and TOEFL or IELTS scores are required for international students. A clearly written statement of career interests as well as three letters of recommendation are required of all students and must be submitted to the department at the time of application. Students may apply at any time; however, submission of all application materials by January 15 will ensure priority consideration for fellowships and research assistantships for the next academic year. Students can be admitted any semester.

**Courses**—Please refer to Plant Pathology (PlPa) in the course section of this catalog for courses pertaining to the program, or to the department Web site at [www.plpa.agri.umn.edu](http://www.plpa.agri.umn.edu).

**Use of 4xxx Courses**—For M.S. Plan A and Ph.D. students, 4xxx courses are not permitted toward degree requirements.

### M.S. Degree Requirements

Plan A (thesis) and Plan B (without thesis) both require a minimum of 14 course credits in plant pathology and 6 course credits in a minor or related field. In addition, Plan A requires 10 thesis credits and Plan B requires 8 project or elective credits. Regular attendance at weekly plant pathology seminars is expected. Internships are encouraged as part of the graduate experience; financial support is available on a

competitive basis for international or domestic internships. A detailed overview of course offerings and requirements, including additional details on the molecular plant pathology emphasis, is available at [www.plpa.agri.umn.edu](http://www.plpa.agri.umn.edu).

**Language Requirements**—A foreign language is generally not required. However, knowledge of a foreign language may be necessary for students doing research in non-English-speaking countries.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A minimum of 6 credits in PlPa 5xxx or 8xxx courses is required for a master's minor.

### Ph.D. Degree Requirements

The Ph.D. requires a minimum of 17 course credits in plant pathology, which may include 5xxx and 8xxx courses taken before admission to the program (with approval of the director of graduate studies), and to complete 12 credits in a minor or supporting program, and 24 thesis credits. Course requirements include enrollment in a supervised teaching or extension teaching experience. Degree programs are determined by the student and the student's advisory committee, with approval of the director of graduate studies. Regular attendance at weekly plant pathology seminars is expected. Internships are encouraged as part of the graduate experience; financial support is available on a competitive basis for international or domestic internships. A detailed overview of course offerings and requirements, including additional details on the molecular plant pathology emphasis, is available at [www.plpa.agri.umn.edu](http://www.plpa.agri.umn.edu).

**Language Requirements**—A foreign language is generally not required. However, knowledge of a foreign language may be necessary for students doing research in non-English-speaking countries.

### Minor Requirements for Students

**Majoring in Other Fields**—A minimum of 12 credits in PlPa 5xxx or 8xxx is required for a doctoral minor.

## Policy Issues on Work and Pay

### Postbaccalaureate Certificate

**Contact Information**—Policy Issues on Work and Pay, 101 Westbrook Hall, 77 Pleasant Street S.E., Minneapolis, MN 55455 (612-624-4000; [adv@cce.umn.edu](mailto:adv@cce.umn.edu); [www.cce.umn.edu/pdm/bmcmmain.shtml](http://www.cce.umn.edu/pdm/bmcmmain.shtml)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

#### Professor

John Budd, Human Resources and Industrial Relations, M  
Morris Kleiner, Public Affairs, M  
James Griffin Scoville, Human Resources and Industrial Relations, M

#### Associate Professor

Maria Hanratty, Public Affairs, M

**Curriculum**—This certificate provides an understanding of and the ability to evaluate federal, state, and local policies that affect the employment relationship. Students learn about the role of government in the employment relationship including statutes and how employers, unions, and the government interpret policies. Courses are drawn from the Humphrey Institute of Public Affairs as well as the Industrial Relations Center in the Carlson School of Management, with auxiliary courses in law, history, and sociology.

**Prerequisites for Admission**—Students must have a bachelor's degree from an accredited U.S. university or its foreign equivalent. Applicants should have mathematics courses at least up through algebra and a course in microeconomics (Econ 1101 is offered via distance education at the University). A GPA of 3.00 is required and, for international students, a TOEFL score consistent with the Graduate School's requirements.

**Courses**—Core courses (5 credits): PA 5431 (3 cr); HRIR 5053 (2 cr). Elective courses: HRIR 5021 (4 cr); HRIR 5023 (2 cr); HRIR 8071 (4 cr); HRIR 8021 (3 cr); HRIR 8024 (2 cr); PA 8386 (3 cr); PA 5401 (3 cr); Hist 5844 (3 cr); Law 6203 (3 cr); Law 6231 (3 cr).

**Use of 4xxx Courses**—4xxx courses may not be used to meet certificate requirements.

### Postbaccalaureate Certificate Requirements

The certificate consists of at least 15 credits: 5 credits in the core (required courses), and 10 credits of supporting electives. Courses are drawn primarily from the Humphrey Institute of Public Affairs and the Industrial Relations Center in the Carlson School of Management, with additional courses from the College of Liberal Arts and the Law School. Students complete 10 elective credits that allows them to focus on the area of public policy that is most relevant to their professional and educational goals and needs. Note that some elective courses require prerequisites which do not count toward the certificate.

**Completion Requirements**—Early in the program, each student should file a certificate program plan with the College of Continuing Education indicating the courses that will be taken, subject to change with faculty approval. Completion of the certificate program requires completion of the indicated courses with core courses requiring a grade of B or better and with an overall GPA in certificate coursework of 3.00 or higher.

## Political Psychology Minor Only

**Contact Information**—Doctoral Minor in Political Psychology, Center for the Study of Political Psychology, University of Minnesota, 1227 Social Sciences Building, 267 19th Avenue S., Minneapolis, MN

55455; (612-624-0864; fax 612-625-2078; [cspp@polisci.umn.edu](mailto:cspp@polisci.umn.edu); <[www.polisci.umn.edu/polipsyc/minor/index.html](http://www.polisci.umn.edu/polipsyc/minor/index.html)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### **Regents Professor**

John L. Sullivan, Political Science, M

#### **Professor**

Patricia G. Avery, Curriculum and Instruction, M  
Eugene Borgida, Psychology, M  
Karlyn K. Campbell, Communication Studies, M  
Ronald J. Faber, Journalism and Mass Communication, M  
William H. Flanigan, Political Science, M  
David W. Johnson, Educational Psychology, M  
Paul E. Johnson, Information and Decision Sciences, M  
Geoffrey M. Maruyama, Educational Psychology, M  
R. Michael Paige, Educational Policy and Administration, M  
W. Phillips Shively, Political Science, M  
Mark Snyder, Psychology, M  
Daniel B. Wackman, Journalism and Mass Communication, M

#### **Associate Professor**

Guy Charles, Law, M  
Martha H. Gonzales, Psychology, M  
Wendy M. Rahn, Political Science, M  
Alexander J. Rothman, Psychology, M  
Martin W. Sampson III, Political Science, M  
Albert R. Tims, Jr., Journalism and Mass Communication, M

#### **Assistant Professor**

James N. Druckman, Political Science, M  
Christopher Federico, Psychology, Political Science, M  
Samantha C. Luks, Political Science, M  
Joanne Miller, Political Science, M

**Curriculum**—This minor is available to doctoral students only. Political psychology is a rapidly advancing field of scientific inquiry concerned with psychological aspects of political behavior. It encompasses a variety of interdisciplinary research perspectives, drawing on the theories and methods of core disciplines such as psychology, political science, law, and sociology, as well as interdisciplinary fields such as mass communication and decision sciences. The minor's structured curriculum provides a foundation in basic areas in political psychology: social attitudes and cognition, judgment and decision making, group relations, personality and leadership, mass communication, public opinion, mass political behavior, and political socialization. In addition to providing a background in political psychology, the program trains students in the theory and methods useful to this field, such as content analysis, survey analysis, and experimental design. The faculty is drawn from ten programs within the Graduate School and Law School.

**Prerequisites for Admission**—Admission is contingent upon prior admission to the Graduate School and a doctoral program in a degree-granting department. Applicants are required to demonstrate knowledge of research methods useful in the study of political psychology by successfully completing (grade of B or better) two or more of the following courses: EPsy 8261, 8262, or 8266; Pol 8101, 8123, or 8131; Psy

5862 or 8884; Soc 8811; or Stat 5021 or 5302. The director of graduate studies in political psychology must approve admission.

**Courses**—Please contact the minor program office for information on relevant coursework.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to director of graduate studies approval.

#### **Minor Only Requirements**

The doctoral minor requires a minimum of 14 graduate credits, including 8 credits in required courses and 6 credits in at least two electives from outside the student's department or program and from a minimum of two of the following four modules: 1) psychological aspects of political behavior; 2) political socialization and human development; 3) politics in sociocultural context; and 4) psychological approaches to political decision making: public policy and international relations. Students are able to tailor the minor to complement their major programs. The required courses are the Proseminar in Political Psychology (Pol 8307, 8308 or Psy 8211, 8212; 2 credits), Political Psychology and Socialization (Pol 8311; 3 credits), and Social Cognition (Psy 8201; 3 credits).

## **Political Science**

**Contact Information**—Department of Political Science, University of Minnesota, 1414 Social Sciences Building, 267 19th Avenue S., Minneapolis, MN 55455 (612-624-4144; fax 612-626-7599; [office@polisci.umn.edu](mailto:office@polisci.umn.edu); <[www.polisci.umn.edu/graduate/](http://www.polisci.umn.edu/graduate/)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### **Regents Professor**

John L. Sullivan, SM

#### **Professor**

Mary G. Dietz, SM  
Raymond D. Duvall, SM  
James Farr, SM  
William H. Flanigan, SM  
Edwin Fogelman, SM  
John R. Freeman, SM  
Robert T. Holt (emeritus), ASM  
Lawrence R. Jacobs, SM  
Ethan B. Kapstein, SM  
Robert B. Kvavik, SM  
August H. Nimtz, Jr., SM  
Steven J. Rosenstone, SM  
William Scheuerman, SM  
Thomas M. Scott, SM  
W. Phillips Shively, SM  
Kathryn A. Sikkink, SM  
David E. Wilkins, ASM

#### **Adjunct Professor**

Timothy R. Johnson, M2

#### **Associate Professor**

Lisa J. Disch, SM  
Daniel Kelliher, SM  
Wendy M. Rahn, SM  
Diana E. Richards, SM  
Martin W. Sampson III, SM  
David J. Samuels, SM

#### **Assistant Professor**

Jamie Druckman, M2  
Christopher Federico, M2  
Samantha C. Luks, M2  
Timothy R. Johnson, M2  
Colin H. Kahl, M2  
Jeffrey D. Lomonaco, M2  
Joanne Miller, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The curriculum is divided into five subfields: formal models and methodology, political theory, American politics, international relations, and comparative politics.

**Prerequisites for Admission**—The department's graduate admissions committee selects the strongest applicants based upon consideration of all components of the application file. The committee accepts students who have or are completing B.A. or B.S. degrees and students who have or are completing M.A. degrees.

**Special Application Requirements**—All students, except those in the special master's program, are admitted directly into the Ph.D. program. The following should be sent directly to the department: department application form; GRE scores; a complete set of transcripts in addition to that required by the Graduate School; a brief statement expressing the applicant's purpose and goals in pursuing graduate work (in addition to and separate from the statement required as part of the Graduate School application form); three letters of recommendation from professors who know the applicant's academic work, particularly in political science; and samples of the applicant's written work (papers written for political science courses preferred). Send photocopies of written work; the department cannot guarantee that materials will be returned.

Graduate study in the Ph.D. program must begin in fall semester; the application deadline is January 1. Graduate study in the special M.A. program may begin in any semester; the application deadline for fall semester is May 1; spring semester is October 1.

The department and the Humphrey Institute of Public Affairs jointly offer a program that leads to an M.A. in public affairs and a Ph.D. in political science. To be eligible, students must be admitted separately by political science and public affairs. Normally, students begin their study in public affairs and later apply to the Ph.D. program in political science. However, students may begin in either program, so it is possible to apply initially to either program or both. Students interested in this joint degree program should contact the director of graduate studies.

**Courses**—Please refer to Political Science (Pol) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—4xxx and 5xxx courses from other departments usually are acceptable for supporting or minor programs with approval of the department that teaches the course. Political science courses at these levels are generally not open to Ph.D. students, who are expected to take 8xxx seminars. They are open to professional M.A. students.

### **M.A. Degree Requirements Plan B Only**

This program is for secondary school teachers, journalists, government employees, political professionals, and others who would like to cover broad areas of study in political science and related disciplines without the depth and extensive research emphasized in the Ph.D. program. Students may choose among several subfields, including political theory, comparative politics, international relations, American politics, and formal models and methodology.

The M.A. degree, Plan B (without thesis), requires 34 credits, distributed between major courses and minor or related field courses; three research papers, usually written in connection with coursework, are also required.

**Language Requirements**—None.

**Final Exam**—The final exams are written and oral.

### **Ph.D. Degree Requirements**

The program is divided into five subfields: American politics, comparative politics, political theory, international relations, and formal models and methodology. A joint M.A.-Ph.D. program is also available that leads to an M.A. in public affairs from the Hubert H. Humphrey Institute of Public Affairs and a Ph.D. in political science.

Students concentrate in two of the five subfields and take a minimum of 10 political science seminars, including Pol 8101 and the core seminars in each of their subfields (Pol 8201, 8301, 8401, 8601). In addition, they take three advanced seminars in their first subfield and three in their second, or four advanced seminars in their first subfield and two in their second subfield (formal models and methodology can be used only as a second subfield).

**Language Requirements**—Students must demonstrate one of the following:  
a) high proficiency in one foreign language,  
b) high proficiency in research methodology,  
c) low proficiency in two foreign languages,  
d) low proficiency in one foreign language and low proficiency in research methodology.

Students who concentrate in comparative politics must have appropriate language competence in their area(s) of specialization.

### **Minor Requirements for Students**

**Majoring in Other Fields**—A doctoral minor requires a minimum of 9 credits of graduate-level courses and an exam.

## Portuguese

See Hispanic and Luso-Brazilian Literatures and Linguistics.

## Program Evaluation

### **Minor Only**

**Contact Information**—Director of Graduate Studies, Program Evaluation Program, University of Minnesota, 330 Wulling Hall, 86 Pleasant Street S.E., Minneapolis, MN 55455 (612-624-1006; fax 612-624-3377; [kingx004@umn.edu](mailto:kingx004@umn.edu); <http://education.umn.edu/EdPA/>).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### **Professor**

Michael Baizerman, Social Work, Work, Community, and Family Education, Educational Policy and Administration, M  
Nancy N. Eustis, Public Affairs, M  
Judith Garrard, Health Services Research, Policy, and Administration, M  
David R. Johnson, Institute on Community Integration, M  
Richard A. Krueger, Work, Community, and Family Education, M  
Frances P. Lawrenz, Curriculum and Instruction, M  
Darell R. Lewis, Educational Policy and Administration, M  
Phyllis L. Pirie, Epidemiology, M  
Patricia S. Seppanen, AM

### **Associate Professor**

Jean A. King, Educational Policy and Administration, M

**Curriculum**—A minor in program evaluation may be pursued at both the doctoral and the master's levels. The core of the curriculum consists of courses in the foundations of evaluation, evaluation theory, and internship experiences.

**Prerequisites for Admission**—Prior admission into an established M.A. or Ph.D. is required. Admission to the minor, therefore, will be contingent upon enrollment in good standing within a recognized degree-granting program of the Graduate School.

### **Special Application Requirements**

Students apply for admission through the director of graduate studies and faculty. Students must demonstrate relevant academic background, including research methodology, and experience in a field in which program evaluation is practiced (e.g., public health, social work, and education). Students from existing evaluation programs in EdPA and EPsy are *not* eligible for the minor.

**Courses**—Please refer to Educational Policy and Administration (EdPA), Educational Psychology (EPsy), Family Social Science (FSoS), Public Health (PubH), and Work, Community, and Family Education (WCFE) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses is not permitted.

### **Minor Only Requirements**

Students need a minimum of 15 credits for the doctoral minor and a minimum of 9 credits for the master's minor. Individual programs are designed through consultation among the student, the major adviser, and the director of graduate studies.

## Psychological Foundations of Education

See Educational Psychology.

## Psychology

**Contact Information**—Department of Psychology, University of Minnesota, 249 Elliott Hall, 75 East River Road, Minneapolis, MN 55455 (612-624-4181; fax 612-626-2079; [psyapply@umn.edu](mailto:psyapply@umn.edu); [www.psych.umn.edu](http://www.psych.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### **Regents Professor**

Ellen S. Berscheid, SM

### **Professor**

Eugene Borgida, SM  
Thomas J. Bouchard, Jr., SM  
Dwight A. Burkhardt, SM  
James N. Butcher, SM  
John P. Campbell, SM  
Robert A. Cudeck, SM  
Patricia A. Frazier, SM  
Jo-Ida C. Hansen, SM  
William G. Iacono, SM  
Daniel J. Kersten, SM  
Gordon E. Legge, SM  
Gloria R. Leon, SM  
Matthew K. McGue, SM  
Stephan J. Motowidlo, SM  
J. Bruce Overmier, SM  
Christopher J. Patrick, SM  
Paul R. Sackett, SM  
Mark Snyder, SM  
Neal F. Viemeister, SM  
David J. Weiss, SM

### **Associate Professor**

Charles R. Fletcher, SM  
Martha H. Gonzales, SM  
William M. Grove, SM  
Sheng He, SM  
Robert F. Krueger, SM  
Monica Luciana, SM  
Chad J. Marsolek, SM  
Michael H. Miner, M2  
Deniz S. Ones, SM  
Gail Burton Peterson, SM  
Alexander J. Rothman, SM

### **Assistant Professor**

Joyce E. Bono, M2  
Christopher M. Federico, M2  
Jonathan C. Gewirtz, M2  
Richard M. Lee, SM  
Shigehiro Oishi, M2  
Paul R. Schrater, M2

### **Adjunct Professor**

Richard D. Arvey, Human Resources and Industrial Relations, ASM  
Marilyn E. Carroll, Psychiatry, ASM  
Mark L. Davison, Educational Psychology, ASM  
Byron Egeland, Child Development, ASM  
Dorothy K. Hatsukami, Psychiatry, ASM  
Paul E. Johnson, Information and Decision Sciences, ASM

Thomas J. Kiresuk, Psychiatry, AM2  
 Eric Klingler, Social Sciences, Morris, ASM  
 Allen S. Levine, Psychiatry, ASM  
 Rodney G. Loper, University Counseling and Consulting Services, ASM  
 Ann S. Masten, Child Development, ASM  
 Herbert L. Pick, Jr., Child Development, ASM  
 Sheldon B. Sparber, Pharmacology, ASM  
 L. Alan Sroufe, Child Development, ASM  
 Richard A. Weinberg, Child Development, ASM  
 James E. Ysseldyke, Educational Psychology, ASM

#### **Adjunct Associate Professor**

James P. Cleary, AM2  
 Darwin D. Hendel, Educational Policy and Administration, AM2  
 Matt G. Kushner, Psychiatry, ASM  
 Carol H. Pazandak, AM2  
 William N. Robiner, AM  
 Connie R. Wanberg, Human Resources and Industrial Relations, ASM

#### **Adjunct Assistant Professor**

Kathy J. Christensen, Neurology, AM2  
 Celia W. Gershenson, AM2  
 Theresa M. Glomb, Human Resources and Industrial Relations, AM2  
 John C. Gonsiorek, AM2  
 Harriett L. C. Haynes, University Counseling and Consulting Services, AM  
 Carol B. Peterson, AM  
 Scott R. Sponheim, AM2  
 Linda K. Van Egeren, AM2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Except for the psychometric methods specialization and in special circumstances, students are admitted only for the Ph.D. However, a number of Ph.D. subareas require a Plan A master's to ensure that research training starts early. Doctoral program specialties are offered in biological psychopathology, clinical science and psychopathology research, cognitive and biological psychology, counseling psychology, differential psychology/behavior genetics, industrial/organizational psychology, personality research, psychometric methods, school psychology, and social psychology.

**Prerequisites for Admission**—Prospective students generally have completed 12 credits (three to four courses) of psychology work beyond introductory psychology, including one course in statistics or psychological measurement. For the clinical science program, a course in abnormal psychology is required. An undergraduate major in psychology is desirable, but not necessary.

#### **Special Application Requirements**—

Applications are accepted for fall admission only; the deadline is January 5. A department application, a statement of career interests, goals, and objectives, three letters of recommendation from persons familiar with the applicant's scholarship and research potential, and scores from the General Test of the GRE should accompany applications. The GRE Subject Test in psychology is recommended. Although there are no specific required minimums for GPAs and GRE scores, the range of scores for those admitted

in previous years, as well as other specific requirements, are available from the psychology graduate admissions office.

To ensure full consideration for fellowships and teaching and research assistantships, send the Graduate School application form, transcripts, and application fee to the Graduate School by December 1.

**Courses**—Please refer to Psychology (Psy) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Certain 4xxx courses may be taken for graduate credit. Students should consult the instructor or director of graduate studies.

#### **M.A. Degree Requirements**

Each student's program is planned in consultation with an adviser. Plan A requires a minimum of 14 credits in psychology and 6 credits in a minor/related field, and a research thesis. Plan B requires one to three review papers in lieu of a thesis, and a minimum of 30 course credits, of which 14 credits must be in psychology and 6 credits in one or more related fields. For Plan A, the final exam is oral; for Plan B, it may be written, oral, or both.

**Language Requirements**—None.

#### **Minor Requirements for Students**

**Majoring in Other Fields**—A master's minor requires a minimum of 6 credits, with specific courses determined in consultation with an adviser and other faculty.

#### **Ph.D. Degree Requirements**

Students must satisfy the general area distribution requirement using selected courses in four areas outside their specialization. There are no other general departmental course requirements. Each student's program is individually planned in consultation with an adviser to meet both the individual's goals and the area requirements. The programs in clinical psychology and counseling psychology include specific requirements for applied coursework and practicum and internship experience. Each specialization also requires completion of a series of Ph.D. seminars covering scholarship and research skills. Students also complete 12-15 credits in a minor or supporting program.

**Language Requirement**—None.

#### **Minor Requirements for Students**

**Majoring in Other Fields**—The doctoral minor requires a minimum of 12 credits and is designed according to student needs.

## **Public Affairs**

**Contact Information**—Director of Admissions, Hubert H. Humphrey Institute of Public Affairs, University of Minnesota, 301 19th Avenue South, Minneapolis, MN 55455, (612-624-3800; fax 612-626-0002; [admissions@hhh.umn.edu](mailto:admissions@hhh.umn.edu); [www.hhh.umn.edu](http://www.hhh.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

#### **Regents Professor**

G. Edward Schuh, M2

#### **Professor**

Dean E. Abrahamson (emeritus), AM  
 John S. Adams, M2  
 Sandra O. Archibald, M2  
 Ragui A. Assaad, M2  
 J. Brian Atwood, M2  
 John E. Brandl, M2  
 John M. Bryson, M2  
 Nancy N. Eustis, M2  
 Katherine Fennelly, M2  
 Edward G. Goetz, M2  
 Stephen A. Hoenack, M2  
 Leonid Hurwicz (emeritus), AM  
 Ethan B. Kapstein, M2  
 Kenneth H. Keller, M2  
 Sally J. Kenney, M2  
 Morris M. Kleiner, M2  
 Robert T. Kudrle, M2  
 Ann R. Markusen, M2  
 George W. Morse, Applied Economics, AM  
 Samuel L. Myers, M2  
 Carlisle F. Runge, Applied Economics, AM  
 Esther Wattenberg, Social Work, AM

#### **Associate Professor**

Robert A. Connor, Healthcare Management, AM  
 Maria J. Hanratty, M2  
 Deborah Levison, M2  
 Melissa M. Stone, M2

#### **Assistant Professor**

Kevin J. Krizek, M2

#### **Other**

Zbigniew M. Bochniarz, AM  
 Harry C. Boyte, AM2  
 William Craig, AM  
 Barbara C. Crosby, AM2  
 Gary M. DeCramer, AM2  
 Marsha A. Freeman, AM  
 Ali K. Galaydh, AM2  
 Thomas F. Luce, AM  
 Barbara L. Lukermann, AM  
 Lee Munnich, AM  
 Joseph H. Nathan, AM  
 Joseph A. Ritter, AM  
 Jodi R. Sandfort, AM2  
 Paul C. Stone, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The master of public affairs (M.P.A.) is intended for mid-career professionals. It is a broad, generalist program that emphasizes leadership and policy making. Completion of degree requirements should be possible within a calendar year (two semesters and a summer) of full-time enrollment, or two to three years of part-time enrollment. Structured concentrations include advanced policy analysis methods; economic and community development; foreign policy and international affairs; public and nonprofit leadership and management; science and technology policy; social policy; women and public policy; land use/urban design planning; regional, economic and workforce development; housing and community development; environmental planning; and transportation planning.

**Prerequisites for Admission**—Ten years or more of career or public affairs experience and a U.S. bachelor's degree or foreign equivalent is required.

**Special Application Requirements**—In addition to the materials submitted to the Graduate School, applicants must submit to the Humphrey Institute a photocopy of the Graduate School admission application, a Humphrey Institute Applicant Data form, copies of all transcripts, a statement of purpose, at least three letters of recommendation, and a professional résumé. The deadline for applications is April 1 of the preceding academic year. Entry is for fall semester.

**Courses**—Please refer to Public Affairs (PA) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses on degree program forms is permitted with instructor's and adviser's permission.

### M.P.A. Degree Requirements

The M.P.A. requires 30 credits, including PA 5941—Leadership for the Common Good (4 cr), PA 8001—Transforming Public Policy (4 cr), and PA 8002—Synthesis Workshop (4 cr); 9 credits in concentration electives; 6 credits in skills courses; and 3 credits of electives. Participants have the option to pursue a minor or related field offered by another college within the University.

**Language Requirements**—None.

**Final Exam**—Projects in the synthesis seminar and workshop fulfill the requirements for the final oral exam.

## Public Health

### Minor Only

**Contact Information**—Student Services Center, School of Public Health, University of Minnesota, MMC 819, 420 Delaware Street S.E., Minneapolis, MN 55455 (612-626-3500 or 1-800-774-8636; fax 612-626-6931; [sph-uofm@greg2.sph.umn.edu](mailto:sph-uofm@greg2.sph.umn.edu); <[www.sph.umn.edu](http://www.sph.umn.edu)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### Professor

Michael Baizerman, Social Work, M  
Robert W. Blum, Pediatrics, M  
Judith E. Brown, M  
Judith M. Garrard, M  
Susan G. Gerberich, M  
Robert W. Jeffery, M  
Barbara J. Leonard, Nursing, M  
A. Marshall McBean, M  
Michael D. Resnick, Pediatrics, M  
Robert L. Veninga, M  
Carolyn L. Williams, M

#### Associate Professor

Lester E. Block, M  
Ann W. Garwick, M  
Leslie A. Grant, Carlson School of Management, M  
Wendy L. Hellerstedt, M  
Patricia M. McGovern, M  
Joan M. Patterson, M

#### Other

Lee E. Schacht, M

**Curriculum**—The public health minor is available to master's (M.A. and M.S.) and doctoral students.

**Prerequisites for Admission**—Admission is contingent upon prior admission to a master's or doctoral degree-granting program within the Graduate School. Students enrolled in graduate programs within the School of Public Health are not eligible for this minor.

**Special Application Requirements**—Students declaring a minor in public health should contact the director of graduate studies in public health as early as possible. Enrollment is contingent upon approval of the application by the director of graduate studies, after which a minor program adviser(s) is assigned.

**Courses**—Please refer to Public Health (PubH) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses is not permitted.

### Minor Only Requirements

The master's minor requires a minimum of 8 graduate credits; the doctoral minor requires a minimum of 14 graduate credits. Courses for the minor must be selected from those offered by the School of Public Health. In order to meet the minor requirements, students must successfully complete graduate coursework in each of the following disciplines: biostatistics, epidemiology, and environmental health. Suggested courses include PubH 5414—Biostatistical Methods I; PubH 5320—Fundamentals of Epidemiology; and PubH 5200—Environmental Health.

If students have already taken comparable graduate level courses in these disciplines, other public health courses can be used to complete the minor requirement with the approval of the public health adviser and the director of graduate studies. Since public health courses may have prerequisites or enrollment limitations, early planning with an adviser is suggested.

**Language Requirements**—None.

## Public Policy

**Contact Information**—Director of Admissions, Hubert H. Humphrey Institute of Public Affairs, University of Minnesota, 301 19th Avenue South, Minneapolis, MN 55455 (612-624-3800; fax 612-625-3513; [admissions@hhh.umn.edu](mailto:admissions@hhh.umn.edu); <[www.hhh.umn.edu](http://www.hhh.umn.edu)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### Regents Professor

G. Edward Schuh, M2

#### Professor

Dean E. Abrahamson (emeritus), AM  
John S. Adams, M2  
Sandra O. Archibald, M2  
Ragui A. Assaad, M2

J. Brian Atwood, M2  
Richard S. Bolan (emeritus), AM  
John E. Brandl, M2  
John M. Bryson, M2  
Nancy N. Eustis, M2  
Katherine Fennelly, M2  
Edward G. Goetz, M2  
Stephen A. Hoenack, M2  
Leonid Hurwicz (emeritus), AM  
Ethan B. Kapstein, M2  
Kenneth H. Keller, M2  
Sally J. Kenney, M2  
Morris M. Kleiner, M2  
Robert T. Kudrle, M2  
Ann R. Markusen, M2  
George W. Morse, Applied Economics, AM  
Samuel L. Myers, M2  
Carlisle F. Runge, Applied Economics, AM  
Esther Wattenberg, Social Work, AM

#### Associate Professor

Robert A. Connor, Healthcare Management, AM  
Maria J. Hanratty, M2  
Deborah Levison, M2  
Melissa Stone, M2

#### Assistant Professor

Kevin J. Krizek, M2

#### Other

Zbigniew M. Bochniarz, AM  
Harry C. Boyte, AM2  
William Craig, AM  
Barbara C. Crosby, AM2  
Marsha A. Freeman, AM  
Ali K. Galaydh, AM2  
Thomas F. Luce, AM  
Barbara L. Lukermann, AM  
Lee W. Munnich, AM  
Joseph H. Nathan, AM  
Joseph A. Ritter, AM  
Jodi R. Sandfort, AM2  
Paul C. Stone, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The master of public policy (M.P.P.) curriculum is built upon a core of required theoretical and methodological courses. In remaining courses, students choose either to emphasize more advanced study of analysis or management, or to focus on a particular substantive area of public policy. Structured concentrations include advanced policy analysis methods, economic and community development, foreign policy and international affairs, public and nonprofit leadership and management, science and technology policy, social policy, and women and public policy. Students have multiple opportunities to apply the concepts learned in their coursework to real-life policy problems, including cases presented in courses, their internships, and workshops. Dual degrees include M.P.P./juris doctor; M.P.P./master of science in health services research, policy, and administration; M.P.P./master of social work.

**Prerequisites for Admission**—Students are expected to have completed the equivalent of an introductory course in microeconomics and have a U.S. bachelor's degree or foreign equivalent.

**Special Application Requirements**—In addition to the materials submitted to the Graduate School, applicants must submit to the Humphrey Institute a photocopy of the Graduate School admission application, the Humphrey Institute Applicant Data Form, copies of all academic transcripts, a statement of purpose, at least three letters of recommendation, and a GRE official score report. Students who wish to be considered for financial aid should apply no later than January 1 of the preceding academic year. Entry is for fall semester.

**Courses**—Please refer to Public Affairs (PA) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses towards degree requirements is permitted with instructor's and adviser's permission.

### M.P.P. Degree Requirements

The M.P.P. requires 45 credits including up to 20 credits in required core courses, a three-course concentration (9 credits minimum), and a 3-credit course to complete the professional paper. Remaining credits are taken in elective courses. A non-credit internship is also required, unless the student is exempted based on previous relevant employment.

**Language Requirements**—None.

**Final Exam**—No final exam is required.

### Minor Requirements for Students

**Majoring in Other Fields**—A minor is constructed in consultation with the student's minor adviser.

## Quaternary Paleoecology Minor Only

**Contact Information**—Emi Ito, Director of Graduate Studies, Quaternary Paleoecology Graduate Program, University of Minnesota, 108 Pillsbury Hall, 310 Pillsbury Drive S.E., Minneapolis, MN 55455 (612-624-7881; fax 612-625-3819; [qpminor@umn.edu](mailto:qpminor@umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Regents Professor

Herbert E. Wright, Jr. (emeritus), Geology and Geophysics, M

### Professor

Subir K. Banerjee, Geology and Geophysics, M  
Dwight A. Brown, Geography, M  
Edward J. Cushing, Ecology, Evolution, and Behavior, M  
R. Lawrence Edwards, Geology and Geophysics, M  
Guy E. Gibbon, Anthropology, M  
Emi Ito, Geology and Geophysics, M  
Thomas C. Johnson, Large Lakes Observatory, Duluth, M  
Edward A. Nater, Soil, Water, and Climate, M  
Richard H. Skaggs, Geography, M  
Peter S. Wells, Anthropology, M

### Associate Professor

James Cotner, Ecology, Evolution, and Behavior, M  
Katherine Klink, Geography, M

### Assistant Professor

Greg Laden, Anthropology, M  
Shinya Sugita, Ecology, Evolution, and Behavior, M  
Martha Tappen, Anthropology, M  
Susy S. Ziegler, Geography, M

**Curriculum**—The faculty of the graduate minor in quaternary paleoecology hold appointments in several departments. Students in this unique program benefit from the broad range of expertise and experience available at a large research university. From their coursework in the minor, graduate students learn techniques and approaches from other areas that can be applied to their own research.

The minor is available to master's (M.A. and M.S.) and doctoral students.

**Prerequisites for Admission**—Admission is contingent on prior admission to a Graduate School degree-granting program.

### Special Application Requirements

Students apply by sending a letter of application to the director of graduate studies ([qpminor@umn.edu](mailto:qpminor@umn.edu)) as well as a letter of recommendation from their current adviser. Application may be made at any time.

**Courses**—See <http://lrc.geo.umn.edu/QPcourses.pdf> and contact the director of graduate studies at [qpminor@umn.edu](mailto:qpminor@umn.edu) for information on relevant coursework.

**Use of 4xxx Courses**—Any 4xxx course included in the published list at <http://lrc.geo.umn.edu/QPcourses.pdf> may be used to satisfy the minor requirement.

### Minor Only Requirements

Students develop their curricula in consultation with their major advisers and the director of graduate studies in quaternary paleoecology. Students choose courses from two lists found at <http://lrc.geo.umn.edu/QPcourses.pdf>. Master's students must take one of the three courses from List A plus one or more courses from List B for a total of 6 credits. Ph.D. students take two of the three courses from List A plus one additional course from List B for a total of 9 credits. Some requirements may be waived depending on the student's background.

In all cases, the selected courses must be outside the student's major field for List A and outside the cluster that includes the student's major field in List B.

## Recreation, Park, and Leisure Studies

**Contact Information**—Director of Graduate Studies, School of Kinesiology, University of Minnesota, 220 Cooke Hall, 1900 University Avenue S.E., Minneapolis, MN 55455 (612-625-5300; fax 612-626-7700; [rpls@umn.edu](mailto:rpls@umn.edu); <http://education.umn.edu/klsl/>).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Dorothy H. Anderson, Forest Resources, AM2  
William C. Gartner, Applied Economics, AM2  
Mary Jo Kane, M2  
Leo H. McAvoy, Jr., M2  
John E. Rynders, Educational Psychology, AM2  
Michael G. Wade, M2

### Associate Professor

Bruce D. Anderson, M2  
Carla E. S. Tabourne, M2  
Diane M. Wiese-Bjornstal, M2

### Assistant Professor

Kenneth Barlett, Work, Community and Family Education, AM2  
W. Corliss Outley, M2

### Instructor

JoAnn Buysse, M2  
Stephan P. Carlson, Forest Resources, AM2  
Robert Danforth, AM2  
Maurice K. Fahnestock, AM2

### Research Associate

Carol A. Leitschuh, M2  
Ingrid E. Schneider, Forest Resources, AM2

### Senior Research Associate

David W. Lime (emeritus), Forest Resources, AM2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Emphasis areas in the master's program are park and recreation administration, outdoor recreation/education, sport management, and therapeutic recreation.

**Prerequisites for Admission**—Although prospective students generally have an undergraduate degree in recreation, park, and leisure studies, others with a baccalaureate degree including related preparation and a significant background and interest in the scientific study of recreation, park, and leisure studies may be admitted. Admitted students may be required to complete background preparation in undergraduate and graduate recreation, park, and leisure studies and related coursework.

### Special Application Requirements

Applicants must submit a completed University of Minnesota-Twin Cities Graduate School application form, a Division of Recreation, Park, and Sport Studies application form including a clearly written statement of academic interests, goals, and objectives, scores from the General Test of the GRE (verbal and quantitative) or the Miller Analogies Test that are less than five years old, three letters of recommendation from persons familiar with their scholarship and research potential, a scholarly paper, and copies of official transcripts. Students may apply at any time; however, submission of all application materials by January 15 is strongly encouraged to ensure priority consideration as well as teaching and research assistantships awarded for the next academic year. The three letters of recommendation must be sent directly to the department. Students can be admitted any term.

**Research Facilities**—Research facilities include the Institute on Community Integration and the Tucker Center for Research on Girls and Women in Sport.

**Courses**—Please refer to Recreation, Park, and Leisure Studies (Rec) in the course section of this catalog for courses pertaining to the program.



**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### M.A. Degree Requirements

Students select an emphasis in park and recreation administration, outdoor education/recreation, sport management, or therapeutic recreation.

The M.A. is offered under Plan A and Plan B. Plan A requires 30 credits, including at least 14 credits in recreation, park, and leisure studies, 6 credits in a minor or related field, and 10 thesis credits (Rec 8777). Plan B also requires 30 credits, including at least 14 credits in recreation, park, and leisure studies, 6 credits in a minor or related field, and 4 credits of a research project (Rec 8995). A 3.00 minimum GPA is required to maintain good standing and to graduate.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

## Rehabilitation Science

**Contact Information**—Program in Rehabilitation Science, MMC 388, 420 Delaware St. S.E., Minneapolis, MN 55455, (612-625-3966; fax 612-625-7192; [adamc002@umn.edu](mailto:adamc002@umn.edu); <[www.med.umn.edu/rehabsci/](http://www.med.umn.edu/rehabsci/)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Richard DiFabio, SM  
 Carl Kukulka, SM  
 Robert Patterson, SM

### Associate Professor

James Carey, SM  
 Dennis Dykstra, SM  
 Virgil Mathiowetz, SM  
 Glenn Scudder, M2  
 Erica Stern, SM  
 LaDora Thompson, SM

### Assistant Professor

Paula Ludewig, SM  
 Jon Samuel Nelson, M

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Physical rehabilitation optimizes recovery from disease or injury. The program prepares individuals to have a critical mind and research skills that will advance this clinical science. Emphasis areas in neurological rehabilitation and musculoskeletal rehabilitation are offered.

**Prerequisites for Admission**—Applicants must hold a bachelor's degree or graduate degree in a discipline related to rehabilitation such as biomedical engineering, medicine, occupational therapy, physical therapy, or speech/audiology. International students must hold a comparable foreign degree from an accredited program. Depending on the educational background of the applicant, admission may be contingent upon

completion of selected prerequisite coursework (i.e., physics). All applicants must have a minimum undergraduate GPA of 3.00 and an agreement from a rehabilitation science faculty member to serve as an adviser. Compatibility of research interests is a major determinant in the selection of a student/adviser relationship.

### Special Application Requirements

Applicants must submit the following materials: GRE General Test scores; official transcripts; three letters of reference; and TOEFL score for international students.

**Courses**—Please refer to Rehabilitation Science (RSc) and Physical Medicine and Rehabilitation (PMed) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms requires adviser and director of graduate studies approval. The use of 4xxx courses on degree program forms is highly discouraged.

### M.S. Degree Requirements

Plan A (thesis) requires a minimum of 33 credits: a minimum of 14 credits in the major, including 6 credits of rehabilitation science seminar (PMed 8100) and a research design course in rehabilitation science; a minimum of 6 credits in a minor or related fields; a statistics course (EPsy 5261 or equivalent); and a minimum of 10 thesis credits (RSc 8777). In place of the 10 thesis credits for Plan A, Plan B (without thesis) requires courses chosen in consultation with an adviser and a Plan B project. Students must maintain a 3.00 minimum GPA for all coursework taken in the program. The Graduate School requires ethics in research training. Students should work with an adviser to identify a plan to meet this requirement. For additional information, visit <[www.research.umn.edu/ethics](http://www.research.umn.edu/ethics)> or contact the program.

**Language Requirements**—None.

**Final Exam**—For Plan A, the final exam is oral; for Plan B, it may be written, oral, or both.

### Ph.D. Degree Requirements

The Ph.D. requires a minimum of 36 course credits: 16 credits in core courses, including 6 credits of rehabilitation science seminar PMed 8100; 12 credits in a minor or supporting program; 8 credits in statistics (credits earned in core courses and statistics cannot be applied to the minor or supporting program); and 24 thesis credits. Students must maintain a 3.00 minimum GPA for all coursework taken in the program. In addition to these minimum requirements, the adviser may require additional courses. The Graduate School requires ethics in research training. Students should work with an adviser to identify a plan to meet this requirement. For additional information, visit <[www.research.umn.edu/ethics](http://www.research.umn.edu/ethics)> or contact the program.

**Language Requirements**—None.

## Religions in Antiquity

See Classical and Near Eastern Studies.

## Religious Studies

### Minor Only

**Contact Information**—Director of Graduate Studies, Department of Classical and Near Eastern Studies, University of Minnesota, 305 Folwell Hall, 9 Pleasant Street S.E., Minneapolis, MN 55455 (612-625-5353).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Frederick M. Asher, Art History, M  
 Bernard S. Bachrach, History, M  
 Caesar E. Farah, African American and African Studies, M  
 Jasper S. Hopkins, Philosophy, M  
 Riv-Ellen Prell, American Studies, M  
 Theofanis G. Stavrou, History, M  
 James D. Tracy, History, M  
 Gayle Graham Yates, American Studies, M

### Associate Professor

William W. Malandra, M  
 Jonathan S. Paradise, M  
 Philip H. Sellow, M

**Curriculum**—The minor in religious studies is available to master's (M.A. and M.S.) and doctoral students in relevant fields such as history, classics, English, anthropology, philosophy, and American studies, and is under the general direction of members of the graduate faculty who represent a broad spectrum of disciplines.

**Prerequisites for Admission**—Admission is contingent on prior admission to a master's or doctoral degree-granting program within the Graduate School.

### Special Application Requirements

Students should consult with the director of graduate studies for the program as early as possible, and in any case no later than their third semester of study. The director of graduate studies must approve the applicant's proposed course of study and sign the student's degree program form.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to approval by the director of graduate studies.

### Minor Only Requirements

The minor requires 9 credits for an M.A. and 12 credits for the Ph.D. All minors will have at least one of the religious studies graduate faculty as members of their examination committees. All students enrolled in the minor take RelA 5700—Theory and Method in Religious Studies, and choose two (M.A.) or three (Ph.D.) from the following courses to complete the program: Afro 5036, AmSt 5101, ANE 5501/2, 5503/4, Anth 5059, Arab 5542, ArtH 5795, Clas 5088/9, 5252, JwSt 5013, 5960, 5111, Phil 8081, 8550, RelA 5071, 5072, 5073, 5080, 8310, SALC 5412/3.

**Language Requirements**—There are no special language requirements beyond those of the student's major program.

## Rhetoric and Scientific and Technical Communication

**Contact Information**—Department of Rhetoric, University of Minnesota, 64 Classroom Office Building, 1994 Buford Avenue, St. Paul, MN 55108 (612-624-4761; fax 612-624-3617; [rhetoric@umn.edu](mailto:rhetoric@umn.edu); <[www.rhetoric.umn.edu](http://www.rhetoric.umn.edu)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Rhetoric and Scientific and Technical Communication Graduate Faculty

#### Professor

John H. Beatty, Ecology, Evolution, and Behavior, ASM  
 Carol Ann Berkenkotter, SM  
 Lillian S. Bridwell-Bowles, English, ASM  
 Karlyn K. Campbell, Communication Studies, ASM  
 Terence G. Collins, General College, AM  
 Ann Hill Duin, SM  
 Shirley N. Garner, English, ASM  
 Michael F. Graves, Curriculum and Instruction, ASM  
 Alan G. Gross, Rhetoric, SM  
 Laura J. Gurak, Rhetoric, SM  
 Mary M. Lay, Rhetoric, SM  
 Helen E. Longino, Women's Studies, AM  
 Earl E. McDowell, Rhetoric, SM  
 Victoria M. Mikelonis, Rhetoric, SM  
 Donald J. Ross, Jr., English, AM  
 Edward A. Schiappa, Communication Studies, ASM  
 Robert L. Scott (emeritus), Communication Studies, ASM  
 Dale Lee Sullivan, SM  
 Richard A. Swanson, Work, Community, and Family Education, ASM  
 Elaine E. Tarone, SM  
 Billie J. Wahlstrom, Rhetoric, SM  
 Arthur E. Walzer, Rhetoric, SM

#### Associate Professor

Lisa Albrecht, General College, AM  
 William A. Babcock, Journalism and Mass Communication, AM  
 Robert L. Brown, Jr., Cultural Studies and Comparative Literature, ASM  
 Simon Hooper, Curriculum and Instruction, AM  
 Thomas M. Scanlan, Rhetoric, M2

#### Assistant Professor

Lee-Ann Kastman Breuch, M2  
 Janel Anderson Crider, M2  
 Richard J. Graff, M2  
 John Logie, M2  
 Bernadette C. Longo, M2  
 Daniel J. Philippon, M2

### Scientific and Technical Communication Graduate Faculty

#### Professor

Carol Ann Berkenkotter, M2  
 Ann Hill Duin, M2  
 Alan G. Gross, Rhetoric, M2  
 Laura J. Gurak, Rhetoric, M2  
 Mary M. Lay, Rhetoric, M2  
 Earl E. McDowell, Rhetoric, M2  
 Victoria M. Mikelonis, Rhetoric, M2  
 Dale Lee Sullivan, M2  
 Billie J. Wahlstrom, Rhetoric, M2  
 Arthur E. Walzer, Rhetoric, SM

#### Associate Professor

Thomas M. Scanlan, Rhetoric, M2

#### Assistant Professor

Lee-Ann Kastman Breuch, M2  
 Janel Anderson Crider, M2  
 Richard J. Graff, M2  
 John Logie, M2  
 Bernadette C. Longo, M2  
 Daniel J. Philippon, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The M.S. focuses on applying basic theory and research to the practice of scientific and technical communication in the workplace. It is designed for students who plan to be technical communicators or information developers in business and industry. Required courses include Rhet 5111, 5112, and 5511.

The M.A. and Ph.D. in rhetoric and scientific and technical communication prepare students to address complex issues in language, science, and technology. The programs are flexible enough to allow students to approach their studies from a variety of perspectives and research methods. This option prepares students for teaching at a university and conducting research in rhetoric and scientific and technical communication. The programs can also prepare students for specialist positions in industry and government that require the analysis and design of human communication systems. Required courses include theory, research, and practice in rhetoric and scientific and technical communication and in a minor or related field.

All M.S., M.A., and Ph.D. applicants must meet the admission requirements of the Graduate School and will be expected to have completed coursework or have equivalent experience in advanced communication (e.g., writing/editing, oral communication, visual communication, organizational communication, or communication theory) and one of the following areas: computer science, management information systems, science, technology, mathematics, engineering, or other related fields.

**Special Application Requirements**—Scores from the General Test of the GRE that are less than five years old are required of students with baccalaureate degrees from U.S. institutions. International students are encouraged to take the General Test of the GRE and to have those results forwarded to the Graduate School. Non-native speakers of English are required to take the TOEFL with satisfactory scores. All applicants must submit three letters of recommendation, two writing samples, and a professional objective statement. M.S. deadlines are June 15 for fall semester admission and October 15 for spring semester admission. All M.A. and Ph.D. applicants begin in the fall semester and have a January 15 deadline.

**Courses**—Please refer to Rhetoric (Rhet) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### M.S. and M.A. Degree Requirements

The M.S. in scientific and technical communication requirements for Plan A and Plan B are the same except that Plan A requires a thesis (10 credits) and 24 course credits and Plan B requires 30 course credits and 5 project credits. Students take six courses in theory, research, and practice in technical communication. An internship is required for any student who has not yet worked as a technical communicator in industry. Students take additional electives in rhetoric to complete 34 credits for Plan A or 35 credits for Plan B.

The M.A. requirements for Plan A and Plan B are the same except that Plan A requires a thesis (10 credits) and Plan B requires a project (5 credits). Students take six courses (18 credits) in theory, research, and practice in rhetoric and scientific and technical communication and in a minor or related field. An internship (3 credits) is required for those intending to pursue research or specialist positions in industry. Minor or related fields (6 credits) may focus on areas such as communication studies, English, curriculum and instruction, women's studies, cognitive psychology, and history of science.

**Language Requirements**—None for M.S. students. M.A. students must demonstrate proficiency in a foreign language of their choice either by taking 3 credits of a beginning level language course or having their adviser and the director of graduate studies certify that they have reading comprehension in a particular language. A student could fulfill this requirement by taking a beginning 3 credit course or by completing a non-credit course such as Fren 0001—Reading French in the Arts and Sciences or Ger 222—Beginning German. These courses are offered through the College of Continuing Education, usually in the summer.

**Final Exam**—For both Plans A and B, students must pass an oral examination in which they defend their master's work and demonstrate competence in their chosen field of study.

### Ph.D. Degree Requirements

Ph.D. students in rhetoric and scientific and technical communication are required to earn a minimum of 42 credits beyond the master's. This plan requires a minimum of 21 credits in rhetoric seminars—two of those seminars must be in rhetorical theory and criticism within rhetoric course offerings. Students take two courses (6 credits) in rhetorical theory and criticism beyond the M.A. requirements; two courses in technical communication research and theory (6 credits) including Rhet 8011 and 8012; two courses (6 credits) in a particular area of study such as rhetoric of science and technology; feminist theory in science, technology, and communication; scientific and technical communication pedagogy; or technology and culture; 6 credits in research methods courses; and 12 credits in a minor or

related field. Minor or supporting programs may focus on areas such as communication studies, English, curriculum and instruction, women's studies, cognitive psychology, or history of science. In addition, 6 elective credits are needed to fulfill the minimum credit requirement. Students may fulfill 18 credits of Ph.D. work in completing M.A. requirements (usually two courses in rhetorical theory and three courses in other core areas). Twenty-four thesis credits are also required. The final exam is oral.

**Language Requirements**—Ph.D. students must demonstrate proficiency in a foreign language of their choice either by taking 3 credits of a beginning level language course or having their adviser and the director of graduate studies certify that they have reading comprehension in a particular language. A student could fulfill this requirement by taking a beginning 3 credit course or by completing a non-credit course such as Fren 0001—Reading French in the Arts and Sciences or Ger 222—Reading German. These courses are offered through the College of Continuing Education, usually in the summer.

**Minor Requirements for Students Majoring in Other Fields**—For M.A. and M.S. students, the minor requires 6 credits in 5xxx and 8xxx rhetoric courses. The minor for Ph.D. students requires 12 credits of 5xxx and 8xxx courses (6 of which can be taken for the M.A. or M.S. degree) with one course being in rhetorical theory and criticism. Students may choose the remaining courses from any of rhetoric's graduate courses.

## Russian Area Studies

**Contact Information**—Russian Area Studies, Area Studies Programs, University of Minnesota, 214 Social Sciences Building, 267 19th Avenue S., Minneapolis, MN 55455 (612-624-8543; fax 612-626-2242).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

John S. Adams, Public Affairs, M2  
Iraj Bashiri, Linguistics, ESL, and Slavic Languages and Literatures, M2  
Gary R. Jahn, Linguistics, ESL, and Slavic Languages and Literatures, M2  
Anatoly Liberman, German, Scandinavian, and Dutch, M2  
Theofanis G. Stavrou, History, M2

### Associate Professor

Irina H. Corten, Linguistics, ESL, and Slavic Languages and Literatures, M2  
Leonard A. Polakiewicz, Linguistics, ESL, and Slavic Languages and Literatures, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—This program provides students with the knowledge to better understand the Russian world, its history, culture, and restructuring in the post-Soviet era. As Russia redefines its place in the

world, and as trade and cultural links between Russian and the United States grow, Russian area specialists are increasingly needed. Areas of concentration include Russian history, Russian literature, and twentieth-century Russia.

**Prerequisites for Admission**—A bachelor's degree from an accredited university or college is required.

**Special Application Requirements**—The following must be forwarded directly to the department: three letters of recommendation, a copy of one or more papers representative of current level of scholarly development, and a statement of the student's purpose. Scores from the General Test of the GRE are required. Prospective students should contact the department for further information. Students are admitted each semester.

**Courses**—Please refer to Russian Area Studies (RAS), Russian (Russ), Global Studies (GloS), Central Asian Studies (CAS), Polish (Plsh), and Slavic (Slav) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### M.A. Degree Requirements

The M.A. program uses an interdisciplinary approach involving both the humanities and the social sciences. Students must complete required coursework, master appropriate theoretical frameworks, and acquire a concise understanding of topic(s) developed in the Plan A thesis or in three Plan B papers. The thesis/papers must show a broad knowledge of the Russian area, methodological sophistication, and clear evidence of research in Russian language sources. Students must also demonstrate advanced Russian language proficiency.

All students complete six distribution courses (18 credits), including two courses on Russian literature (Russ 5421—Literature: Middle Ages to Dostoevsky in Translation and Russ 5422—Literature: Tolstoy to the Present in Translation), one course in social science (Geog 5181—Russia and Environs), two graduate level courses in Russian history, and a scope and methods course (Area 8061). Plan A students must complete three additional courses (9 credits) in their declared area of concentration and 10 thesis credits. Plan B students must complete four additional courses (12 credits) in their declared area of concentration.

**Language Requirements**—Students must demonstrate advanced Russian language proficiency by passing a special exam or by earning a B or better average in Russ 3101-02 or the equivalent.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students Majoring in Other Fields**—The master's minor requires intermediate proficiency in the Russian language (as demonstrated by passing a special exam or by earning a B or

better average in Russ 3001-02 or the equivalent) and completion of three courses (9 credits) in the field, including at least two semesters of seminars/proseminars.

## Scandinavian Studies

See Germanic Studies.

## School Psychology

See Educational Psychology.

## Science, Technology, and Environmental Policy

**Contact Information**—Director of Admission, Hubert Humphrey Institute of Public Affairs, University of Minnesota, 301 19th Avenue South, Minneapolis, MN 55455 (612-624-3800; fax 612-625-3513; [admissions@hhh.umn.edu](mailto:admissions@hhh.umn.edu); [www.hhh.umn.edu](http://www.hhh.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Regents Professor

G. Edward Schuh, AM

### Professor

Dean E. Abrahamson (emeritus), AM  
John S. Adams, M2  
Sandra O. Archibald, M2  
Ragui A. Assaad, M2  
J. Brian Atwood, M2  
John E. Brandl, M2  
John M. Bryson, M2  
Nancy N. Eustis, M2  
Katherine Fennelly, M2  
Edward G. Goetz, M2  
Stephen A. Hoenack, M2  
Robert T. Holt, AM  
Ethan B. Kapstein, M2  
Kenneth H. Keller, M2  
Sally J. Kenney, M2  
Morris M. Kleiner, M2  
Robert T. Kudrle, M2  
Ann R. Markusen, M2  
Samuel L. Myers, M2  
Carlisle F. Runge, Applied Economics, AM  
Esther Wattenberg, Social Work, AM

### Associate Professor

Maria J. Hanratty, M2  
Deborah Levison, M2  
Melissa M. Stone, M2

### Assistant Professor

Kevin J. Krizek, M2

### Other

Zbigniew M. Bochniarz, AM  
Harry C. Boyte, AM2  
William Craig, AM  
Barbara C. Crosby, AM2  
Marsha A. Freeman, AM  
Ali K. Galaydh, AM2  
Thomas F. Luce, AM  
Barbara L. Lukermann, AM  
Lee W. Munnich, AM  
Joseph H. Nathan, AM  
Joseph A. Ritter, AM  
Jodi R. Sandfort, AM2  
Paul C. Stone, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The M.S. program provides students with an understanding of the role of science and technology in food and health, the economy, energy and the environment, security, and education; the impact of science and technology on the political and economic relationships among nations; and the analysis and design of policies for appropriate promotion and regulation of science and technology regionally, nationally, and internationally. The program educates students with natural and social science backgrounds to assume roles in public policy development. An M.S./juris doctor dual degree program is available.

**Prerequisites for Admission**—Students typically have undergraduate degrees or advanced coursework in one of the natural or engineering sciences. They are also expected to have completed the equivalent of an introductory course in microeconomics and have a U.S. bachelor's degree or foreign equivalent.

**Special Application Requirements**—In addition to the materials submitted to the Graduate School, applicants must submit to the Humphrey Institute a photocopy of the Graduate School application, the Humphrey Institute Applicant Data Form, copies of all academic transcripts, a statement of purpose, at least three letters of recommendation, and a GRE official score report. Students who wish to be considered for financial aid should apply no later than January 1 of the preceding academic year. Entry is for fall semester.

**Courses**—Please refer to Public Affairs (PA) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses toward degree requirements is permitted with instructor's and adviser's permission.

### M.S. Degree Requirements

The M.S., which is offered under both Plan A (thesis) and Plan B (without thesis), requires 40 credits including at least 21 credits in five core areas—12 credits in the area of science, technology, and environmental policy and 9 credits of the politics of public affairs, economic reasoning, and empirical analysis. Students should take an additional 6 credits to complement their previous training: appropriate courses in natural or engineering science or its history or philosophy for those with social science backgrounds; appropriate courses in the social sciences for those with natural or engineering science backgrounds. Plan A also requires 10 thesis credits. Plan B requires completion of a Plan B paper (3 credits). The remaining elective credits are chosen in consultation with the student's adviser.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

## Scientific and Technical Communication

See Rhetoric and Scientific and Technical Communication.

## Scientific Computation

**Contact Information**—Director of Graduate Studies, 139 Smith Hall, 207 Pleasant St. S.E., Minneapolis, MN 55455 (612-625-0769; fax 612-626-7541; <[www.scicomp.umn.edu](http://www.scicomp.umn.edu)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Regents Professor

Daniel D. Joseph, Aerospace Engineering and Mechanics, SM  
L. E. Scriven, Chemical Engineering and Materials Science, SM

### Professor

Ronald E. Anderson, Sociology, SM  
Daniel L. Boley, Computer Science and Engineering, SM  
Graham V. Candler, Aerospace Engineering and Mechanics, SM  
James R. Chelikowsky, Chemical Engineering and Materials Science, SM  
J. Bernardo Cockburn, Mathematics, SM  
Christopher J. Cramer, Chemistry, SM  
Jeffrey J. Derby, Chemical Engineering and Materials Science, SM  
Timothy J. Ebner, Neuroscience, SM  
Jiali Gao, Chemistry, SM  
Efi Foufoula-Georgiou, Civil Engineering, SM  
Apostolos P. Georgopoulos, Neuroscience, SM  
Alexander Y. Grosberg, Physics and Astronomy, SM  
Thomas W. Jones, Astronomy, SM  
Daniel J. Kersten, Psychology, SM  
Vipin Kumar, Computer Science and Engineering, SM  
David J. Lilja, Electrical and Computer Engineering, SM  
John S. Lowengrub, Mathematics, SM  
Mitchell B. Lusk, Mathematics, SM  
John L. Nieber, Biosystems and Agricultural Engineering, SM  
Hans G. Othmer, Mathematics, SM  
N. P. Papanikolopoulos, Computer Science and Engineering, SM  
Haesun Park, Computer Science and Engineering, SM  
Yousef Saad, Computer Science and Engineering, SM  
Guillermo R. Sapiro, Electrical and Computer Engineering, SM  
George R. Sell, Mathematics, SM  
J. Ilya Siepmann, Chemistry, SM  
Jaideep Srivastava, Computer Science and Engineering, SM  
Harlan W. Stech, Mathematics and Statistics, Duluth, SM  
David D. Thomas, Biochemistry, SM  
Luke Jon Tierney, Statistics, SM  
Donald G. Truhlar, Chemistry, SM  
Vaughan R. Voller, Civil Engineering, SM  
George L. Wilcox, Neuroscience, SM  
Paul R. Woodward, Astronomy, SM  
David A. Yuen, Geology and Geophysics, SM

### Associate Professor

David M. Ferguson, Medicinal Chemistry, Pharmacognosy, SM

### Assistant Professor

Victor H. Barocas, SM  
George Karypis, Computer Science and Engineering, M2  
Norman J. Troullier, Computer Science and Engineering, M2  
Darrin M. York, Chemistry, SM

### Other

Daniel M. Kroll, Pharmacy, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—This program encompasses coursework and research on the fundamental principles for using intensive computation to support research in the physical, biological, and social sciences and engineering. Emphasis is on research issues, state-of-the-art methods, and applying these methods to outstanding problems in science, engineering, and other fields that use scientific computation, numerical analysis and algorithm development, symbolic and logic analysis, high-performance computing tools, supercomputing and heterogeneous networks, and visualization. A handbook that describes the program and degree requirements in detail is available from the program.

**Prerequisites for Admission**—Applicants fill out a form provided by the program as well as applicable Graduate School forms. A bachelor's degree in a field that uses scientific computation is required for admission.

**Special Application Requirements**—Applicants must submit scores from the General Test of the GRE, three letters of recommendation from persons familiar with their scholarship and research potential, a complete set of official transcripts, and a clearly written statement of career interests, goals, and objectives. Students may apply at any time; however, submission of all application materials by January 1 is strongly encouraged to ensure priority consideration for fellowships and assistantships.

**Courses**—Please refer to the Scientific Computation (SciC) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval. Students from other majors may include such courses subject to their own program's approval.

### M.S. Plan A Degree Requirements

The program is offered under Plan A (thesis), which includes a minimum of 20 course credits and 10 thesis credits. The course credits must include at least 6 credits from the scientific computation core and at least 6 credits in a minor. Only 3 credits from courses offered in a student's minor may be counted toward the core requirements in scientific computation. A course listed in both the core requirements of scientific computation and a student's minor may not be counted under both.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students**

**Majoring in Other Fields**—The master's minor requires approval of the director of graduate studies and a minimum of 4 credits from the core curriculum; the credits may not be from courses in the student's major field.

**Ph.D. Degree Requirements**

A minimum of 24 course credits is required with a minimum of 12 credits in core courses; 24 thesis credits are also required. Students have two options:

- 1) Ph.D. with supporting program. In addition to the core credits, this option requires 12 credits in subjects that support computational science—these can include core credits beyond the required 12 credits.
- 2) Ph.D. with minor. In addition to the core credits, this option requires 12 credits in a minor. Many minor programs require more than 12 credits; in such cases, the greater requirements will be in effect. The minor field must be declared before the student takes the preliminary oral exam.

**Language Requirements**—None.

**Minor Requirements for Students**

**Majoring in Other Fields**—A doctoral minor requires approval of the director of graduate studies and a minimum of 12 credits (a minimum of 6 of these in core courses with remaining credits from supplementary courses). A student may use one course from their major field to satisfy the requirement of a minor in scientific computation, provided there is no rule prohibiting this in the student's major field.

**Social, Administrative, and Clinical Pharmacy**

**Contact Information**—College of Pharmacy, University of Minnesota, 7-155 Weaver-Densford Hall, 308 Harvard Street S.E., Minneapolis, MN 55455 (612-624-2973; fax 612-625-9931; [tesda001@umn.edu](mailto:tesda001@umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

**Professor**

- Robert J. Cipolle, Pharmaceutical Care and Health Systems, SM
- James C. Cloyd, Experimental and Clinical Pharmacology, SM
- Judith M. Garrard, Public Health, SM
- Cynthia R. Gross, Experimental and Clinical Pharmacology, SM
- David R. Guay, Experimental and Clinical Pharmacology, M2
- Ronald S. Hadsall, Pharmaceutical Care and Health Systems, SM
- Joseph T. Hanlon, Experimental and Clinical Pharmacology, SM
- Thomas E. Lackner, Experimental and Clinical Pharmacology, M2
- Tom Alan Larson, Pharmaceutical Care and Health Systems, M2
- Henry J. Mann, Experimental and Clinical Pharmacology, SM
- Peter C. Morley, Pharmaceutical Care and Health Systems, SM
- Rory P. Remmel, Medicinal Chemistry, SM
- John C. Rotschafer, Experimental and Clinical Pharmacology, M2

- Stephen W. Schondelmeyer, Pharmaceutical Care and Health Systems, SM
- Stuart M. Speedie, Health Informatics, Medical School, SM
- Linda M. Strand, Pharmaceutical Care and Health Systems, SM
- Timothy S. Tracy, Experimental and Clinical Pharmacology, SM
- Donald L. Uden, Pharmaceutical Care and Health Systems, M2
- Vernon E. Weckwerth, Health Services Administration, SM
- Darwin E. Zasko, Experimental and Clinical Pharmacology, M2
- Cheryl L. Zimmerman, Pharmaceutics, SM

**Adjunct Professor**

- Paul C. Langley, Pharmaceutical Care and Health Systems, ASM
- Deborah A. Wingert, Pharmaceutical Care and Health Systems, AM2

**Associate Professor**

- Sidney B. Benson, Pharmaceutical Care and Health Systems, M2
- Richard C. Brundage, Experimental and Clinical Pharmacology, SM
- Brian J. Isetts, Pharmaceutical Care and Health Systems, M2
- Wendy L. St. Peter, Pharmaceutical Care and Health Systems, M2
- Jon C. Schommer, Pharmaceutical Care and Health Systems, SM
- Robert J. Straka, Experimental and Clinical Pharmacology, M2

**Assistant Professor**

- Margaret Artz, Experimental and Clinical Pharmacology, M2
- Angela K. Birnbaum, Experimental and Clinical Pharmacology, SM
- Richard R. Cline, Pharmaceutical Care and Health Systems, M2
- Pamala A. Jacobson, Experimental and Clinical Pharmacology, M2
- Kristin K. Janke, Pharmaceutical Care and Health Systems, M2
- Michael Kotlyar, Experimental and Clinical Pharmacology, M2
- Raquel Rodriguez, Pharmaceutical Care and Health Systems, M2
- Debra J. Skaar, Experimental and Clinical Pharmacology, M2

**Adjunct Assistant Professor**

- Carolyn Harley, Pharmaceutical Care and Health Systems, AM2
- Samuel Wagner, Pharmaceutical Care and Health Systems, AM2

**Clinical Professor**

- Daniel E. Keyler, Experimental and Clinical Pharmacology, AM2

**Clinical Associate Professor**

- John V. St. Peter, Experimental and Clinical Pharmacology, M2

**Clinical Assistant Professor**

- Angeline M. Carlson, Pharmaceutical Care and Health Systems, M2
- Leo J. Sioris, Experimental and Clinical Pharmacology, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Students are prepared for research and related activities investigating relationships between biological and physical factors in social settings that involve the drug use process. This flexible interdisciplinary program uses the resources of the

University's many health and social science departments. Programs include courses and offerings from public health, geriatrics, management, sociology, psychology, and public affairs.

The program focuses on the discovery and dissemination of new knowledge to foster appropriate use of drugs in order to improve patient outcomes at the individual and societal level. Students are educated and mentored to become professional scientists. Those who complete the program will understand the process of conducting high quality research and problem solving through the application of disciplinary and interdisciplinary knowledge, theory, and research methodology.

Two program tracks are available. The emphasis of the social and administrative pharmacy (SAPh) track is the application of behavior-oriented interdisciplinary theories to pharmacy problem solving and pharmacy system development. This includes the study of the social, psychosocial, political, legal, public policy, historic, and economic factors that impinge upon the use, non-use, and abuse of drugs.

The emphasis of the experimental and clinical pharmacology (ECP) track is to advance the science of human pharmacology and therapeutics to improve the safe, effective, and economical use of drugs by patients. This includes the translation of both laboratory and clinical research to the medical use process.

**Prerequisites for Admission**—Although the majority of students in the program are pharmacists, a pharmacy education is not required. A bachelor's degree or its foreign equivalent from a recognized college of pharmacy and a strong scholastic record are desirable. Individuals from other fields such as economics, engineering, computer science, medicine, psychology, sociology, or public health may be admitted if their undergraduate coursework satisfies the prerequisites for graduate coursework.

**Special Application Requirements**—Applicants must complete a department supplementary application form in addition to the Graduate School forms. The supplementary form along with three letters of recommendation should be sent directly to the department. GRE scores are required and a minimum score of 580 is required on the TOEFL for all international applicants whose native language is not English.

**Courses**—Please refer to Social, Administrative, and Clinical Pharmacy (SACP), Social and Administrative Pharmacy (SAPh), and Experimental and Clinical Pharmacology (ECP) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses towards degree requirements is permitted with director of graduate studies approval.

**M.S. Degree Requirements**

The M.S. program is offered under Plan A and Plan B.

Plan A requires at least 31 credits, including 15 credits in the major field, at least 6 credits in a minor or related field, and 10 thesis credits.

Plan B requires at least 30 credits, including 15 credits in the major field and at least 6 credits in a minor or related field; the balance of coursework is determined by agreement between the student and adviser. Plan B also requires two papers of publishable quality; one paper must include a research component with an analysis of data.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students**

**Majoring in Other Fields**—A master's minor requires 6 credits in program courses, which is determined in consultation with the director of graduate studies.

**Ph.D. Degree Requirements**

The Ph.D. requires 34 credits in the major, 12 credits in a minor or supporting program, and 24 thesis credits. Two preliminary written exams are required: one concentrates on research design, methodological issues, and statistical analysis, the other on material specific to the student's chosen track. Students must also pass a preliminary oral exam.

**Language Requirements**—None.

**Minor Requirements for Students**

**Majoring in Other Fields**—A doctoral minor requires a minimum of 12 credits in program courses determined in consultation with the director of graduate studies.

## Social and Philosophic Studies of Education

**Minor Only**

**Contact Information**—Department of Educational Policy and Administration, University of Minnesota, 330 Wulling Hall, 86 Pleasant Street S.E., Minneapolis, MN 55455 (612-624-1006; fax 612-624-3377; <<http://education.umn.edu/edpa/>>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

**Professor**

John J. Cogan, Educational Policy and Administration, M  
Darrell R. Lewis, Educational Policy and Administration, M  
Josef A. Mestenhauser (emeritus), Educational Policy and Administration, AM  
R. Michael Paige, Educational Policy and Administration, M  
Karen Rose Seashore, Educational Policy and Administration, M

**Associate Professor**

Arthur M. Harkins, Educational Policy and Administration, M  
Jean A. King, Educational Policy and Administration, M

**Lecturer**

Richard Nunneley, Educational Policy and Administration, AM

**Curriculum**—The graduate minor provides a multidisciplinary foundation for the study of education from the perspectives of history, philosophy, and the social sciences. The minor program is shaped to suit the particular needs and interests of the student at either the master's or doctoral level. In consultation with a faculty member in social and philosophic studies of education in the Department of Educational Policy and Administration (EdPA), 5xxx and 8xxx courses are selected both in EdPA and in related fields.

**Prerequisites for Admission**—Admission is contingent upon prior admission to a master's or doctoral degree-granting program within the Graduate School. Interested students should consult with a faculty member in social and philosophic studies of education in the Department of Educational Policy and Administration to develop a proposed course of study.

**Special Application Requirements**—The director of graduate studies in the Department of Educational Policy and Administration must approve the applicant's proposed course of study by signing the student's degree program form.

**Courses**—Please contact the minor program office for information on relevant coursework.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

**Minor Only Requirements**

M.A. students must complete at least 9 graduate credits (at least one course each) in the two areas of study below. Doctoral students must complete at least 12 graduate credits (at least two courses each) in the two areas of study.

Area I—history and philosophy of education: EdPA 5021, 5023, 5024, 5028, 5032, Phil 4324, WoSt 5103.

Area II—social sciences and education: EdPA 5041, 5044, 5103, 5128, 5302, 5352, 8104.

**Social Work**

**Contact Information**—School of Social Work, University of Minnesota, 105 Peters Hall, 1404 Gortner Avenue, St. Paul, MN 55108 (612-625-1220 or 1-800-779-8636; fax 612-624-3744; <[jreinard@che.umn.edu](mailto:jreinard@che.umn.edu)>; <<http://ssw.che.umn.edu>>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

**Professor**

Michael Baizerman, SM  
Jerome Beker, SM  
Neil F. Bracht (emeritus), ASM  
Jeffrey L. Edleson, SM  
Jane F. Gilgun, SM  
Clifton D. Hollister, SM  
Rosalia A. Kane, Public Health, SM

Helen Q. Kivnick, SM  
David J. Klaassen, AM2  
Dario Menanteau-Horta, SM  
Susan S. Meyers, M2  
Jean K. Quam, SM  
Ronald H. Rooney, SM  
Mark S. Umbreit, SM  
Esther Wattenberg (emeritus), ASM  
Susan Wells, SM  
Oliver J. Williams, SM

**Associate Professor**

Sandra Beeman, SM  
William Bradshaw, SM  
Irl E. Carter (emeritus), SM  
Linda E. Jones, SM  
James R. Reinardy, SM  
Edward Taylor, M2

**Assistant Professor**

Laura Abrams, M2  
Mark G. Frenzel, AM  
Priscilla Gibson, M2  
Elizabeth Lightfoot, M2  
Yat-Sang (Terry) Lum, M2  
Ronald L. Pitzer, M2

**Instructor**

Eileen Arnold, M2

**Other**

Kevin John Burke, M2  
Sonia Davila-Williams, M2  
Trude D. Hendrickson, M2  
Nancy J. Johnston, M2  
Nan L. Kalke, M2  
Gloria M. McGee, M2  
Janelle Rae Miedema, M2  
Megan H. Morrissey, M2  
Maura Sullivan, M2  
Victoria Van Slyke, M2  
Mary Weeks, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The M.S.W. prepares students for advanced social work practice. A 50-credit program and a 34-credit advanced standing program are available. Concentrations in the master's program include practice in direct practice and community practice.

The School of Social Work and the Humphrey Institute of Public Affairs offer two dual master's degrees: the master of social work/ master of public policy (M.S.W./M.P.P.), and the master of social work/master of urban and regional planning (M.S.W./M.U.R.P.). Dual degree students generally take coursework in each department for the first two years, and in the third year, take courses concurrently in two departments, facilitating the integration of content from both fields. Students may apply some credits taken in the dual degree programs toward requirements in both departments. Each dual degree option is a minimum sequence of three years of full-time study. Students who choose an M.S.W. concentration in direct practice will need longer than six semesters to complete both programs. Students may begin their studies in either program.

A dual master of social work/master of public health (M.S.W./M.P.H.) is offered with the School of Public Health. The M.S.W./M.P.H. degree provides exposure to a blend

of course offerings in biometry, community health education, environmental health, epidemiology, health services administration, maternal and child health, and public health nutrition. The purpose of this degree is to educate and prepare professional public health social workers that are competent in the practice of professional social work with the additional outlook, skills, and expertise of public health. Students are able to complete the requirements for both degrees in approximately six to eight academic semesters or less, depending upon the number of credits carried each semester.

The Ph.D. program prepares students to provide intellectual leadership for the social work profession through advanced levels of scholarship, research, theory development, and policy analysis. Students are expected to acquire skill in research design and statistics and to develop a comprehensive knowledge of social work and social welfare history, theory, and policy.

The Ph.D. program does not focus on the development of advanced skills for clinical practice, although students gain knowledge of practice theory and research related to social work practice is encouraged. Many graduates assume positions as university faculty. Consequently, the program offers opportunities for students to acquire skills in teaching and curriculum development.

**Prerequisites for Admission**—Applicants to the MSW program must have a background in the liberal arts including completion of 26 semester credits or 39 quarter credits in the social sciences, e.g., sociology, political science, economics, psychology, history, and anthropology, and a college-level course in statistics. A college-level biology course with content on human anatomical and physiological development is also required. Please contact the School of Social Work about possible changes to this requirement. One year of paid or volunteer experience in the social services is required of all applicants. Doctoral applicants must meet requirements and standards set by the Graduate School and the School of Social Work. It is preferred that applicants have earned the master's degree in social work from a school of social work accredited by the Council on Social Work Education; however, applicants with a master's degree in a closely related discipline will be considered for admission. Preference is also given to candidates with at least two years of post-M.S.W. practice experience. Candidates for the Ph.D. program who do not have an M.S.W. may be required to take several master's level foundation courses.

**Special Application Requirements**—Three letters of recommendation, a complete set of transcripts (in addition to that required by the Graduate School), an example of academic or scholarly writing, a personal statement, and a department application form are required of all applicants. GRE scores are not required for admission to the master's program, but are required if the applicant wishes to be

considered for a Graduate School Fellowship and from applicants who do not have an official grade point average from their undergraduate degree. GRE scores are required for admission to the doctoral program. The application deadline for both degrees is January 8. The Ph.D. program has a March 5 deadline for the second review. Beginning students in either program are admitted fall semester only.

**Courses**—Please refer to Social Work (SW) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses toward degree requirements is permitted with director of graduate studies approval.

### M.S.W. Coursework Only Degree Requirements

The M.S.W. requires 50 credits; a 34-credit advanced standing program is available to graduates of undergraduate social work programs accredited by the Council on Social Work Education. All credits for the M.S.W. must be completed within seven years of the date of the earliest coursework taken for the degree.

The 50-credit program includes a set of required foundation courses (25 credits), courses from a selected concentration, two field internships, and social work electives. A maximum of 24 credits may be transferred from the following sources with School of Social Work approval: up to 8 credits as a non-degree seeking student registered for graduate credit at the University of Minnesota; up to 24 credits from another regionally and professionally accredited school of social work if the student was registered as a graduate student in the program.

The 34-credit advanced standing program includes courses from a selected concentration, one field internship, and social work electives. A maximum of 16 credits may be transferred from the following sources with School of Social Work approval: 16 credits completed as a graduate student in another accredited M.S.W. program; up to 6 credits as a non-degree seeking student registered for graduate credit at the University of Minnesota.

**Language Requirements**—None.

**Final Exam**—None.

### Ph.D. Degree Requirements

The Ph.D. program emphasizes mastery of student-determined and program-determined objectives rather than an accumulation of course credits. Degree requirements vary according to background and educational goals. Typically 40 credits plus 24 required thesis credits beyond the M.S.W. are required. Required courses include core seminars in social work research, social welfare history, social welfare policy, and theory and model development; a social work teaching course; a supervised research practicum and practicum seminar; supporting program courses; statistics courses. Students

must also have teaching experience in the School of Social Work while in the program and fulfill the computer skills requirement.

**Language Requirements**—None.

## Sociology

**Contact Information**—Graduate Program Assistant, Department of Sociology, University of Minnesota, 909 Social Sciences Building, 267 19th Avenue S., Minneapolis, MN 55455 (612-624-2093; fax 612-624-7020; [socdept@atlas.socsci.umn.edu](mailto:socdept@atlas.socsci.umn.edu)).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Regents Professor

Joanne B. Eicher, Design, Housing, and Apparel, AM2

### Professor

Ronald R. Aminzade, SM  
Ronald E. Anderson, SM  
John Arthur, Sociology-Anthropology, Duluth, AM2  
Barry C. Feld, Law School, AM2  
David Knoke, SM  
Candace M. Kruttschnitt, SM  
Theodor J. Litman, Health Care Management, ASM  
Carl P. Malmquist, SM  
Dario Menanteau-Horta, Social Work, AM2  
Phyllis Moen, SM  
Jeylan T. Mortimer, SM  
Joel I. Nelson, SM  
Steven Ruggles, History, AM2  
Joel B. Samaha, AM2  
Karen R. Seashore, Educational Policy and Administration, AM2  
Mark Snyder, Psychology, AM2  
Robin S. Stryker, SM

### Associate Professor

Elizabeth H. Boyle, M2  
Rose M. Brewer, African American and African Studies, AM2  
Jeffrey P. Broadbent, SM  
Kathleen T. Call, Public Health, AM2  
Penny A. Edgell, SM  
Scott R. Eliason, SM  
Michael David Finch, AM2  
Douglas Hartmann, M2  
Jennifer L. Pierce, ASM  
Joachim J. Savelsberg, SM  
Christopher Uggen, SM

### Assistant Professor

Joseph Gerteis, M2  
Ann M. Hironaka, M2  
Kathleen E. Hull, M2  
Walt Jacobs, AM2  
Erin L. Kelly, M2  
Karen E. Lutfev, M2  
Ian R. Macmillan, M2  
Jeffrey Robert Maahs, AM  
Evan A. Schofer, M2  
John R. Warren, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Sociology is concerned with the study of human societies, groups, and social life. The program offers substantive training in five areas of specialization: family and life course; inequality—race, class, and gender law; crime, and deviance; organizations, work, and markets; political sociology and social movements. Methodological training is available in historical and comparative research, survey

research, network analysis, advanced statistical analysis, and qualitative research. Training for students interested in both academic and applied employment is generally available.

**Prerequisites for Admission**—A background in basic sociology, usually consisting of the equivalent of 18 credits in undergraduate work, including 9 credits of social science statistical methods, or an M.A. degree in sociology or a closely related field is recommended. Individuals who have completed fewer than 18 credits may be admitted but are generally required to complete background coursework in theory and statistics during their first year of residence.

**Special Application Requirements**—Applicants are evaluated on their general academic potential, commitment to the field, creativity, and potential for contribution to the field. In addition to the Graduate School application, applicants must submit the following: GRE scores; a complete set of transcripts in addition to that required by the Graduate School; an application for department support (if desired); a sample of written work, usually a term paper, written in English; three letters of recommendation; and a statement of professional objectives. The department accepts new students for fall admission only. The final application deadline for admittance and financial aid is December 1. For maximum fellowship support, the final application deadline is January 1.

**Courses**—Please refer to Sociology (Soc) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses is not permitted toward degree requirements.

### M.A. Degree Requirements

Students are admitted only for the Ph.D.; the M.A. is an optional degree for students in the doctoral program.

Students take four required courses or their equivalent (13 credits) and two additional substantive courses in sociology (6 credits). Substantive courses are chosen in consultation with the adviser and program committee to meet the student's educational and professional goals. Students must also complete a minimum of 6 credits in a minor or related field. Plan B students submit two papers, at least one of which is empirical. Plan A requires 10 thesis credits.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Ph.D. Degree Requirements

The doctoral program is for students planning to do research or teach.

Students take four required courses or their equivalent (13 credits), including a course on professional skills development. Beyond that, each student's program is individually planned in consultation with the adviser and program committee to meet both the

student's goals and broad program requirements. Those requirements include four substantive courses in sociology (12-credit minimum) and at least one semester of training in advanced methods (3-credit minimum). Students must also complete a minimum of 12 credits in a minor or supporting program and 24 thesis credits. Students who enter the program with an M.A. in sociology must earn a minimum of 18 credits in the department regardless of the number of courses for which they have petitioned equivalents from other institutions.

**Language Requirements**—Coursework in a foreign language may be used as outside coursework for those students who plan research in comparative sociology.

### Minor Requirements for Students

**Majoring in Other Fields**—A doctoral minor requires four courses in sociology, at least one of which is 8xxx. Course choices are subject to the approval of the director of graduate studies.

## Software Engineering

**Contact Information**—Software Engineering Graduate Program, Center for the Development of Technological Leadership, University of Minnesota, 510 West Bank Office Building, 1300 S. Second Street, Minneapolis, MN 55454-1082 (612-624-5747; fax 612-624-7510; [degrees@cdtl.umn.edu](mailto:degrees@cdtl.umn.edu); [www.cdtl.umn.edu](http://www.cdtl.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Shashi Shekhar, M2  
Jaideep Srivastava, M2

### Associate Professor

John V. Carlis, M2  
Mats P. E. Heimdahl, M2  
Joseph A. Konstan, M2

### Assistant Professor

John E. Collins, M2  
Richard M. Voyles, AM2

### Instructor

Neil A. Bitzenhofer, AM2  
Michael Calvo, AM2  
Jesse D. Freese, AM2  
Richard Hedger, AM2  
Stephen Kan, AM2  
John Kruse, AM2  
Kevin Larsen, AM2  
Elizabeth M. Sisley, AM2  
Michael W. Wold, AM2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The master of science in software engineering (M.S.S.E.) provides a thorough understanding of the fundamental issues related to software development and the software development process. It fosters an awareness of the problems and opportunities associated with software-intensive systems, and explains the methods for quickly evaluating, adopting, and taking

advantage of emerging technologies. This program introduces emerging technologies and their applications and lays the foundation for lifelong learning and professional development in a rapidly changing field. The M.S.S.E. is an interdisciplinary program administered jointly by the Institute of Technology's Center for the Development of Technological Leadership and the Department of Computer Science and Engineering.

The program is offered in a format designed for full-time working professionals. Students take courses one day per week (alternating Fridays and Saturdays) and move through the curriculum as a cohort, taking all classes together for the first three semesters.

**Prerequisites for Admission**—Prospective students should have an undergraduate degree in computer science or a closely related field and a minimum of one year of professional experience working in the software industry. Students with degrees in other fields may be considered for admission based on extensive industrial experience.

**Courses**—Please refer to Software Engineering (SEng) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses toward degree requirements is subject to adviser and/or director of graduate studies approval.

### M.S.S.E. Plan B Degree Requirements

The M.S.S.E. requires 30 credits, including 27 credits of regular coursework and 3 credits for the Plan B project. Students take seven core courses, two or three industrial seminar courses, two or three elective courses, and a capstone course (Plan B project) where students undertake a challenging project.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

## Soil Science

**Contact Information**—Director of Graduate Studies, Department of Soil, Water, and Climate, University of Minnesota, 439 Borlaug Hall, 1991 Upper Buford Circle, St. Paul, MN 55108 (612-625-1244; fax 612-625-2208; [dgs@soils.umn.edu](mailto:dgs@soils.umn.edu); [www.soils.umn.edu](http://www.soils.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Deborah L. Allan, SM  
James L. Anderson, SM  
Jay C. Bell, SM  
Paul R. Bloom, SM  
Terence H. Cooper, SM  
Peter H. Graham, SM  
Satish C. Gupta, SM  
Thomas Halbach, SM  
John A. Lamb, SM  
Gary L. Malzer, SM  
Jean-Alex E. Molina, SM  
John F. Moncrief, SM  
David J. Mulla, SM  
Edward A. Nater, SM  
Gyles W. Randall, SM

George W. Rehm, SM  
Pierre C. Robert, SM  
Carl Rosen, SM  
Michael J. Sadowsky, SM  
Michael A. Schmitt, SM  
Mark W. Seeley, SM

### Adjunct Professor

John M. Baker, SM  
Charles E. Clapp, SM  
William C. Koskinen, SM  
Donald C. Reicosky, AM2  
Michael P. Russelle, SM

### Associate Professor

Albert L. Sims, M2  
Dong Wang, SM

### Assistant Professor

Timothy J. Griffis, M2  
Neil Hansen, SM  
Jennifer Y. King, M2  
Jeffrey S. Strock, M2

### Adjunct Assistant Professor

Jane Johnson, AM2  
Randall Kolka, AM2  
Robert Mabagala, AM2  
Pamela J. Rice, AM2  
Rodney T. Venterea, AM2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The program offers two concentrations: soil science and climatology. This multidisciplinary program encompasses aspects of chemistry, physics, biology, atmospheric sciences, and geology. The discipline is divided into five subdisciplines: climatology, soil chemistry/fertility, soil classification/genesis, soil microbiology/biochemistry, and soil physics. The soil science concentration focuses on the study of soil as it applies to environmental and agricultural issues. The climatology concentration focuses on the interdisciplinary study of earth-atmosphere interactions as well as climate variability as it applies to environmental and agricultural issues. This concentration requires competence in both atmospheric sciences and related areas of soil science. The minor, supporting, or related fields area is usually selected from some allied field such as agronomy, botany, chemistry, microbiology, biochemistry, physics, geology, economics, forestry, agricultural engineering, or atmospheric science.

**Prerequisites for Admission**—The academic background normally required includes standard courses in college physics, chemistry, geology, microbiology, and mathematics, including one course in calculus, and an introductory course in soil science. For agricultural climatology, additional courses in mathematics, physics, meteorology, and engineering may be substituted. Candidates for the Ph.D. degree are normally required to have completed an acceptable master's degree thesis.

**Special Application Requirements**—A statement of career goals and three letters of recommendation evaluating the applicant's potential for graduate study should

accompany applications to both the M.S. and Ph.D. programs. Submission of GRE scores is required of all native English speakers and is strongly recommended for nonnative speakers (in addition to the TOEFL requirement); students whose native language is not English are expected to have ranked in the top 20 percent of their class. Students may be admitted in any semester.

Program-specific requirements and procedures for electronic application for admittance to the soil science graduate program are listed and updated on the department's Web site at [www.soils.umn.edu](http://www.soils.umn.edu).

**Courses**—Please refer to Soil Science (Soil) in the course section of this catalog for courses pertaining to the program or to the department Web site for an updated list of courses.

**Use of 4xxx Courses**—Use of 4xxx courses is permitted toward degree requirements with adviser and/or director of graduate studies approval.

### M.S. Degree Requirements

All M.S. students must complete a minimum of 30 credits: 14 credits in the major area, one seminar (1 credit) teaching experience, and a minimum of 6 credits in a minor or related field. Plan A students must take a minimum of 10 thesis credits; Plan B students must complete a Plan B paper and fulfill the 30 credit minimum by taking 10 credits of coursework or a special project to replace the 10 thesis credits.

Plan A students in the soil science concentration must take three out of the four core courses in soil science. Plan A students in the climatology concentration must take two or more courses in climatology or atmospheric sciences (approved by the student's advisory committee) and two of the four core courses in soil science. Plan B students in the soil science concentration must take all four core courses in soil science. Plan B students in the climatology concentration must take three or more courses in climatology or atmospheric sciences (approved by the student's advisory committee) and two of the four core courses in soil science.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—Students may minor in soil science with the approval of the director of graduate studies and under the direction of a soil science graduate faculty member serving as the minor adviser. The master's minor requires completion of a minimum of two of the four core area courses in soil science and a seminar.

### Ph.D. Degree Requirements

Students must take two seminars (1 credit each), 2 credits of teaching experience, a minimum of 12 credits in a minor or supporting program, and 24 thesis credits.

Students in the soil science concentration must take all four core area courses in soil science.

Students in the climatology concentration must take a minimum of two courses in climatology or atmospheric sciences (approved by the student's advisory committee) and two of the four core area course in soil science.

**Language Requirement**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—Students may minor in soil science with the approval of the director of graduate studies and under the direction of a soil science graduate faculty member serving as the minor adviser. The doctoral minor requires a minimum of 12 credits in soil science, including a minimum of three of the four core area courses in soil science, a seminar, and teaching experience.

## South Asian Languages

See Asian Languages and Literatures.

## Spanish

See Hispanic and Luso-Brazilian Literatures and Linguistics.

## Special Education

See Educational Psychology.

## Statistics

**Contact Information**—School of Statistics, University of Minnesota, 313 Ford Hall, 224 Church Street S.E., Minneapolis, MN 55455 (612-625-8046; fax 612-624-8868; [info@stat.umn.edu](mailto:info@stat.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Christopher Bingham, SM  
R. Dennis Cook, SM  
James M. Dickey, SM  
Morris L. Eaton, SM  
Seymour Geisser, SM  
Charles J. Geyer, SM  
Douglas M. Hawkins, SM  
Glen D. Meeden, SM  
Christopher J. Nachtsheim, Operations and Management Science, SM  
Gary W. Oehlert, SM  
Ronald R. Regal, Mathematics and Statistics, Duluth, SM  
William D. Sudderth, SM  
Sanford Weisberg, SM

### Associate Professor

Birgit Grund, SM  
Frank B. Martin, SM  
Peihua Qiu, SM

### Assistant Professor

Singdhansu Chatterjee, M2  
Tiefeng Jiang, M2  
Galín Jones, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The School of Statistics is the primary venue at the University for research, teaching, and dissemination of the theory, methodology, and applications of statistical procedures. Students may specialize in any area of statistics or probability. The core program for all students has strong components of both theoretical and applied statistics.

**Prerequisites for Admission**—Applicants to the master's program must be familiar with basic statistical concepts and methods, and with mathematics through multivariable calculus and linear algebra. Applicants to the doctoral program must, in addition to the above, be familiar with the elements of real analysis.

**Special Application Requirements**—Two letters of recommendation are required. Applicants for financial support (assistantships) must submit scores from the GRE General Test; other applicants are encouraged to submit GRE scores. Applicants whose native language is not English must submit a TOEFL score of at least 223 (or equivalent IELTS or MELAB); those applying for assistantships must score at least 250. Applicants can be considered for admission at any time, but it is strongly recommend that all new students begin their coursework in the fall semester. Those applying for assistantships should have their applications completed by January 10. Financial support is usually available only to those beginning in the fall semester.

**Courses**—Please refer to Statistics (Stat) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Certain 4xxx courses from other departments may be used to meet degree requirements with the approval of the director of graduate studies.

### M.S. Plan B Degree Requirements

The program prepares students for jobs in industry and the public sector and also for study at the doctoral level.

During the first year, students take a two-semester theory sequence and a two-semester methods sequence. In addition, they usually take two courses from other departments.

During the second year, students take an additional 9 credits of approved 5xxx or 8xxx statistics courses; some of this requirement can be satisfied by taking approved courses with heavy statistical content from other departments. Students also take a 3-credit statistical consulting course and complete their Plan B project. A total of 30 course credits is required. A written preliminary examination is usually taken at the beginning of the second year.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor requires at least 9 credits of 5xxx or 8xxx statistics courses. Stat 4101-4102 may be used to satisfy this requirement.

### Ph.D. Degree Requirements

Students entering the program with a bachelor's degree must take 60 course credits; students entering with a master's degree must take 43 credits; 24 thesis credits are also required. Students take 41 credits in core courses (27 in statistics, 14 in mathematics), an additional 18 credits of approved 8xxx statistics courses (some of which can be satisfied by taking approved courses with heavy statistical content from other departments), and a 3-credit statistical consulting course.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—A doctoral minor requires a theory sequence (Stat 4101-4102 or Stat 5101-5102) and familiarity with various statistical methods. Typical programs include 14 to 18 credits of graduate-level statistical courses. Please note: Stat 4101 and 4102 are available to graduate students from other programs, but not to statistics majors.

## Studies in Africa and the African Diaspora Minor Only

**Contact Information**—Department of African American and African Studies, University of Minnesota, 808 Social Sciences Building, 267 19th Avenue S., Minneapolis, MN 55455 (612-624-9847; fax 612-624-9383).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Adjunct Regents Professor

Joanne B. Eicher, Design, Housing, and Apparel, AM  
Allen F. Isaacman, History, AM

### Adjunct Professor

August H. Nimtz, Jr., Political Science, AM  
Earl P. Scott, Geography, M  
Samuel Myers, Public Affairs, AM

### Associate Professor

Keletso E. Atkins, African American and African Studies, M  
Rose M. Brewer, African American and African Studies, M  
John S. Wright, African American and African Studies, M

### Adjunct Associate Professor

Louis R. Bellamy, Theatre Arts, AM  
Gloria Williams, Design Housing, and Apparel, AM  
Kirt H. Wilson, Communication Studies, AM

### Assistant Professor

Pearl Barner II, African American and African Studies, M  
Victoria B. Coifman, African American and African Studies, M  
Charles Ben Pike, African American and African Studies, M  
Keith A. Mayes, African American and African Studies, M

### Adjunct Assistant Professor

Roderick Ferguson, American Studies, AM  
Priscilla Gibson, Women's Studies, AM  
Gwendolyn Pough, Women's Studies, AM  
Michele Wagner, History, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—This interdisciplinary graduate minor is administered through the Department of African American and African Studies. The minor program gives students from a variety of disciplines a structured graduate curriculum that offers a systematic understanding of the contemporary and historical experiences of peoples of Africa and of African descent. It is organized around a group of core seminars and focuses on two broad areas; the humanities and the arts, and the social and behavioral sciences.

**Prerequisites for Admission**—Admission is contingent upon prior admission to a master's or doctoral degree-granting program within the Graduate School.

**Special Application Requirements**—Students must complete an application form by the end of spring semester to be considered for acceptance for the following academic year. It is expected that no more than 15 students will be admitted to this minor each year. An undergraduate major or minor in African American and/or African studies is not required for admission to the program, but students are expected to have had sufficient background to begin graduate level study.

**Courses**—Please refer to African American and African Studies (Afro) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses towards degree requirements is subject to adviser and/or director of graduate studies approval.

### Minor Only Requirements

Students develop their program in consultation with the director of graduate studies in studies in Africa and the African diaspora and in their major. All courses must be outside the student's major field of study.

The master's minor requires a minimum of 9 graduate credits, including the seminar Afro 5101—Studies in Africa and the African Diaspora. Remaining courses are selected from one of the following two areas: 1) humanities and the arts or 2) behavioral and social sciences.

The doctoral minor requires a minimum of 15 graduate credits, including the seminar Afro 5101—Studies in Africa and the African Diaspora. Students take one additional seminar that focuses on the study of Africa and peoples of African descent. Remaining courses are selected from one of the two areas listed above.

## **Studies of Science and Technology**

### **Minor Only**

**Contact Information**—Director of Graduate Studies, Studies of Science and Technology, University of Minnesota, 746 Heller Hall, 271 19th Ave. S., Minneapolis, MN 55455; (612-625-6635; fax 612-626-8380; [mcps@umn.edu](mailto:mcps@umn.edu); <[www.sst.umn.edu/](http://www.sst.umn.edu/)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### **Professor**

John H. Beatty, Ecology, Evolution, and Behavior, M  
John M. Eyster, History of Medicine, M  
Ronald N. Giere, Philosophy, M  
Alan G. Gross, Rhetoric, M  
Keith Gunderson, Philosophy, M  
William H. Hanson, Philosophy, M  
Geoffrey Hellman, Philosophy, M  
Jeffrey P. Kahn, Bioethics, M  
Kenneth H. Keller, Center for Science, Technology, Public Affairs, M  
Sally G. Kohlstedt, Geology and Geophysics, M  
Helen E. Longino, Women's Studies, Philosophy, M  
Arthur L. Norberg, Computer Science, M  
C. Wade Savage, Philosophy, M  
Naomi Scheman, Philosophy, M  
Robert W. Seidel, Charles Babbage Institute, M  
Alan E. Shapiro, Physics, M

#### **Visiting Professor**

Evelyn Fox Keller, Center for Philosophy of Science, M

#### **Associate Professor**

Bruce P. Braun, Geography, M  
Carl Elliott, Bioethics, M  
Fred N. Finley, Curriculum and Instruction, M  
Laura J. Gurak, Rhetoric, M  
Michael D. Root, Philosophy, M  
C. Kenneth Waters, Philosophy, M

#### **Assistant Professor**

Jennifer K. Alexander, Mechanical Engineering, M  
Jennifer Lee Gunn, History of Medicine, M  
Michel H. Janssen, History of Science and Technology, M  
Jean M. Langford, Anthropology, M  
Hiromi Mizuno, History, M  
Daniel J. Philippon, Rhetoric, M  
John B. Shank, History, M  
Karen Sue Taussig, Anthropology, M

**Curriculum**—Studies of science and technology (SST) deals with a rapidly expanding field that seeks to understand the conceptual foundations, historical development, and social context of science and technology. SST faculty are drawn from a number of research and teaching units dedicated in whole or in part to the history and philosophy of science and technology. The SST minor is for students from any major who want to gain a deeper understanding of the nature and development of science and technology.

The SST minor provides introductory core courses in historiography and philosophy of science, followed by research seminars and other elective courses in four main research areas: models, theories, and reality; physical science; biological and biomedical sciences; and science, technology, and society. Seminar topics vary yearly depending on faculty and student interest.

**Prerequisites for Admission**—Admission is contingent upon prior admission to a master's or doctoral degree-granting program within the Graduate School and is by permission of the director of graduate studies in SST.

#### **Special Application Requirements**—

Prospective students should contact director of graduate studies.

**Courses**—Please refer to Studies of Science and Technology (SST) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses is not permitted toward minor requirements.

#### **Minor Only Requirements**

A master's minor requires 7 graduate credits and a doctoral minor requires 12 graduate credits. Both minors must include HSci 8111; one of either Phil 8601, 8602, or 8605; and SST 8000 Colloquium (one semester for master's, two for doctoral students). Doctoral students must also take one of the SST seminars (SST 8100, 8200, 8300, 8400, or 8420) in an area primarily outside the student's major.

**Language Requirements**—None.

## **Studio Arts**

See Art.

## **Surgery**

**Contact Information**—Department of Surgery, University of Minnesota, 420 Delaware Street S.E., MMC 195, Minneapolis, MN 55455 (612-626-2590; [surgwww@umn.edu](mailto:surgwww@umn.edu)).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### **Professor**

Roderick A. Barke, SM  
R. Morton Bolman, SM  
Henry Buchwald, SM  
Frank B. Cerra, SM  
Bruce L. Cunningham, M2  
Agustin P. Dalmaso, SM  
David L. Dunn, SM  
William C. Engeland, SM  
John E. Foker, SM  
Rainer W. G. Gruessner, M2  
Mark Lyte, ASM  
Michael A. Maddaus, M2  
Arthur J. Matas, SM  
J. Ernesto Molina, M2  
William D. Payne, M2  
David A. Rothenberger, M2  
Sara J. Shumway, M2  
David E. R. Sutherland, SM  
Herbert B. Ward, M2

#### **Clinical Professor**

Arnold S. Leonard, SM  
John S. Najarian, SM

#### **Associate Professor**

Jerome H. Abrams, M2  
Gregory J. Beilman, M2  
David N. Cornfield, M2  
Angelika C. Gruessner, M2  
Steven M. Santilli, M2

#### **Assistant Professor**

Bernhard J. Hering, M2  
Brett K. Levay-Young, M2  
Timothy D. Sielaff, SM  
Karen R. Wasiluk, SM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The general surgery program trains medical doctors for the practice of surgery and for academic positions. See the Medical School for professional degree requirements; see below for academic degree requirements. Trainees spend two to three years in laboratory research, either in a basic science or in surgery, after which they begin their senior residency and chief residency training. The Medical School's laboratory departments offer many graduate courses closely related to surgery (see the graduate programs in anatomy; biochemistry, molecular biology and biophysics; cellular and integrative physiology; microbiology, immunology, and molecular pathobiology; and pharmacology). These fields also offer opportunities for research work. The Department of Surgery offers supervised work in its experimental research laboratories, as well as in its hospital and outpatient departments, in the areas of surgical diagnosis and operative surgery and in some surgical specialties (such as colon and rectal surgery, transplantation, thoracic and cardiovascular surgery, and pediatric surgery).

**Prerequisites for Admission**—Prospective students must be in the general surgery training program and have 2-3 clinical years of training completed.

**Courses**—Please refer to Surgery (Surg) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses is not permitted toward degree requirements.

#### **M.S. Surg. Plan A Degree Requirements**

The M.S.Surg. is offered Plan A only. Students spend two to three years in the Medical School's general surgery program. A minimum of 53 course credits (47 in the major plus 6 in the minor or related fields) plus 10 thesis credits are required for a total of 63 credits.

**Final Exam**—The final exam is oral.

**Language Requirements**—None.

#### **Ph.D. Surg. Degree Requirements**

Students spend two to three years in the Medical School's general surgery program. A minimum of 79 course credits (67 in the major plus 12 to 16 in the minor or supporting program) is required; 24 thesis credits are also required.

**Language Requirements**—None.

## Sustainable Agriculture Systems

### Minor Only

**Contact Information**—Director of Graduate Studies, Sustainable Agriculture Systems Minor, Minnesota Institute for Sustainable Agriculture, University of Minnesota, 411 Borlaug Hall, 1991 Upper Buford Circle, St. Paul, MN 55108 (612-625-8235; fax 612-625-1268; [jorda020@umn.edu](mailto:jorda020@umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

#### Professor

David A. Andow, Entomology, M  
David D. Biesboer, Plant Biology, M  
Vernon B. Cardwell, Agronomy and Plant Genetics, M  
Iris D. Charvat, Plant Biology, M  
Sharon M. Danes, Family Social Science, M  
Ruth Dill-Macky, M  
Peter H. Graham, Soil, Water, and Climate, M  
Jeffrey Lynn Gunsolus, Agronomy and Plant Genetics, M  
Emily E. Hoover, Horticultural Science, M  
Nicholas R. Jordan, Agronomy and Plant Genetics, M  
Robert Philip King, Applied Economics, M  
Richard A. Levins, Applied Economics, M  
Albert H. Markhart III, Horticultural Science, M  
Jean-Alex E. Molina, Soil, Water, and Climate, M  
Roger D. Moon, Entomology, M  
David J. Mulla, Soil, Water, and Climate, M  
Kent D. Olson, Applied Economics, M  
James H. Orf, Agronomy and Plant Genetics, M  
Edward B. Radcliffe, Entomology, M  
Paul C. Rosenblatt, Family Social Science, M  
Michael P. Russele, M  
Craig C. Sheaffer, Agronomy and Plant Genetics, M  
John M. Shutske, Biosystems and Agricultural Engineering, M  
Steve R. Simmons, Agronomy and Plant Genetics, M  
William F. Wilcke, Biosystems and Agricultural Engineering, M  
Donald Wyse, Agronomy and Plant Genetics, M

#### Associate Professor

Deborah L. Allan, Soil, Water, and Climate, M  
John Deen, Clinical and Population Science, M  
Craig A. Hassel, Food Science and Nutrition, M  
Paul Porter, Agronomy and Plant Genetics, M

#### Assistant Professor

Susan M. Galatowitsch, Horticultural Science, M  
Jeffrey H. Gillman, Horticultural Science, M  
Kristen C. Nelson, Forest Resources, M

#### Adjunct Assistant Professor

Helene Murray, Agronomy and Plant Genetics, M

#### Fellow

Carl Vincent Phillips, M

**Curriculum**—The minor in sustainable agriculture systems offers master's (M.A. and M.S.) and doctoral students an interdisciplinary curriculum that considers the biological, sociological, and economic aspects of agriculture. The minor emphasizes a holistic perspective to designing farming and food systems and solving problems in agriculture. The importance of yield and profitability are balanced by considerations of the environment and the health and social well-being of producers, consumers, and communities. The minor complements major programs in ecology, conservation biology, forestry, sociology, geography, political science, and public affairs, as well as majors in the College of Agricultural, Food and Environmental Sciences.

**Prerequisites for Admission**—Admission is contingent upon prior admission to a master's or doctoral degree-granting program within the Graduate School.

**Special Application Requirements**—Contact the director of graduate studies in sustainable agriculture systems for an *Intent to Enroll* form. Students are admitted each semester.

**Courses**—Please refer to Sustainable Agriculture Systems (SAGR) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—4xxx courses are permitted toward minor requirements based on director of graduate studies approval.

#### Minor Only Requirements

The master's minor requires 6 graduate credits from the core curriculum; the doctoral minor requires 12 graduate credits. All students must take SAGR 8010 and 8020. The other core course is Agri 5321—Ecology of Agricultural Systems (cross listed with Ent 5321). A unique component of the minor is an on-site internship with growers, grassroots organizations, or public agencies working in sustainable agriculture.

## Theatre Arts

**Contact Information**—Department of Theatre Arts and Dance, University of Minnesota, 580 Rarig Center, 330 21st Avenue S., Minneapolis, MN 55455 (612-625-5029; fax 612-625-6334; [theatre@umn.edu](mailto:theatre@umn.edu); <http://cla.umn.edu/theatre/>).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

#### Professor

C. Lance Brockman, M2  
Michal Kobialka, SM

#### Associate Professor

Louis R. Bellamy, M2  
Maria Cheng, M2  
Martin B. Gwinup, M2  
Stephen C. Kanee, M2  
Sonja Kufnec, M2  
Mathew J. LeFebvre, M2  
Margaret L. Maddux, M2  
Jean A. Montgomery, M2  
Elizabeth H. Nash, M2  
Joan A. Smith, M2

#### Assistant Professor

Ananya Chatterjea, M2  
Aleksandra Wolska, M2

#### Adjunct Assistant Professor

Matthew D. Wagner, M2

#### Education Specialist

Brent "Mickey" Henry, M  
Pearl Rea, M  
Sherry L. Wagner, M

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Theatre arts programs provide practical and theoretical education for the performer, artist, educator, scholar, and audience member. Training the historian, theorist, artist, and craftsman is linked to and centered in the laboratory experience of live performance as well as in the academic classroom. The programs serve the dual roles of examining the various historical and contextual relationships of past and present theatre while educating audiences and theatre artisans/educators of tomorrow. The programs prepare students for careers in professional or academic theatre and related artistic fields.

**Prerequisites for Admission**—Students are admitted for fall semester only. The M.A./Ph.D. program and the M.F.A. design/technology program admit every year. The M.F.A. directing program currently admits every three years. Prerequisites for the initial screening phase of admission include a U.S. bachelor's degree or comparable foreign degree from a recognized college or university, a minimum of 18 undergraduate credits or the equivalent in theatre arts, and a 3.00 GPA. Applicants for all degree programs must submit scores from the GRE by February 1. International students' TOEFL scores must be submitted by January 15 (a paper score of 550 is considered the minimum for acceptance or 213 on the computer test).

The master's degree is a prerequisite for admission to the Ph.D. program. Students without a master's degree are admitted to the Ph.D. with the intention that the M.A. will be attained in route to the Ph.D. For admission to the M.A./Ph.D. or Ph.D. program, students must have a working knowledge/reading proficiency of at least one foreign language (or a sign language). A computer language will not satisfy this requirement.

**Special Application Requirements**—The application deadline for all degree programs is January 15. Applications received after that date will be considered only if there is an opening in the particular program. M.A./Ph.D. students wishing to have materials reviewed for the Graduate School Fellowship (for support of first-year students) must have materials submitted by January 5. All programs require a current résumé, statement of purpose/intent, and three letters of recommendation to accompany the departmental application.

The M.F.A. directing program requires an audition by invitation in Minneapolis in early March after an initial screening of application files. The directing program does **not** interview with U/RTA.

The M.F.A. design and technology program requires a portfolio review either through the Chicago U/RTA or by submitting materials to be received by February 1. The program also interviews by pre-arrangement during the annual USITT conference.

The M.A./Ph.D. program requires a submitted sample of research writing.

**Courses**—Please refer to Theatre Arts (Th) and Dance (Dnce) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Inclusion of 4xxx theatre and dance courses on degree program forms is subject to approval by the director of graduate studies. Such courses must be taught by a member of the graduate faculty. Students from other programs may include these courses with their own program's approval.

### M.A. Degree Requirements

The M.A. degree emphasizes academic pursuits and is considered a prerequisite for the Ph.D. The areas of study for the M.A./Ph.D. are theatre historiography, design and technical production, and directing (including management). Any of these may serve as a concentration of study, although the Ph.D. ordinarily focuses on the first. Candidates must complete coursework in both academic and performance areas.

For both Plan A and B, 30 credits are required from the following: three of the six sequence courses (8111-8116) plus 8102, totaling 12 credits; 3 credits from a course in performance conventions; 3 credits in independent seminar; 6 elective credits from inside or outside the department; 6 credits at the graduate level from outside the department (outside courses must be at least 3 credits each). For Plan A, 10 additional thesis credits (Th 8777) and an oral defense of the thesis are required. For Plan B, three papers are required.

**Language Requirements**—See the requirements for the Ph.D.

**Final Exam**—For Plan A, the final exam is written and oral. For Plan B, the final exam is written; an oral exam typically is not required, but one may be requested by the M.A. committee.

### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor requires a minimum of 9 credits as approved by the director of graduate studies.

### M.F.A. Degree Requirements

The three-year, performance-oriented M.F.A. degree offers two areas of specialization: directing, and design and technical production. The M.F.A. in directing focuses on developing intellectual and artistic skills and leadership talent through an intensive course of study with an emphasis on performance. For the M.F.A. in design and technology, all areas of design are studied in order to increase understanding in specialization areas, and technology is studied as an essential part of design. Students are expected to achieve proficiency in at least two areas of any combination of design and technology (scenery/properties, costuming, lighting, sound) and a level of expertise in at least one of these areas. Program faculty will work with students to identify the final areas for the degree. The M.F.A. degree is considered a terminal degree in these areas of theatre arts.

The M.F.A. requires 60 graduate credits, although a particular program's requirements may exceed this minimum. The degree requires 6 credits of dramatic literature or theatre history, which may be fulfilled by Th 4177 and 4178; and a minimum of 6 credits from outside the department (at least 3 credits of which must be a University course that contributes substantially to the degree program). Each program requires a final performance practicum and written record of it. For specific program requirements, contact the director of graduate studies.

**Language Requirements**—None.

**Final Exam**—Students must take a final oral exam related to the final creative project and must submit a written record of the project and the research related to it.

### Ph.D. Degree Requirements

The Ph.D. certifies that a degree recipient has a knowledge and understanding of theatre historiography and practice as well as pedagogical and professional strategies for communicating and applying that knowledge. The areas of study for the M.A./Ph.D. are theatre historiography, design and technical production, and directing (including management). Any of these may serve as a concentration of study, although the Ph.D. ordinarily focuses on the first. Candidates must complete coursework in both academic and performance areas.

The core curriculum, designed to help students finish the program within five years, consists of two parts: part I—coursework (three years); and part II—research and dissertation writing. The three years of coursework are tailored so that the first two years are structured, and the third year is more open, allowing students to pursue their individual areas of interest in more depth. Students are required to successfully complete six required courses over the three-year sequence: three courses must be in specific areas of theatre historiography, to be chosen from six seminars (Th 8111-6 sequence); historiography (Th 8102); a course in performance conventions; and an independent seminar in which students refine and materialize their work. This seminar, which can take the form of an independent study, directed reading/production, or a regular course format designed by the student and the adviser, usually takes place at the beginning of the third year. Students must also take coursework in a supporting program or a minor (12 credits); and 24 thesis credits, for a minimum total of 54 credits beyond the B.A. Topics courses and seminars supplement the core curriculum. Students must demonstrate a research technique appropriate to the thesis. This could take the form of a foreign language or a discipline research methodology which might increase the total number of credits required for the degree.

**Language Requirements**—Ph.D. students are expected to demonstrate proficiency in at least one foreign language as certified by the adviser or program faculty in the language.

### Minor Requirements for Students

**Majoring in Other Fields**—A doctoral minor requires a minimum of 12 credits as approved by the director of graduate studies.

## Therigenology

See Veterinary Medicine.

## Toxicology

**Contact Information**—Ken Wallace, Director of Graduate Studies, Toxicology Graduate Program, School of Medicine Duluth, 109 SMed, 1035 University Drive, Duluth, MN 55812 (218-726-7581; fax 218-726-6235; [toxgrad@d.umn.edu](mailto:toxgrad@d.umn.edu)) or V. F. Garry, Associate Director, Stone Laboratory, 421 29th Avenue S.E., Minneapolis, MN 55414 (612-627-4235; fax 612-627-4241).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Yusuf J. Abul-Hajj, Medicinal Chemistry, Pharmacognosy, SM  
David R. Brown, Veterinary Pathobiology, SM  
Robert M. Carlson, Chemistry, Duluth, SM  
Lester R. Drewes, School of Medicine, Duluth, SM  
Vincent F. Garry, Laboratory Medicine and Pathology, SM  
Patrick E. Hanna, Medicinal Chemistry, Pharmacognosy, SM  
Michael J. Murphy, Veterinary Diagnostic Medicine, SM  
Herbert T. Nagasawa, Medicinal Chemistry, Pharmacognosy, SM  
Gerald J. Niemi, Biology, Duluth, SM  
Joseph R. Prohaska, School of Medicine, Duluth, SM  
Jean F. L. Regal, School of Medicine, Duluth, SM  
W. Thomas Shier, Medicinal Chemistry, Pharmacognosy, SM  
Sheldon B. Sparber, Pharmacology, SM  
Kendall B. Wallace, School of Medicine, Duluth, SM

### Associate Professor

Cecilia Giulivi, Chemistry, Duluth, SM  
Lisa A. Peterson, School of Public Health, SM  
Mark S. Rutherford, Veterinary Pathobiology, SM  
Ashok K. Singh, Veterinary Diagnostic Medicine, SM

### Adjunct Associate Professor

Gerald T. Ankley, Duluth, AM2  
John L. Butenhoff, Duluth, AM2  
Glenn G. Hardin, Veterinary Diagnostic Medicine, AM2  
Herve N. Lebrec, Veterinary Diagnostic Medicine, AM2  
John W. Nichols, Duluth, AM2  
Robert R. Roy, Veterinary Diagnostic Medicine, AM2  
Andrew M. Seacat, Veterinary Diagnostic Medicine, AM2  
Robert S. Skoglund, Veterinary Diagnostic Medicine, AM2  
Lawrence P. Wackett, Veterinary Diagnostic Medicine, SM

### Assistant Professor

Subhash C. Basak, School of Medicine, Duluth, AM2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—This University-wide program provides comprehensive training in the broad scope of toxicology. Toxicology, the science of poisons, is devoted to identifying and quantifying potential noxious agents in our environment. Although most chemical agents at sufficiently large doses may be toxic, not all present a significant risk to human health, environmental organisms, or ecosystems. Accordingly, the essence of the science of toxicology is defining the line that distinguishes a risk from a residue. This requires scientific expertise in analytical and environmental chemistry, biology, and mathematics. Advanced courses and research are also available in subdisciplines such as human health risk assessment; epidemiology; environmental chemistry and engineering; ecotoxicology; food additives and nutritional toxicology; biochemical and physiological mechanisms; molecular toxicology and toxicogenomics; histopathology; diagnostic and analytical toxicology; drug metabolism; chemical carcinogenesis and reproductive toxicology; behavioral toxicology; veterinary toxicology; and the toxicity of noxious agents to various organ systems (e.g., nervous, heart, liver, kidneys).

**Prerequisites for Admission**—A B.S. in basic science is required. All applicants should have completed a full year of biology, chemistry, and physics, and have completed mathematics through calculus. The M.S. is not a terminal degree and students are not usually admitted to it. Applicants are evaluated for admission to the Ph.D. program.

**Special Application Requirements**—Applicants must submit scores from the General (Aptitude) Test of the GRE, three letters of recommendation from college-level faculty or equivalent persons who are familiar with the applicant's scholarship and research potential, a complete set of official transcripts, and a clearly written statement of career interests, goals, and objectives. Graduate study in the program begins in fall semester. The application deadline is January 1. All applications are evaluated once each year in early February.

**Courses**—Please refer to Toxicology (Txcl) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses toward degree requirements is permitted with director of graduate studies approval.

### M.S. Degree requirements

The M.S. is offered under plan A and Plan B. Plan A requires 20 course credits and 10 thesis credits. Plan B requires 30 course credits. A core curriculum of 8 credits in toxicology (Txcl 8012, 8013 and 8100) is required for both plans. Additional courses are arranged on an individual basis.

**Language Requirements**—None.

**Final Exam**—The final exam is written and oral.

### Ph.D. Degree Requirements

The Ph.D. requires core courses in physiology, biochemistry, statistics, and toxicology. Students must also complete 12 credits in a minor or supporting program and 24 thesis credits. Because the program spans the Duluth and Twin Cities campuses, the required course numbers differ on each campus.

Additional advanced courses in toxicology or related fields may be specified by the adviser. Students must complete and defend an original research project.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—A doctoral minor requires 12 credits: 8 credits of core courses and 4 credits of advanced toxicology courses.

## Transportation Studies

### Postbaccalaureate Certificate

**Contact Information**—Center for Transportation Studies, University of Minnesota, 511 Washington Ave. S.E., Minneapolis, MN 55455 (612-626-1023; fax 612-625-6381; [cts@umn.edu](mailto:cts@umn.edu); <[www.cts.umn.edu](http://www.cts.umn.edu)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### Professor

John Adams, Geography, M

#### Associate Professor

Gerard McCullough, Applied Economics, M

#### Assistant Professor

David Levinson, Civil Engineering, M  
Kevin Krizek, Public Affairs, M

**Curriculum**—The transportation studies program allows students to gain advanced interdisciplinary knowledge of transportation by taking a set of core courses along with a series of focused electives. Students must complete two courses in transportation policy and planning and a one-credit intelligent transportation technology seminar. In addition to this foundation, students acquire further expertise in a specific area related to transportation by taking at least 9 graduate credits in a field chosen by the student and approved by the director of graduate studies. These credits may consist of any combination of courses that will further the student's knowledge of a specific transportation-related subject area or areas. A broad array of topical areas and course offerings are available including advanced traffic engineering and related mathematical disciplines; transportation pavements or structures; management, logistics, regional planning, or human factors; historical, political, or economic analysis.

**Prerequisites for Admission**—Admission requires a B.S. or B.A. from an accredited U.S. institution or its foreign counterpart. The degree must be in a field related to transportation. Applicants who hold a degree in an unrelated field must demonstrate familiarity with the transportation-related

issues through work experience, community involvement, political leadership, or other activity.

A 3.00 minimum GPA is required for admission. International students must score 550 on the TOEFL exam. Exceptions may be made in cases where applicants have slightly lower than the minimum requirements but have demonstrated their abilities through substantial professional experience. The GRE is not required.

### Special Application Requirements

Prospective students must submit a statement explaining how their work experience, community involvement, political leadership, or other activity has prepared them for the program. Prospective students may supplement this statement with letters of recommendation from employers, community leaders, etc., if appropriate.

**Courses**—The four core courses are PA 5202/Geog 5372, PA 8212, CE 5212, and 5214. CE 5214 covers the systems approach and its application to transportation engineering and planning. Topics include prediction of flows and level of service, production functions and cost optimization, utility theory and demand modeling, transportation network analysis and equilibrium assignment, decision analysis, and multidimensional evaluation of transportation projects.

**Use of 4xxx Courses**—Use of 4xxx courses toward requirements is subject to director of graduate studies approval.

### Postbaccalaureate Certificate Requirements

Completion of two of the four core courses along with the Transportation Technology Seminar, three or more cognate elective courses chosen by the student in consultation with the director of graduate studies, and at least 16 graduate level credits are required. In addition to completing two of the above courses, students are required to complete ME 8772/CE 8213.

## Urban and Regional Planning

**Contact Information**—Director of Admissions, Hubert H. Humphrey Institute of Public Affairs, University of Minnesota, 301 19th Avenue South, Minneapolis, MN 55455 (612-624-3800; fax 612-626-0002; [admissions@hhh.umn.edu](mailto:admissions@hhh.umn.edu); <[www.hhh.umn.edu](http://www.hhh.umn.edu)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

#### Regents Professor

G. Edward Schuh, M2

#### Professor

Dean E. Abrahamson (emeritus), AM  
John S. Adams, M2  
Sandra Archibald, M2  
Ragui A. Assaad, M2  
J. Brian Atwood, M2  
Richard S. Bolan (emeritus), AM

John E. Brandl, M2  
John M. Bryson, M2  
Nancy N. Eustis, M2  
Katherine Fennelly, M2  
Edward G. Goetz, M2  
Stephen A. Hoenaack, M2  
C. David Hollister, AM2  
Ethan B. Kapstein, M2  
Anne R. D. Kapuscinski, Fisheries, Wildlife, and Conservation Biology, AM  
Kenneth H. Keller, M2  
Sally J. Kenney, M2  
Morris M. Kleiner, M2  
Robert T. Kudrle, M2  
Ann R. Markusen, M2  
Judith A. Martin, Geography, AM  
Samuel L. Myers, M2  
Lance M. Neckar, Landscape Architecture, AM  
David G. Pitt, Landscape Architecture, AM2  
Carlisle F. Runge, Applied Economics, AM  
Esther Wattenberg, Social Work, AM

### **Associate Professor**

Maria J. Hanratty, M2  
Deborah Levison, M2  
Melissa M. Stone, M2

### **Assistant Professor**

Kevin J. Krizek, M2  
David M. Levinson, Civil Engineering, AM2

### **Other**

Zbigniew M. Bochniarz, AM  
Harry C. Boyte, AM2  
Candace Campbell, AM  
William Craig, AM  
Barbara C. Crosby, AM2  
Marsha A. Freeman, AM  
Ali K. Galaydh, AM2  
Thomas F. Luce, AM  
Barbara L. Lukermann, AM  
Lee W. Munnich, AM  
Joseph A. Ritter, AM  
Jodi R. Sandfort, AM2  
Paul C. Stone, AM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The master of urban and regional planning (M.U.R.P.) degree is an interdisciplinary program that prepares students to analyze, forecast, design, and implement plans for regions, communities, and neighborhoods. Students develop a comprehensive understanding of the built environment (land use, transportation, housing, regional economies) and the ability to mediate among competing interests. They are prepared for jobs in public, nonprofit, and private sectors. Students can generally complete the M.U.R.P. degree in two years of full-time study. Dual degrees include M.U.R.P./juris doctor, M.U.R.P./master of landscape architecture, M.U.R.P./master of science in civil engineering, and M.U.R.P./master of social work.

**Prerequisites for Admission**—Students are expected to have completed the equivalent of an introductory course in microeconomics and have a U.S. bachelor's degree or foreign equivalent.

**Special Application Requirements**—In addition to the materials submitted to the Graduate School, applicants must submit to the Humphrey Institute a photocopy of their Graduate School application, the Humphrey

Institute Applicant Data Form, copies of all academic transcripts, a statement of purpose, at least three letters of recommendation, and a GRE official score report. Students who wish to be considered for financial aid should apply no later than January 2 of the preceding academic year. Deadline for admission only is April 1. Entry is for fall semester.

**Courses**—Please refer to Public Affairs (PA) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses toward degree requirements is permitted with instructor's and adviser's permission.

### **M.U.R.P. Degree Requirements**

The M.U.R.P., which is offered under Coursework Only and Plan A, requires 48 credits including core courses (26 credits), specialization electives (9 credits), and 10 credits of electives. Each student completes an internship in a public or private planning agency usually during the summer after the first year of the program. All students also take a capstone workshop (3 credits) that constitutes a final professional-level project. Students in the Coursework Only option complete a professional paper. Students selecting the Plan A option register for 10 thesis credits and complete a thesis. Specializations for the degree include housing and community development; regional, economic, and workforce development; transportation planning; land use/urban design planning; and environmental planning.

**Language Requirements**—None.

**Final Exam**—The final exam is oral for Plan A. No final exam required for Coursework Only.

## **Veterinary Medicine**

**Contact Information**—Director of Graduate Studies, Veterinary Medicine, 385 Animal Science/Veterinary Medicine, 1988 Fitch Avenue, St. Paul, MN 55108 (612-624-0750; fax 612-624-3233; [vmedgrad@umn.edu](mailto:vmedgrad@umn.edu); [www.cvm.umn.edu/graduate\\_vmed](http://www.cvm.umn.edu/graduate_vmed)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### **Professor**

Trevor R. Ames, Clinical and Population Sciences, SM  
P. Jane Armstrong, Small Animal Clinical Sciences, SM  
Russell F. Bey, Veterinary Pathobiology, SM  
David R. Brown, Veterinary Pathobiology, SM  
Cathy S. Carlson, Veterinary Diagnostic Medicine, SM  
James E. Collins, Veterinary Diagnostic Medicine, SM  
Melvyn L. Fahning, Clinical and Population Sciences, SM  
Ralph J. Farnsworth, Clinical and Population Sciences, M  
Daniel A. Feeney, Small Animal Clinical Sciences, SM  
John Fetrow, Clinical and Population Sciences, SM  
Douglas N. Foster, Animal Science, ASM  
Sandra M. Godden, Clinical and Population Sciences, M2  
Sagar M. Goyal, Veterinary Diagnostic Medicine, SM  
David A. Halvorson, Veterinary Pathobiology, SM  
Robert M. Hardy, Small Animal Clinical Sciences, SM

David W. Hayden, Veterinary Diagnostic Medicine, SM  
William D. Hueston, Clinical and Population Sciences, SM  
Carl R. Jessen, Small Animal Clinical Sciences, M2  
Han S. Joo, Clinical and Population Sciences, SM  
Mathur S. Kannan, Veterinary Pathobiology, SM  
Vivek Kapur, Veterinary Pathobiology, SM  
Jeffrey S. Klausner, Small Animal Clinical Sciences, SM  
Alan Lipowitz, Small Animal Clinical Sciences, SM  
Jody P. Lulich, Small Animal Clinical Sciences, SM  
Samuel K. Maheswaran, Veterinary Pathobiology, SM  
Thomas W. Molitor, Clinical and Population Sciences, SM  
Roger D. Moon, Entomology, ASM  
Robert B. Morrison, Clinical and Population Sciences, SM  
Michael P. Murtaugh, Veterinary Pathobiology, SM  
Kakambi V. Nagaraja, Veterinary Pathobiology, SM  
Timothy D. O'Brien, Veterinary Diagnostic Medicine, M2  
Carl A. Osborne, Small Animal Clinical Sciences, SM  
Phillip K. Peterson, Medicine, AM2  
Carlos Pijoan, Clinical and Population Sciences, SM  
David J. Polzin, Small Animal Clinical Sciences, SM  
Michael Pullen, Clinical and Population Sciences, M  
Patrick T. Redig, Small Animal Clinical Sciences, M2  
Bradley E. Seguin II, Clinical and Population Sciences, SM  
Jagdev M. Sharma, Veterinary Pathobiology, SM  
Bert E. Stromberg, Veterinary Pathobiology, SM  
Tracy A. Turner, Clinical and Population Sciences, SM  
Larry J. Wallace, Small Animal Clinical Sciences, SM  
Douglas J. Weiss, Veterinary Pathobiology, SM  
Jonathan E. Wheaton, Animal Science, ASM

### **Associate Professor**

Scott A. Dee, Clinical and Population Sciences, SM  
John Deen, Clinical and Population Sciences, SM  
Moses K. Njenga, Veterinary Pathobiology, M2  
Elaine P. Robinson, Small Animal Clinical Sciences, SM  
Mark S. Rutherford, Veterinary Pathobiology, SM  
Ava M. Trent, Clinical and Population Sciences, M2  
Stephanie J. Valberg, Clinical and Population Sciences, SM  
Patricia A. Walter, Small Animal Clinical Sciences, M2  
Scott J. Wells, Clinical and Population Sciences, SM

### **Assistant Professor**

Jeff B. Bender, Clinical and Population Sciences, SM  
Dori L. Borjesson, Veterinary Diagnostic Medicine, M2  
Kay S. Faaberg, Veterinary Pathobiology, M2  
James R. Lokensgard, Medicine, AM2  
Petra A. Mertens, Small Animal Clinical Sciences, M  
Kenneth P. Roberts, Urologic Surgery, AM2  
Kurt D. Rossow, Veterinary Diagnostic Medicine, SM  
Sheila M. F. Torres, Small Animal Clinical Sciences, M2

### **Associate Clinical Specialist**

Betty A. Kramek-Heffernan, Small Animal Clinical Sciences, M2  
Abby M. Sage, Clinical and Population Sciences, M2

### **Assistant Clinical Specialist**

Erin D. Malone, Clinical and Population Sciences, M2  
Jane E. Quandt, Small Animal Clinical Sciences, M2  
Margaret V. Root Kustritz, Small Animal Clinical Sciences, M2

### **Research Associate**

Connie J. Gebhart, Veterinary Pathobiology, SM  
Lisa M. Schrott, Pharmacology, AM2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—Emphases in the major are large, small, comparative, and food animal medicine. Emphasis can further be directed toward specific systems or population medicine.

The veterinary medicine graduate program encompasses all the clinical and applied graduate education of the College of Veterinary Medicine. The program is divided into five specialty tracks: comparative medicine and pathology; population medicine; infectious disease; surgery, radiology, and anesthesiology; and theriogenology. Program faculty are drawn from all the departments of the college as well as from other colleges within the University.

The program emphasizes quality clinical training with state-of-the-art research in areas of animal disease at the individual and population levels. All species of domestic animals are the subject of both teaching and research, the program being particularly strong in population-based medicine and epidemiology. Other areas of strength include feline and canine urology, radiology, pain, molecular epidemiology in food animals, microbiology, and immunology. The program also has quality research and teaching in the area of theriogenology.

**Prerequisites for Admission**—Applicants must meet the stated requirements of the Graduate School, including a minimum undergraduate GPA of 3.00 and a minimum TOEFL score of 550 or a minimum computer-based TOEFL score of 213.

The majority of applicants have a D.V.M. degree or its equivalent. Applicants lacking a D.V.M. degree, including those currently enrolled in a D.V.M. degree program, can be accepted upon approval by the director of graduate studies.

Applicants are requested but not required to take the GRE prior to consideration for admission.

**Special Application Requirements**—Applicants must submit a letter of intent stating career goals and defining the specialty of graduate study selected (e.g., subdiscipline or animal species). Also required are three letters of recommendation from individuals knowledgeable about the applicant's academic performance. These letters must be sent directly to the director of graduate studies or the program coordinator.

**Research Facilities**—Research facilities available to the veterinary medicine graduate student include the Advanced Genetic Analysis Center, the Clinical Investigation Center, the Raptor Center, the Swine Center, the Swine Disease Eradication Center, and the Avian Disease Research Center.

**Courses**—Please refer to Veterinary Medicine (VMed) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of selected 4xxx courses to meet degree requirements is acceptable.

### M.S. Degree Requirements

The M.S. is offered under Plan A and Plan B. Plan A requires 20 credits; a minimum of 14 credits in the major, 6 credits in a minor or related field, and in addition 10 thesis credits. Plan B requires 30 course credits, 14 of which must be in the major and 16 in a minor or related field, chosen in consultation with the adviser. Three papers are also required (e.g., a case report, a research project, and a literature review).

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor requires 6 course credits taken from recommended courses in the veterinary medicine major.

### Ph. D. Degree Requirements

There are no minimum requirements but students usually take 24 to 30 credits in the major field and 12 credits minimum for official minor or supporting program. In addition, 24 thesis credits are required.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—A doctoral minor requires 12 course credits taken from recommended courses in the veterinary medicine major.

## Vocational Education

See Work, Community, and Family Education.

## Water Resources Science

**Contact Information**—Director of Graduate Studies—Twin Cities, Water Resources Science, University of Minnesota, 173 McNeal Hall, 1985 Buford Avenue, St. Paul, MN 55108 (612-624-9282; fax 612-625-1263; [juerg001@umn.edu](mailto:juerg001@umn.edu)); and Associate Director of Graduate Studies—Duluth, Water Resources Science, 213 RLB, University of Minnesota, Duluth, MN 55812 (218-726-8891; fax 218-726-6979).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

E. Calvin Alexander, Jr., Geology and Geophysics, SM  
Dorothy Anderson, Forest Resources, SM  
James L. Anderson, Soil, Water, and Climate, SM  
Sandra O. Archibald, Public Affairs, SM  
Roger E. A. Arndt, Civil Engineering, SM  
Marvin Bauer, Forest Resources, SM  
David D. Biesboer, Plant Biology, SM  
Paul R. Bloom, Soil, Water, and Climate, SM  
Patrick L. Brezonik, Civil Engineering, SM  
Kenneth N. Brooks, Forest Resources, SM  
Dwight A. Brown, Geography, SM  
Charles J. Clanton, Biosystems and Agricultural Engineering, SM  
K. William Easter, Applied Economics, SM  
Ehsan Feroz, Accounting, Duluth, AM2

Leonard Ferrington, Entomology, SM  
Efi Foufoula, Civil Engineering, SM  
Philip J. Gersmehl, Geography, SM  
Florence K. Gleason, Plant Biology, SM  
Sagar M. Goyal, Veterinary Diagnostic Medicine, SM  
John S. Gulliver, Civil Engineering, SM  
Satish C. Gupta, Soil, Water, and Climate, SM  
Emi Ito, Geology and Geophysics, SM  
Thomas C. Johnson, Geological Sciences, Duluth, SM  
Andrew R. Klemer, Biology, Duluth, SM  
Robert O. Megard, Ecology, Evolution, and Behavior, SM  
John F. Moncrief, Soil, Water, and Climate, SM  
David J. Mulla, Soil, Water, and Climate, SM  
Edward A. Nater, Soil, Water, and Climate, SM  
John L. Nieber, Biosystems and Agricultural Engineering, SM  
John Pastor, Biology, Duluth, SM  
James A. Perry, Fisheries, Wildlife, and Conservation Biology, SM  
Hans-Olaf Pfannkuch, Geology and Geophysics, SM  
Carl Richards, Minnesota Sea Grant, Duluth, SM  
Michael Sadowsky, Soil, Water, and Climate, SM  
Mark W. Seeley, Soil, Water, and Climate, SM  
Michael J. Semmens, Civil Engineering, SM  
Heinz G. Stefan, Civil Engineering, SM  
Robert W. Sterner, Ecology, Evolution, and Behavior, SM  
Deborah L. Swackhamer, Environmental and Occupational Health, SM  
Michael Sydor, Physics, Duluth, SM  
Bruce N. Wilson, Biosystems and Agricultural Engineering, SM

### Adjunct Professor

John Baker, Soil, Water, and Climate, SM  
Carol A. Johnston, Geological Sciences, Duluth, SM

### Associate Professor

Randal J. Barnes, Civil Engineering, SM  
James C. Bell, Soil, Water, and Climate, SM  
Erik T. Brown, Geological Sciences, Duluth, SM  
James B. Cotner, Ecology, Evolution, and Behavior, SM  
Susan M. Galatowitsch, Horticultural Science, SM  
Randall E. Hicks, Biology, Duluth, SM  
Frances R. Homans, Applied Economics, M2  
Raymond N. Hozalski, Civil Engineering, SM  
Katherine Klink, Geography, SM  
Timothy LaPara, Civil Engineering, SM  
Howard D. Mooers, Geological Sciences, Duluth, SM  
Raymond M. Newman, Fisheries, Wildlife, and Conservation Biology, SM  
Paige J. Novak, Civil Engineering, SM  
Steven J. Taff, Applied Economics, SM  
Dong Wang, Soil, Water, and Climate, SM

### Adjunct Associate Professor

Paul D. Capel, Civil Engineering, ASM  
Bruce C. Vondracek, Fisheries, Wildlife, and Conservation Biology, SM

### Assistant Professor

William Arnold, Civil Engineering, SM  
Donn Branstrator, Biology, Duluth, SM  
Neil C. Hansen, Soil, Water, and Climate, M2  
Brian May, Physics, Duluth, M2  
Kristopher McNeill, Chemistry, SM  
Kristen C. Nelson, Forest Resources, SM  
Elise A. Ralph, Physics, Duluth, SM  
Gary R. Sands, Biosystems and Agricultural Engineering, M2  
Matt Simcik, Environmental and Occupational Health, SM  
Jeff Strock, Soil, Water, and Climate, M2  
John Swenson, Geological Sciences, Duluth, M2  
Josef Werne, Chemistry, Duluth, M2  
Tongxin Zhu, Geography, Duluth, M2

### Adjunct Assistant Professor

Mary Renwick, Applied Economics, M2  
James Almendinger, Fisheries, Wildlife, and Conservation Biology, AM2

### Research Associate

Richard P. Axler, Natural Resources Research Institute, Duluth, SM  
Prasanna Gowda, Soil, Water, and Climate, SM  
Lucinda B. Johnson, Natural Resources Research Institute, Duluth, M2  
Carol Johnston, Natural Resources Research Institute, Duluth, SM  
John C. Kingston, Natural Resources Research Institute, Duluth, SM  
Ingrid Schneider, Forest Resources, SM

### Senior Fellow

Lawrence Baker, Water Resources Center, SM

### Other

Lorin Hatch, Macalaster College, AM2  
Elon S. Verry, USDA Forest Service, ASM

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—This cross-campus interdisciplinary program provides comprehensive training in water resources science, with integration across scientific disciplines. A structured interdisciplinary graduate curriculum is offered. The program includes a set of core courses plus electives in the following areas of specialization at the M.S. and Ph.D. levels: aquatic biology, environmental chemistry, hydrologic science, limnology, water management technology, water policy, water quality, and watershed science and management. Approximately 80 courses offered within 15 other graduate programs are available to students majoring in water resources science.

The goal of the program is to produce scientists with strong technical skills in disciplines relevant to water resources and a broad understanding of 1) the hydrologic cycle and associated ecosystems, 2) the interconnectedness of the sciences involved in managing aquatic resources, and 3) the interplay between the biophysical sciences and social sciences in developing and implementing public policies related to water.

The program involves faculty from the following departments on the Twin Cities campus: Applied Economics; Biosystems and Agricultural Engineering; Civil Engineering; Ecology, Evolution, and Behavior; Entomology; Environmental and Occupational Health; Fisheries, Wildlife, and Conservation Biology; Forest Resources; Geography; Horticultural Science; Geology and Geophysics; Microbiology, Plant Biology; Soil, Water, and Climate; and the Humphrey Institute of Public Affairs. It also involves faculty from the following departments on the Duluth campus: Biology, Chemical Engineering, Chemistry, Geography, Geological Sciences, Physics, and Political Science, as well as the Large Lakes Observatory and the Natural Resources Research Institute in Duluth.

**Prerequisites for Admission**—The program is flexible enough to accommodate students from a variety of backgrounds. Normally students have a bachelor's degree in physical

or biological science or engineering. Recommended academic preparation includes one year (or two semesters) each of calculus, physics, and chemistry and one biology course. Further preparation may be expected from students wishing to specialize in certain areas of the program.

### Special Application Requirements

Applicants must submit three letters of recommendation to the director of graduate studies. These letters should be from professors qualified to estimate applicants' class rank and evaluate their ability to complete a program of graduate study, or from persons who can assess their professional potential. These letters also may be used in applying for financial aid. Applicants must also submit a résumé of their academic history and professional experience and a statement of purpose, including the proposed area of emphasis. Applicants are strongly encouraged to submit results of the GRE. Those who have not taken the GRE are at a disadvantage in competing for financial aid. Students may be admitted any semester but are strongly encouraged to begin fall semester and to submit their application by January 1 in the year they expect to begin their studies.

**Courses**—Please refer to Water Resources Science (WRS) in the course section of this catalog for courses pertaining to the program. Check the department Web site at <http://wrs.coafes.umn.edu> for additional course information.

**Use of 4xxx Courses**—Use of 4xxx courses is permitted for degree requirements based on approval by the director of graduate studies.

### M.S. Degree Requirements

Students may choose Plan A, which requires a thesis, or Plan B, which requires additional coursework and a major project. Both plans incorporate courses offered on the Twin Cities and Duluth campuses.

Students must complete courses in four core areas: 1) hydrology (surface and/or hydrogeology); 2) environmental/water chemistry; 3) limnology; and 4) water resources policy, economics, and management, and at least three electives in such areas of emphasis as aquatic biology, hydrologic science, watershed science and management, and water management technology. One elective must be from an approved list of technical courses dealing with water quality science/management; two electives must be in the student's focus area. A minimum of two supporting courses (at least 6 credits) outside of aquatic science also are required.

A minimum of 20 course credits (plus 10 thesis credits) are required for Plan A and a minimum of 30 credits are required for Plan B (up to 3 credits of independent study may be used for the Plan B project). Students who had classes equivalent to those in the WRS core as undergraduates may substitute other classes to meet the Graduate School minimum requirement of 20 credits.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor requires 9 credits, including WRS 5101 (3 credits) and two of the other core courses described under M.S. degree requirements.

### Ph.D. Degree Requirements

Coursework is tailored to student interests, and many areas of specialization are possible. Core courses are offered on both the Twin Cities and Duluth campuses.

Students complete coursework equivalent to that of an M.S. in water resources science, with additional coursework in an area of specialization. There are no specific credit requirements in the major, but Ph.D. programs normally include at least 40 course credits beyond the B.S. level, including relevant coursework taken for a master's degree and a required minimum of 12 credits in a minor or supporting program.

**Language Requirements**—None.

### Minor Requirements for Students

**Majoring in Other Fields**—Doctoral students must complete 12 credits, including WRS 5101 (3 credits), two other core courses described under the M.S. degree requirements, and an elective from one of the fields of specialization.

## Wildlife Conservation

**Contact Information**—Kathleen Walter, College of Natural Resources, University of Minnesota, 135 Skok Hall, 2003 Upper Buford Circle, St. Paul, MN 55108-6146 (612-624-2748; fax 612-624-6282; [kwalter@forestry.umn.edu](mailto:kwalter@forestry.umn.edu); [www.fw.umn.edu](http://www.fw.umn.edu)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Yosef Cohen, SM  
Francesca J. Cuthbert, SM  
Ralph J. Gutiérrez, SM  
John Pastor, Biology, Duluth, SM  
Donald B. Siniff, Ecology, Evolution, and Behavior, SM  
J. L. David Smith, SM  
Anthony M. Starfield, Ecology, Evolution, and Behavior, SM

### Adjunct Professor

David E. Andersen, SM  
L. David Mech, SM

### Associate Professor

James A. Cooper, SM  
Peter A. Jordan, SM

### Adjunct Associate Professor

Glenn D. DeGiudice, SM  
David C. Fulton, SM  
David L. Garshelis, SM  
Richard O. Kimmel, M

### Assistant Professor

Todd Arnold  
Robert B. Blair, SM  
John P. Loegering, M2  
Kristen C. Nelson, SM

**Adjunct Assistant Professor**

Alan Franklin, M2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—This program, administered within the Department of Fisheries, Wildlife, and Conservation Biology, is an applied program emphasizing resource-management applications. For the M.S. degree, emphasis is on wildlife biology and related areas in ecology, animal behavior, physiology, and human dimensions as these relate to resource management and conservation problem solving. For many students, the M.S. is a terminal degree leading to employment with government resource-management agencies. For the Ph.D. program, emphasis is on basic biology and ecology with concentrated work in independent, original research generally relating basic social science to management/conservation challenges.

This program combines basic biology and ecology with other academic areas and with applied problem solving in natural resource management and conservation areas such as animal behavior, population modeling, habitat management, integrated resource management, and animal physiology.

**Prerequisites for Admission**—For the M.S., a bachelor's degree with a biological sciences background is required, preferably with emphasis on terrestrial or wetland vertebrates, and with a natural-resource management orientation. A strong background in physical sciences and mathematics is expected; familiarity with statistics and computer use is desirable. For the Ph.D., a master's degree in wildlife science or a closely related field is normally required.

**Special Application Requirements**—Three letters of recommendation are required from persons able to evaluate the applicant's scholarship and professional experience. Also required are scores from the GRE General Test. Applicants taking the examination should list the wildlife management major field code (0115). Applications are accepted at any time; however, because the faculty reviews most applications in late January for admission the following fall, applications should be sent before January 1.

**Courses**—Please refer to Fisheries and Wildlife (FW) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—Use of 4xxx courses toward degree requirements is subject to adviser and director of graduate studies approval. Students from other majors may include such courses subject to their own program's approval.

**M.S. Degree Requirements**

Plan A is recommended; Plan B is available under special circumstances. Students must become familiar with factors underlying wildlife population and habitat ecology,

management techniques, and how management agencies function. Academic work includes coursework in animal ecology, wildlife management, and statistics. The Plan A thesis should involve at least one field season, but generally two. Plan B students complete one to three projects involving field, laboratory, or planning work.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

**Minor Requirements for Students**

**Majoring in Other Fields**—A master's minor requires a minimum of 6 credits as approved by the director of graduate studies.

**Ph.D. Degree Requirements**

Degree programs include basic wildlife biology, development of analytical skills, and one or more areas of specialization.

**Language Requirements**—A foreign language is required only when the advisory committee determines that a language is needed to support the student's research objectives. Symbolic language (computer programming) is recommended for all students.

**Minor Requirements for Students**

**Majoring in Other Fields**—A doctoral minor requires a minimum of 12 credits as approved by the director of graduate studies.

**Work, Community, and Family Education**

**Contact Information**—Jerry McClelland, Director of Graduate Studies, Department of Work, Community, and Family Education, University of Minnesota, R-350 Vocational and Technical Education Building, 1954 Buford Avenue, St. Paul, MN 55108 (612-624-1221; fax 612-625-8140; [wcfefe@umn.edu](mailto:wcfefe@umn.edu); <<http://www.education.umn.edu/wcfefe/>>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

**Professor**

Thomas Brothen, General College, AM  
James M. Brown, SM  
Terence George Collins, General College, AM  
Jeanne Louise Higbee, General College, AM  
Judith J. Lambrecht, SM  
Theodore Lewis, SM  
Gary N. McLean, SM  
Roland L. Peterson, SM  
David J. Pucel, SM  
Richard A. Swanson, SM  
Ruth G. Thomas, SM

**Adjunct Professor**

Richard A. Krueger, Extension, SM

**Associate Professor**

Laura Coffin Koch, General College, AM  
Gary W. Leske, SM  
Jerry H. McClelland, SM  
Rosemarie J. Park, SM  
Jane E. Plihal, SM  
Marilyn A. M. Rossmann, SM  
Shelia K. Ruhland, SM  
James R. Stone III, SM  
Cathrine A. Wambach, General College, AM  
Baiyin Yang, SM

**Assistant Professor**

Kenneth R. Bartlett, SM  
Richard M. Joerger, M2  
Shari L. Peterson, SM  
Thomas Joseph Reynolds, General College, AM

**Lecturer**

John R. Vreyens, International Agricultural Programs, AM2

**Other**

Jeanette R. Daines, AM2  
Barrycraig Johansen, Rochester, AM2  
James C. Kielsmeier, AM2  
Marie J. Maher, Rochester, AM2  
Tom Peacock, Education, Duluth, AM2  
Jerome Stein, Extension 4H Center for Youth Development, AM2  
Joyce Walker, Extension 4H Center for Youth Development, AM2

Along with the program-specific requirements listed below, please read the General Information section of this catalog for Graduate School requirements that apply to all major fields.

**Curriculum**—The Ed.D. offers specializations in adult education; agriculture, food, and environmental education; business and industry education; family education; human resource development; and comprehensive work, community, and family education. Students combine study and related experiences to develop, apply, analyze, synthesize, and evaluate knowledge of the purposes, practices, issues, and problems of work, community, and family education; social, economic, historical, political, cultural, educational, technological, and psychological contexts within which work, community, and family education exist; and types of research that contribute to or apply that knowledge to the specialization.

See also Education—Work, Community, and Family Education for information about the M.A. and Ph.D. degrees.

**Prerequisites for Admission**—Prospective master's degree students generally have completed an undergraduate degree or extensive coursework in the specialization area. Prospective doctoral degree students should have academic background and experience in at least one specialization area.

**Special Application Requirements**—Scores from the GRE general test are required for applicants with a bachelor's degree from a U.S. institution. Applicants should designate the specific specialization to which they seek admission in their goal statement. A current resume is required. Students are admitted each term.

**Courses**—Please refer to Adult Education (AdEd), Agricultural, Food, and Environmental Education (AFEE), Business and Industry Education (BIE), Family Education (FE), Human Resource Development (HRD), and Work, Community, and Family Education (WCFE) in the course section of this catalog for courses pertaining to the program.

**Use of 4xxx Courses**—A maximum of 15 credits from 4xxx courses may be used in the supporting program. Students are responsible for determining that the course was available for graduate credit and the offering department criteria for graduate credit were satisfied. Degree programs must include rationale for the use of 4xxx course credits.

**Ed.D. Degree Requirements**

The Ed.D. requires 60 course credits and 24 field study credits (thesis credits). Course credits include a minimum of 12 credits in general aspects, a minimum of 11 credits in research, and a minimum of 28 credits in the specialization, 4 of which must be internship credits. Course credits must also include 12 credits from outside the department, which may overlap with those in general aspects, research, and the specialization.

**Language Requirements**—None.

**Final Exam**—A written preliminary exam in each of the program areas (general aspects, research, and specialization) and a final oral exam are required.

**Minor Requirements for Students**

**Majoring in Other Fields**—A doctoral minor requires a minimum of 12 credits in one of the specializations, approved by the director of graduate studies.

## Related Fields

Graduate degree programs do not exist in the following fields. However, students may earn graduate credit in courses related to their program and use faculty members on their examining committees from these fields. For graduate courses, see the Courses section in this catalog.

## Chicano Studies

**Professor**

Dennis Valdes, E

**Associate Professor**

Guillermo Rojas, E

## Dermatology

**Professor**

Mark V. Dahl (emeritus), E

**Assistant Professor**

James C. Vance, E

## Neurosurgery

**Professor**

Walter A. Hall, E  
Walter C. Low, E  
Robert E. Maxwell, E  
Gaylan L. Rockswold, E

## Pediatrics

**Regents Professor**

Alfred F. Michael, E  
James G. White, E

**Professor**

David M. Brown, E  
Carlyle C. Clawson, E  
Patricia Ferrieri, E  
G. Scott Giebink, E  
Edward L. Kaplan, Epidemiology, E  
James H. Moller, E  
Harvey Sharp, E  
Warren J. Warwick, E

**Associate Professor**

Amos S. Deinard, E

**Assistant Professor**

Pi-Nian Chang, E  
Elizabeth E. Giles, E

## Psychiatry (AdPy and CAPy)

**Professor**

Gerald J. August, E  
Marilyn E. Carroll, E  
Elke D. Eckert, E  
William H. Frey, Pharmacy, E  
Judith G. Garrard, Health Services Research, Policy and Administration, E  
Dorothy Hatsukami, Epidemiology, E  
Jerome L. Kroll, E  
Thomas B. Mackenzie, E  
Michael K. Popkin, E

**Associate Professor**

Michael L. Bloomquist, E  
Carrie M. Borchardt, E  
Scott J. Crow, E  
George Realmuto, E

**Assistant Professor**

Daniel R. Hanson, E

## Therapeutic Radiology

**Professor**

John J. Kersey, Pediatrics, E  
Faiz M. Khan, E  
Chang W. Song, E

**Associate Professor**

Bruce J. Gerbi, E  
Patrick D. Higgins, E

**Assistant Professor**

Parham Alaei, E

# Courses



*This is the Courses section—  
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# Courses

## Course Numbers, Symbols, and Abbreviations

The courses in this catalog are not offered every semester. For a listing of courses offered in a particular semester, consult the *Class Schedule* at <<http://onestop.umn.edu/schedule/html/tc.html>>.

**Course Numbers**—Courses numbered from 5000 to 5999 (listed as 5xxx if individual course number is unspecified) are primarily for graduate students, but are also open to third or fourth year undergraduate students. (5xxx courses in the School of Dentistry and in some clinical departments of the Medical School may not be applied to graduate programs.) Courses numbered 8000 or above (8xxx) are open to graduate students only.

Courses at the 6000 (6xxx) and 7000 (7xxx) levels are for postbaccalaureate students in professional degree programs not offered through the Graduate School. Courses numbered at the 4000 (4xxx) level are primarily for undergraduate students in their fourth year of study. 4xxx, 6xxx, and 7xxx courses may be applied toward a Graduate School degree with approval by the student's major field and if the course is taught by a member of the graduate faculty or an individual authorized by the program to teach at the graduate level. Course descriptions for 4xxx, 6xxx, and 7xxx courses can be found online at <[www.semesters.umn.edu/tc/](http://www.semesters.umn.edu/tc/)>.

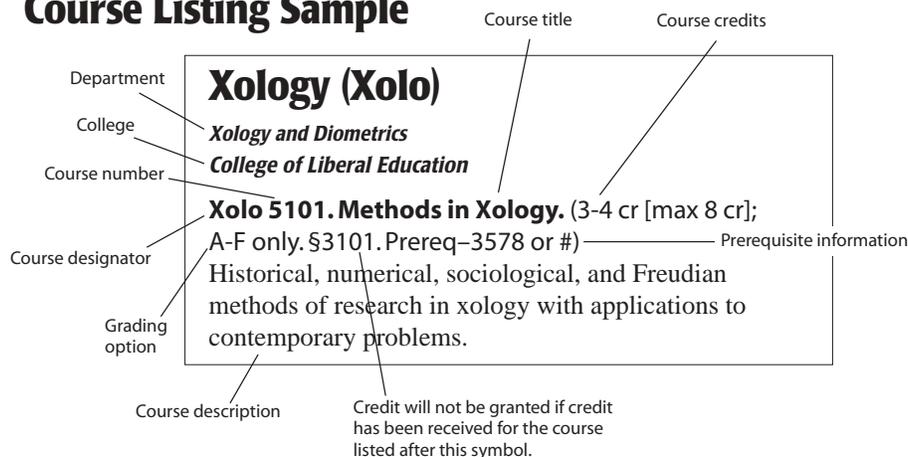
Courses at the 1000 (1xxx), 2000 (2xxx), and 3000 (3xxx) levels are for undergraduates and may not be applied to graduate programs. Courses numbered 0000 to 0999 do not carry credit.

**Course Designators**—In conjunction with course numbers, departments and programs are identified by a 2-, 3-, or 4- letter prefix known as a designator (e.g., CE for Civil Engineering, Pol for Political Science, WoSt for Women's Studies). When no course designator precedes the number of a course listed as a prerequisite, that prerequisite course is in the same discipline as the course being described.

**Course Symbols and Abbreviations**—The following abbreviations and symbols are used throughout the course descriptions of most University catalogs to denote common and recurring items of information.

- Prereq ..... Course prerequisites.
- cr ..... Credit.
- 1-4 cr [max 6] ..... The course can be taken for 1 to 4 credits and may be repeated for up to 6 credits.
- ! ..... Work for this course will extend past the end of the term. A grade of K will be assigned to indicate that the course is still in progress.
- † ..... All courses preceding this symbol must be completed before credit will be granted for any term of the sequence.
- § ..... Credit will not be granted if credit has been received for the course listed after this symbol.
- ¶ ..... Concurrent registration is required (or allowed) in the course listed after this symbol.
- # ..... Approval of the instructor is required for registration.
- Δ ..... Approval of the department offering the course is required for registration.
- ..... Approval of the college offering the course is required for registration.
- , ..... In prerequisite listings, comma means "and."
- DGS ..... Director of graduate studies.
- W ..... Following a course number, the W indicates the course is writing intensive.
- A-F, S-N, NGA ... Grading options. NGA means "no grade associated." If no grading option is listed, the course may be taken either A-F or S-N. For more information about grading, see page 14.

### Course Listing Sample



The courses in this catalog are current as of March 20, 2003. Check the University Catalogs Web site at <[www.catalogs.umn.edu/courses.html](http://www.catalogs.umn.edu/courses.html)> for the most current course information.

# Accounting (Acct)

## Department of Accounting

### Curtis L. Carlson School of Management

**Acct 5100. Corporate Financial Reporting.** (4 cr; A-F only. Prereq—Mgmt student, non-accounting major) Overview of asset/liability valuation and income measurement. Focus on how economic events are reported in the financial statements. Examines accounting theory and the accounting standard-setting process.

**Acct 5101. Intermediate Accounting I.** (4 cr; A-F only. Prereq—Grade of at least B- in 2050, [mgmt major or mgmt grad student]) Valuation, measurement, and reporting issues related to selected assets/liabilities of a firm. Theory underlying accounting issues. Applying accounting principles.

**Acct 5102. Intermediate Accounting II.** (4 cr; A-F only. Prereq—5101; mgmt or grad mgmt student) Basic valuation problems encountered in financial reporting. Focuses on valuation of liabilities. Accounting for leases, pensions, and deferred taxes. Introduces consolidated financial statements.

**Acct 5125. Auditing Principles and Procedures.** (4 cr; A-F only. Prereq—[3101/5101 or 5100/6100], [accounting major or grad mgmt student]) Auditing financial information systems. Independent audits and internal auditing. Ethics. Legal responsibilities.

**Acct 5126. Internal Auditing.** (2 cr; A-F only. Prereq—[3101/5101 or 5100/6100], 3001) Financial and operational auditing. Standards. Managing the function.

**Acct 5135. Fundamentals of Federal Income Tax.** (4 cr; A-F only. Prereq—2050 or 8030 or 8130, [mgmt or grad mgmt student]) Introduction to the U.S. federal system of taxation. Concepts of gross income, deductions, and credits. Analysis of the structure of the Internal Revenue Code and its provisions with respect to specific areas of the law. Examination of the interrelationships between legislative, judicial and administrative authority. Introduces the various methods, tools and techniques to conduct tax research.

**Acct 5150. Current Financial Accounting Issues.** (2 cr; A-F only. Prereq—MBT student; 2050) Accounting principles and practices underlying preparation of financial statements and additional disclosures. Includes recent pronouncement on financial accounting.

**Acct 5160. Financial Statement Analysis.** (2 cr; A-F only. Prereq—[5100/6100 or 3101/5101], [accounting or finance major]) Interpretation/analysis of financial statements. Introduces basic techniques of financial statement analysis and applies them in different settings (e.g., in investment/credit decisions).

**Acct 5180. Consolidations and Advanced Reporting.** (2 cr; A-F only. Prereq—5102, mgmt or mgmt grad student) Theory underlying the preparation of consolidated financial statements, as well as the mechanical computations needed to prepare the statements themselves.

**Acct 5200. Tax Accounting Methods and Periods.** (4 cr; A-F only. Prereq—MBT student; 5135) Rules affecting timing of income and deductions for tax purposes. Examination of cash and accrual accounting methods on an overall basis and with respect to individual items of income and deductions; rules for changing accounting methods and periods; annual accounting and transactional concepts, including the claim of right doctrine, the Arrowsmith doctrine, and the tax benefit rule.

**Acct 5220. Tax Research, Communication, and Practice.** (4 cr; A-F only. Prereq—MBT student; 5135) In-depth treatment of tax research methodology including tax questions, locating potential authority, assessing potential authority, and communicating research results. Substantive material on dealing with the IRS including sources of IRS policy; processing returns, auditing returns; rulings and determination letters; closing agreements; assessments and collections.

**Acct 5230. Corporate Taxation I.** (2 cr; A-F only. Prereq—MBT student; 5135) Federal income taxation of corporations and shareholders. Organization of a corporation; establishment of its capital structure; determination of its tax liability; dividends and other nonliquidating distributions; stock redemptions, and liquidations.

**Acct 5236. Introduction to Taxation of Business.** (2 cr; A-F only. Prereq—5135, acct major) Introduction to the income tax laws governing the taxation of corporations, partnerships, limited liability companies, limited liability partnerships, and S corporations. Students will also increase their knowledge and skills related to tax research by writing research memorandums.

**Acct 5271. Accounting Information Systems.** (2 cr. Prereq—3101/5101 or 5100/6100) Applications of electronic data processing systems in accounting, including modeling, financial planning, auditing, and data security. Analysis/design of accounting information systems.

**Acct 5281. Special Topics in Financial Reporting.** (2 cr; A-F only. Prereq—5102, mgmt or grad mgmt student) Covers areas of financial reporting frequently covered on the CPA exam, including partnerships, foreign operations, and accounting for government and nonprofit organizations.

**Acct 5310. International Accounting.** (2 cr; A-F only. Prereq—2050, mgmt student) Review of macroeconomic concepts of international economics, including trade, international markets for capital, and the role of accounting. Survey of different accounting policies and approaches among nations. Reading and understanding financial statements produced in countries other than the United States.

**Acct 5320. Current Topics in Accounting.** (2 cr; A-F only. Prereq—5102, acct major) Topics vary.

**Acct 5325. Advanced Tax Principles.** (2 cr; A-F only. Prereq—5135, MBT student) In-depth coverage of issues affecting all tax entities, focusing on topics pertaining to individuals and partnerships: at-risk provisions, passive activity loss rules, Alternative Minimum Tax/AMT credit for individuals, tax benefit rule and claim of right doctrine, like-kind exchanges of personal property, net operating losses, hobby losses, and business/rental use of residences.

**Acct 5330. Taxation of Corporations II.** (2 cr; A-F only. Prereq—5230, MBT student) Corporate readjustments related to multiple corporations and consolidated returns.

**Acct 5333. Tax Aspects of Consolidated Returns.** (2 cr; A-F only. Prereq—5230, MBT student) Covers aspects of filing consolidated federal income tax returns. Includes determining affiliated groups; election and filing requirements; intercompany transactions, limitations on certain loss and credit carryforwards; allocation of federal income tax liability; E&P and investment basis adjustments; loss allowance rules; and excess loss accounts.

**Acct 5335. Taxation of the Small Business Corporation.** (2 cr; A-F only. Prereq—5230, MBT student) Federal income taxation of S corporations. Election eligibility; termination of status; treatment of income and deduction items; distributions, basis of stock and debt. Compensation arrangements in closely held corporations; fiscal year issues; personal service corporations; advantages of C corporations vs. S corporations; corporation liquidation and redemption rules; S corporation's built-in gains tax.

**Acct 5340. Taxation of Partners and Partnerships.** (2 cr; A-F only. Prereq—5135, MBT student) Reviews tax consequences associated with formation, operation, and dissolution of a partnership.

**Acct 5350. Taxation of Estates and Gifts.** (2 cr; A-F only. Prereq—5135, MBT student) Taxation of transfers under federal estate and gift tax laws. Includes property owned by the decedent; retained life estates; transfers taking effect at death; revocable transfers; joint interest; powers of appointment; valuation problems; expenses, debts and taxes; charitable bequests, marital deduction, taxable inter vivos gifts, splitting and credits.

**Acct 5351. Estate Planning.** (2 cr; A-F only. Prereq—5135, MBT student) Addresses various topics related to planning the transfer of property during lifetime and at death.

**Acct 5353. Income Taxation of Fiduciaries.** (2 cr; A-F only. Prereq—5135, MBT student) Simple, complex, and revocable trusts; estates; accumulation distributions, income in respect of decedents; trust accounting income and principal; distributable net income; terminations; and excess distributions.

**Acct 5356. Taxation of Compensation Arrangements.** (2 cr; A-F only. Prereq—5135, MBT student) Federal income taxation of corporate deferred compensation and fringe benefits with emphasis on pension plans, profit sharing plans, stock option plans, individual retirement accounts, annuities and insurance, medical related compensation benefits, and reporting requirements.

**Acct 5360. State and Local Taxation.** (2 cr; A-F only. Prereq—5135, MBT student) Examines state levying of individual income, corporate income, property, sales, and excise taxes. Tax problems of businesses with multistate operations.

**Acct 5370. Taxation of Property Transactions.** (2 cr; A-F only. Prereq—5135, MBT student) Determining realized gain or loss and recognized gain or loss, and tax treatment of that gain or loss on property dispositions. Consequences of property transactions including depreciation, depletion, basis, and capital gains problems.

**Acct 5380. Tax Aspects of International Business I.** (2 cr; A-F only. Prereq—5230, MBT student) Multinational business operations and transactions involving foreign income. Tax consequences of transactions with foreign organizations and by related foreign companies.

**Acct 5381. Tax Aspects of International Business II.** (2 cr; A-F only. Prereq—5380, MBT student) Foreign tax credit and Subpart F planning opportunities, international structuring (including joint ventures and use of the new entity classification regulations), transfer pricing, and foreign currency. Recent legislative, regulatory, and judicial developments in the international tax area, and the challenges and opportunities presented by these developments.

**Acct 5390. Topics in Taxation.** (1-4 cr [max 24 cr]. Prereq—MBT student) Current tax legislation and problems. Topics may vary. S-N grading allowed with MBT program approval.

**Acct 5500. Business, Government, and Economic Tax Policy.** (4 cr. Prereq—5135, MBT student) Modern macroeconomics and its effects on taxation and public finance including government expenditures. History of taxation and the institution and individuals affecting tax policy. Goals of an effective tax system and various proposed major tax reforms.

**Acct 8801. Empirical Research in Capital Markets.** (4 cr. Prereq—Business admin PhD student or #; offered alt yrs) Econometric studies of information contained in accounting numbers; volume and price reactions to accounting disclosure; earnings management; accounting based valuation; market microstructure.

**Acct 8802. Emerging Issues in Accounting.** (4 cr [max 8 cr]. Prereq–Business admin PhD student or #; offered alt yrs)  
Topics vary.

**Acct 8811. Information Economics I.** (4 cr. Prereq–Business admin PhD student or #; offered alt yrs) Asymmetric information, incentives, and contracts. Moral hazard, adverse selection, reputation, and signaling phenomena. Applications to accounting such as transfer pricing, budgeting, cost allocations, performance measurement, audit pricing.

**Acct 8812. Information Economics II.** (4 cr. Prereq–Business admin PhD student or #; offered alt yrs) Information in capital markets; asset pricing with asymmetric information; economics of disclosure and information acquisition.

**Acct 8821. Experimental Economics.** (4 cr. Prereq–Business admin PhD student or #; offered alt yrs) Auction markets; price formation in experimental asset markets; experimental studies of information transfer and capital market efficiency; experimental tests of strategic behavior, trust, and reciprocity.

**Acct 8822. Behavioral Research in Accounting.** (4 cr. Prereq–Business admin PhD student or #; offered alt yrs) Heuristics and biases in information processing, auditor judgment, mental accounting, and decision aids.

**Acct 8892. Readings in Accounting.** (1-8 cr [max 16 cr]. Prereq–Business admin PhD student or #) Readings appropriate to an individual student's program or objectives that are not available in regular courses.

**Acct 8894. Research in Accounting.** (1-8 cr [max 16 cr]. Prereq–Business admin PhD student or #) Individual research on an approved topic appropriate to student's program and objectives.

## Adult Education (AdEd)

*Department of Work, Community, and Family Education*

*College of Education and Human Development*

**AdEd 5001. Survey: Human Resource Development and Adult Education.** (3 cr)

Overview of fields of human resource development and adult education. Includes societal context, systems theory, processes, definitions, philosophies, goals, sponsoring agencies, professional roles, participants, and resources. Emphasis on the unique characteristics and ways the fields overlap and enhance one another.

**AdEd 5101. Strategies for Teaching Adults.** (3 cr; A-F only)

Psychological theories of adult learning; learning styles and personality types; teaching styles; group and team learning; moderating and study circles; teaching technologies and distance learning; gender, race, and cultural communication. Applications of strategies.

**AdEd 5102. Perspectives of Adult Learning and Development.** (3 cr)

Emphasis on major adult development theorists, theories, and current applications. Transformative learning, self-directed learning, experiential learning, and cooperative learning provide theoretical framework for exploring physiological, psychological, sociological, and cultural aspects of adult development through the life span.

**AdEd 5103. Designing the Adult Education Program.** (3 cr; A-F only)

Designing and implementing educational programs for adults. Application of concepts, theories, and models in different adult learning situations.

**AdEd 5196. Field Experience in Adult Education.** (3-6 cr [max 6 cr]; S-N only)

Supervised fieldwork and practice. Presentations and evaluations of adult education practices.

**AdEd 5201. Introduction to Adult Literacy.** (3 cr) Definitions of literacy: workplace, community and family. Issues: poverty, welfare, ethnicity, cultural diversity, social class, language and learning, immigrants. Review of literacy programs, funding, and professionalization. Reaching and recruiting undereducated adults. The role of the family and schools; community, state and local government. New social action approaches required for licensure.

**AdEd 5202. Assessment of Adult Literacy.** (3 cr) Assessment of adult literacy problems as they affect work, family and community. Setting educational goals; formal versus informal assessment; case studies; educational planning.

**AdEd 5203. Methods of Teaching Adult Literacy.** (3 cr) Approaches to teaching reading, writing, and mathematics to adults. Technology as a teaching tool. Teaching students with disabilities. Cultural and gender differences. English as a second language. Evaluation of commercial materials and software.

**AdEd 5301. Survey of Distance Education.** (3 cr) Survey of distance education concepts, theory, history, present practice, delivery systems, course design, major issues, and future directions.

**AdEd 5302. Continuing Education for Professionals.** (3 cr)

Analysis of philosophies, issues, policies, trends, professional needs and statutory requirements in continuing professional education programs. Role of the program director and organization.

**AdEd 5303. Working with Volunteers in Community Settings.** (3 cr)

Uses collaborative, experiential methods to address fundamental issues and practices in volunteer development. Explore personal philosophies, staffing, and key issues and trends in the administration of volunteer programs.

**AdEd 5611. Futurism in Human Resource Development and Adult Education.** (3 cr)

Implications of future developments in areas of theory/practice in human resource development and adult education.

**AdEd 5612. Managing and Consulting in Human Resource Development and Adult Education.** (3 cr. Prereq–5001W or HRD 5001W)

Theory of managing/consulting in human resource development and adult education. Assessment of role requirements. Experimentation with practical management/consultation processes/techniques.

**AdEd 5700. Special Topics in Adult Education.** (1-8 cr [max 12 cr])

Exploration of issues, methods, and knowledge in areas of adult education. Content varies.

**AdEd 8001. Advanced Theory in Human Resource Development and Adult Education.** (3 cr; A-F only. Prereq–5001 or HRD 5001)

Theoretical understanding of individuals and organizations as adaptive entities; roles of human resource development and adult education in mediating complex demands.

## Adult Psychiatry (AdPy)

*Department of Psychiatry  
Medical School*

**AdPy 5515. Neuropsychology: University Hospitals.** (3-9 cr)

**AdPy 8205. Special Assignments.** (1-16 cr)

**AdPy 8206. Research.** (1-16 cr)

**AdPy 8249. Clinical NeuroPsychoPharmacology.** (1-15 cr. Prereq–Resident status or 3rd- or 4th-yr med student or 8248 for grad students)

The course is designed for a two-day presentation, four hours one afternoon, followed by eight hours the next day, to include the following subject matter: introduction to neurotransmitter theory and

mechanism of action of psychotropic drugs; evaluation of anxiety states and use of anti-anxiety agents; clinical picture of depression, use of antidepressants, and principles of drug combinations; schizophrenia diagnosis, use of antipsychotic drugs, antiparkinson medication, parkinson side effects of neuroleptics, and tardive dyskinesia; clinical evaluation of epilepsy and use of anticonvulsants; neurophysiology of sleep, prescription of hypnotics and sedatives, and significance of over-the-counter sleep aids; use of anorexians, over-the-counter appetite suppressants, and opiate analgesics; geriatric psychopharmacology; classification of drug side effects and principles of drug interaction; abused drugs; and ethnopsychopharmacology.

**AdPy 8970. Directed Studies.** (1-24 cr)

## Aerospace Engineering and Mechanics (AEM)

*Department of Aerospace Engineering and Mechanics  
Institute of Technology*

**AEM 5401. Intermediate Dynamics.** (3 cr. Prereq–IT upper div or grad, 2012, Math 2243)

Three-dimensional Newtonian mechanics, kinematics of rigid bodies, dynamics of rigid bodies, generalized coordinates, holonomic constraints, Lagrange equations, applications.

**AEM 5501. Continuum Mechanics.** (3 cr. Prereq–IT upper div or grad, 3031, Math 2243 or equiv or #)

Concepts common to all continuous media; elements of tensor analysis; motion, deformation, vorticity; material derivatives; mass, continuity equation; balance of linear, angular momentum; geometric characterization of stress; constitutive equations.

**AEM 5503. Theory of Elasticity.** (3 cr; A-F only)

Prereq–4501 or equiv, Math 2263 or equiv or #) Introduction to the theory of elasticity, with emphasis on linear elasticity. Linear and nonlinear strain measures, boundary-value problem for linear elasticity, plane problems in linear elasticity, three dimensional problems in linear elasticity. Topics from nonlinear elasticity, micromechanics, contact problems, fracture mechanics.

**AEM 8000. Seminar: Aerospace Engineering and Mechanics.** (1 cr [max 4 cr]; S-N only. Prereq–DGS consent)

**AEM 8201. Fluid Mechanics I.** (3 cr. Prereq–4201 or equiv, Math 2263 or equiv)

Mathematical and physical principles governing the motion of fluids. Kinematic, dynamic, and thermodynamic properties of fluids; stress and deformation; equations of motion; analysis of rotational and irrotational inviscid incompressible flow; two-dimensional and three-dimensional potential flow.

**AEM 8202. Fluid Mechanics II.** (3 cr. Prereq–8201)

Analysis of incompressible viscous flow; creeping flow; boundary layer flow.

**AEM 8203. Fluid Mechanics III.** (3 cr. Prereq–8202)

Analysis of compressible flow and shock waves; method of characteristics for one-dimensional unsteady flow and for two-dimensional steady flow.

**AEM 8207. Hydrodynamic Stability.** (3 cr. Prereq–8201)

Theory of hydrodynamic stability. Stability of shear flows, rotating flows, boundary layer, two fluid flows, fingering flows, Rayleigh-Taylor instability, Kelvin-Helmholtz instability, capillary instability, convective/absolute stability. Methods of linear stability, normal modes, energy theory of stability, nonlinear perturbation, bifurcation theory, transition to turbulence.

**AEM 8211. Theory of Turbulence I.** (3 cr. Prereq–8202)

Reynolds equations, methods of averaging, elements of stability theory and vortex dynamics; description of large vortical structures in mixing layers and boundary layers; horseshoe vortices; flow visualization.

**AEM 8212. Theory of Turbulence II.** (3 cr. Prereq–8211) Prandtl’s mixing length theory applied to classical boundary layer, pipe, jet, and wake flows; prediction methods used at Stanford Conference; law of wall; law of wake; K-epsilon method.

**AEM 8213. Turbulent Shear Flows.** (3 cr; A-F only. Prereq–8201, 8202)

Equations of motion for turbulent flow. Isotropic/homogeneous turbulence. Free shear flows. Wall turbulence, elements of vortex dynamics.

**AEM 8221. Rheological Fluid Mechanics.** (3 cr. Prereq–8201 or 5501 or #)

Methods of solution for flows of simple fluids with general constitutive equations. Topics from viscometric flow, extensional flow, perturbations of the rest state with steady and unsteady flow, secondary flow.

**AEM 8231. Physical Gas Dynamics.** (3 cr. Prereq–4201 or equiv, 4203 or equiv, ME 3324 or equiv)

Molecular and chemical effects in gas flows. Use of collision theory to determine mean free path, velocity distributions; statistical mechanics; partition function; Maxwellian and Boltzmann distributions; nonequilibrium flows; applications in rarefied and hypersonic flows.

**AEM 8241. Perturbation Methods in Fluid Mechanics.** (3 cr. Prereq–8202 or #)

Method of matched asymptotic expansions presented through simple examples and applied to viscous flows at high and low Reynolds numbers and other problems in fluid mechanics and applied mathematics.

**AEM 8251. Finite-Volume Methods in Computational Fluid Dynamics.** (3 cr. Prereq–4201 or 8201 or equiv, CSci 1107 or equiv)

Development of finite-volume computational methods for solution of compressible Navier-Stokes equations. Accuracy, consistency, and stability of numerical methods; high-resolution upwind shock-capturing schemes; treatment of boundary conditions; explicit and implicit formulations; considerations for high performance computers; recent developments and advanced topics.

**AEM 8253. Computational Methods in Fluid Mechanics.** (3 cr; A-F only. Prereq–4201)

Spatial discretization. Spectral methods. Temporal discretization. Nonlinear sources of error. Incompressible Navier-Stokes equations. Compressible Navier-Stokes equations.

**AEM 8261. Nonlinear Waves in Mechanics.** (3 cr. Prereq–5501 or #)

Theory of kinematic, hyperbolic, and dispersive waves, with application to traffic flow, gas dynamics, and water waves.

**AEM 8271. Experimental Methods in Fluid Mechanics.** (3 cr. Prereq–4201, #)

Overview of computer organization, including external communications and A/D, D/A conversion. Measurement techniques, such as pressure measurements and hot-wire and laser Doppler anemometry. Signal processing and uncertainty; computer control of experiments.

**AEM 8295. Selected Topics in Fluid Mechanics.** (1–4 cr [max 8 cr]. Prereq–Δ)

Includes individual student projects completed under guidance of a faculty sponsor.

**AEM 8333. FTE: Master’s.** (1 cr; NGA. Prereq–Master’s student, adviser and DGS consent)

**AEM 8400. Seminar: Dynamical Systems and Controls.** (1 cr [max 4 cr]; S-N only)

Developing program of research in dynamical systems/controls. Discussions of current research/topics of interest.

**AEM 8401. Modern Feedback Control.** (3 cr. Prereq–4311 or #)

State space theory for multiple-input-multiple-output (MIMO) aerospace systems. Singular value decomposition (SVD) technique and its applications to performance and robustness. Linear quadratic gaussian (LQG) and eigenstructure assignment design methodologies. Topics in H $\infty$ . Applications.

**AEM 8411. Advanced Dynamics.** (3 cr. Prereq–5401 or equiv or #)

Lagrange’s equations; calculus of variations and Lagrange multipliers, kinematics and dynamics of rigid bodies, and Hamilton’s principle; applications to discrete and continuous systems.

**AEM 8412. Nonlinear Systems.** (3 cr. Prereq–8411)

Introduction to nonlinear dynamical systems. Method of averaging and its applications; Liapunov stability, center manifold, and normal form theories; bifurcation analysis; introduction to chaotic phenomena.

**AEM 8413. Advanced Nonlinear Systems.** (3 cr. Prereq–8412 or #)

Dynamical systems with emphasis on higher dimensional (more than three) systems and global and chaotic phenomena. Bifurcation analysis with codimension greater than one, Melnikov method, and Silnikov phenomena. Concepts of symmetry. Application to problems modeled by partial differential equations.

**AEM 8421. Robust Multivariable Control Design.** (3 cr. Prereq–8411 or equiv)

Application of robust control theory to aerospace systems. Role of model uncertainty/modeling errors in design process. Control analysis and synthesis, including H $_2$  and H $\infty$  optimal control design and structural singular value  $\mu$  techniques.

**AEM 8426. Optimization and System Sciences.** (3 cr; A-F only. Prereq–8401, IT grad student)

Applications of modern finite dimensional optimization techniques in system/control theory. Linear/nonlinear programming, duality, complexity theory, interior point methods, matrix inequalities, convex optimization over cones, bilinear matrix inequalities, rank-constrained problems.

**AEM 8431. Trajectory Optimization.** (3 cr. Prereq–4311 or equiv or #)

Parameter optimization problems. Topics in calculus of variations; necessary conditions of nonlinear optimal control problems; classification of trajectory optimization algorithms; steady-state aircraft flight; minimum-time climb aircraft trajectory; aero-assisted orbital transfer trajectories; optimal space trajectories.

**AEM 8444. FTE: Doctoral.** (1 cr; NGA. Prereq–Doctoral student, adviser and DGS consent)

**AEM 8495. Selected Topics in Dynamical Systems and Controls.** (1–4 cr [max 8 cr]. Prereq–Δ)

Includes individual student projects completed under guidance of a faculty sponsor.

**AEM 8500. Research Seminar in Mechanics of Materials.** (1–3 cr [max 12 cr]; A-F only. Prereq–#)

Seminars given by students, faculty, and visitors on topics drawn from current research.

**AEM 8511. Advanced Topics in Continuum**

**Mechanics.** (3 cr [max 6 cr]; A-F only. Prereq–5501 or #) Constitutive equations; invariance and thermodynamic restrictions. Nonlinear elasticity theory; exact solutions, minimization, stability. Non-Newtonian fluids; viscometric flows, viscometric functions, normal stress. Other topics may include reactive and/or nonreactive mixtures, nonlinear plasticity, and deformable electromagnetic continua.

**AEM 8521. Advanced Topics in Elasticity.** (3 cr; A-F only. Prereq–5503)

Contact stresses, finite deformations, and other topics.

**AEM 8523. Elastodynamics.** (3 cr; A-F only. Prereq–4581 or 5501 or #)

Waves and vibrations in rods, beams, and plates; dispersion; volume and surface waves; reflection; energy theorems; vibrations of bounded media and relation to technical theories; elements of nonlinear waves, inelastic waves, and stability of motion of elastic systems.

**AEM 8531. Fracture Mechanics.** (3 cr; A-F only. Prereq–5503 or #)

Theories of mechanical breakdown. Kinetic rate theories and instability considerations; formation of equilibrium cracks and circular crack propagation

under pulses; statistical aspects of strength and fracture of micromolecular systems; time and temperature dependency in fracture problems and instability of compressed material systems.

**AEM 8533. Theory of Plasticity.** (3 cr. Prereq–5203 or #)

Theory of permanent deformation of ductile metals; bi-linear material models, Drucker’s three bar truss, and other examples; 3-D continuum formulation, yield surfaces, hardening rules, and material stability; slip line theory, Prandtl punch solution; single crystal plasticity.

**AEM 8541. Mechanics of Crystalline Solids.** (3 cr. Prereq–5501 or #)

Atomic theory of crystals and origins of stress in crystals. Relation between atomic and continuum description; phase transformations and analysis of microstructure; effects of shear stress, pressure, temperature, electromagnetic fields, and composition on transformation temperatures and microstructure; interfacial energy in solids.

**AEM 8595. Selected Topics in Mechanics and Materials.** (1–4 cr [max 8 cr]. Prereq–Δ)

Includes individual student projects completed under guidance of a faculty sponsor.

**AEM 8601. Finite Element Methods in Computational Mechanics.** (3 cr. Prereq–Δ)

Fundamental concepts and techniques of finite element analysis. Variational equations and Galerkin’s method; weak formulations for problems with nonsymmetric differential operators; Petrov-Galerkin methods; examples from solid and fluid mechanics; properties of standard finite element families, implementation.

**AEM 8602. Finite Element Methods in Computational Fluid Mechanics.** (3 cr. Prereq–8601)

Finite element methods for time-dependent problems. Stability, convergence, and accuracy concepts; analysis and applications of Petrov-Galerkin formulations for convection-diffusion equations; incompressible Navier-Stokes equations; vorticity-stream function formulation and velocity-pressure formulation; hyperbolic systems, compressible Euler equations.

**AEM 8666. Doctoral Pre-Thesis Credits.** (1–18 cr [max 60 cr]; NGA. Prereq–Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**AEM 8777. Thesis Credits: Master’s.** (1–18 cr [max 50 cr]; NGA. Prereq–Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**AEM 8880. Plan B Project.** (1–3 cr [max 3 cr]. Prereq–Grad aerospace engineering or mechanics major, Δ)

Satisfies project requirement for Plan B Master’s degree. May appear on M.S. program but does not count toward 20-credit minimum in the major field. Topic arranged by student and adviser; written report required.

**AEM 8888. Thesis Credits: Doctoral.** (1–24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer; 24 cr required)

## African American and African Studies (Afro)

*Department of African American and African Studies*

*College of Liberal Arts*

**Afro 5072. Racism: Social and Psychological Consequences for Black Americans.** (3 cr)

Racism and its effects on African Americans; definitions, determinants, and dynamics. Examined in an experiential context to reflect individual and institutional racism.

**Afro 5101. Seminar: Studies in Africa and the African Diaspora.** (3 cr)

Comparatist frameworks, related theories, and pivotal texts in study of Africa and African Diaspora.

**Afro 5143. Geography of West Africa.** (3 cr)  
West Africa from Senegal to Cameroon. Social geography of resource use, population, settlement, economic development, and international relations.

**Afro 5145. Development in Africa.** (3 cr)  
Economic, political, and social development in Africa from independence to the present, emphasizing the reordering of colonial landscapes, bases for North-South relations, big power interventions, and participation in the world economy.

**Afro 5181. Blacks in American Theater.** (3 cr)  
Historical survey of significant events in the development of American black theater traditions. Essays, plays, playwrights, and theaters from early colonial references to the Black Arts Movement.

**Afro 5182. Contemporary Black Theater: 1960 to Present.** (3 cr)  
Essays, plays, playwrights, and theaters that have contributed significantly to contemporary black theater. From the beginning of the Black Arts movement to the present.

**Afro 5191. Seminar: The African American Experience in South Africa.** (3 cr. \$Hist 5438)  
Ideological, political, religious, and cultural ties that have informed African American and black South African relations from late 18th century to present.

**Afro 5301. The African Novel.** (3 cr. Prereq-Grad or #)  
The novel in contemporary Africa in English, French and African languages. Non-English language works in translation.

**Afro 5352. Black Families in Comparative Perspective.** (3 cr)  
Cross-cultural perspectives of family formation, social structure, and gender patterns of families of African descent.

**Afro 5401. Field Studies in African American and African Studies.** (1-6 cr. Prereq-[[African American or African Studies] major or minor], #)  
Supervised field study/internship focused on African American or African culture(s), language(s), and development.

**Afro 5405. The African American Child.** (3 cr. \$3405)  
Research carried out by African American psychologists and behavioral/social scientists, and by experts on African American child/youth development.

**Afro 5551. Methods: Use of Oral Traditions as Resources for History.** (3 cr)  
Use of spoken information through time as a source for writing history. Use of canons of history to analyze and critique oral traditions and integrate them into written history.

**Afro 5593. The African American Novel.** (3 cr)  
Contextual readings of 19th- and 20th-century black novelists, including Chesnut, Hurston, Wright, Baldwin, Petry, Morrison, and Reed.

**Afro 5597. Seminar: Harlem Renaissance.** (3 cr)  
A multidisciplinary review of the Jazz Age's Harlem Renaissance: literature, popular culture, visual arts, political journalism, and major black and white figures.

**Afro 5598. Seminar: Black Arts Renaissance, 1960s and 1970s.** (3 cr)  
Multidisciplinary perspectives on the 1960s and 1970s Black Power "renaissance" of African American art and politics.

**Afro 5655. African American Cinema.** (3 cr)  
Exploration of African American cinematic achievements, from the silent films of Oscar Micheaux through contemporary Hollywood and independent films, using class screenings and critical readings.

**Afro 5701. Proseminar: Classic Works in African American Studies.** (3 cr)  
Classic works in African American studies. Conceptual frameworks. Multidisciplinary focus.

**Afro 5702. Proseminar: Major Figures in African American Studies.** (3 cr)  
Major figures from various fields in African American studies. Bio-critical focus.

**Afro 5741. Minorities and the Mass Media.** (3 cr; A-F only. Prereq-Jour major or minor, Jour 3004, Δ)  
Analysis of relationships between mass media and communities of color in the United States. Focuses on issues of content and control.

**Afro 5756. Social History of Blacks in Sports.** (3 cr)  
Social/cultural contexts surrounding eras of athletes such as Jack Johnson, Jackie Robinson, Joe Louis, Jesse Owens, Althea Gibson, Wilma Rudolph, Muhammad Ali, Michael Jordan, and Tiger Woods. Impact of these athletes on national/international events. Periods when it was not uncommon for black entertainers/athletes to become involved in politics and community activism.

**Afro 5864. Proseminar: African-American History.** (3-4 cr. Prereq-#)  
Examination of issues including slavery, Reconstruction, the Great Depression, and civil rights movement using cultural and intellectual history and autobiography/biography. Focuses on dynamics of race, gender, class, region, sexuality, and religion.

**Afro 5865. Proseminar: African-American History.** (3-4 cr. Prereq-#)  
Construction of a detailed research agenda, locating appropriate depositories of primary materials and secondary sources, and developing appropriate methodologies and frameworks.

**Afro 5876. Proseminar: Approaches to African Development.** (3 cr)  
Study, critical analysis, and comparison of primary documents relevant to African development.

**Afro 5910. Topics in African American and African Studies.** (1-3 cr [max 9 cr])  
Topics specified in *Class Schedule*.

**Afro 5993. Directed Study.** (1-3 cr. Prereq-#)  
Guided individual reading/study for qualified seniors and graduate students.

**Afro 8202. Seminar: Intellectual History of Race.** (3 cr)  
Shifting and contested meanings of "race" from the "Age of Conquest" to the present. Starting from the proposition that race is not a fixed or stable category of social thought or being, the seminar seeks to ascertain how and why Western ideas about race have changed.

**Afro 8554. Seminar: Gender, Race, Nation, and Policy—Perspectives from Within the African Diaspora.** (3 cr. Prereq-#)  
Interdisciplinary analysis of U.S. domestic and foreign policies as they affect Africans and peoples of African descent in the diaspora. Intersections of gender, race, nation, and class.

**Afro 8590. Figures in Contemporary Black Fiction.** (3 cr [max 9 cr])  
Each term focuses on works of an individual writer, such as Toni Morrison, Paule Marshall, and Jamaica Kincaid. Critical studies.

**Afro 8802. Seminar: Orientalism.** (3 cr)  
Recent arguments related to Orientalism as a trend in modern literary and cultural criticism.

**Afro 8910. Topics in Studies of Africa and the African Diaspora.** (3 cr [max 9 cr])  
Topics specified in *Class Schedule*.

## Agricultural, Food, and Environmental Education (AFEE)

*Department of Work, Community, and Family Education*

*College of Education and Human Development*

**AFEE 5111W. Agricultural Education: Methods of Teaching.** (4 cr)  
Use of teaching resources; principles of teaching and learning; problem-solving techniques, lesson plan construction for large group, small group and individual investigations; student management; and assessment.

**AFEE 5112. Agricultural Education Program Organization and Curriculum for Youth.** (3 cr)  
Development of community school program in agriculture, agribusiness, and environmental science. Program to meet graduation outcomes and determine student needs.

**AFEE 5113. Adult Agricultural Education Program Development and Technology.** (3 cr; A-F only)  
Organization and implementation of education programs for farmers, farm managers, and agribusiness personnel using community and environmental resources, agricultural and instructional technology, and management information systems to attain family and business goals.

**AFEE 5114. Agricultural Education Teaching Seminar.** (1 cr)  
Reflective learning on teacher preparation experience; identify issues and problems facing the discipline; needs for continual preparation and program adjustment.

**AFEE 5116. Coordination of SAE Programs: Work-based Learning.** (2 cr; A-F only. Prereq-Agricultural education major or #)  
Principles/techniques for coordinating work-based learning. Supervised agricultural experience in agricultural education. Historical/philosophical roots of experiential learning, integration with classroom instruction, legal aspects, record keeping, coordination techniques, current agreement laws.

**AFEE 5118. Strategies for Managing and Advising the FFA Organization.** (2 cr; A-F only. Prereq-Agricultural education major or #)  
Principles/techniques to advise an FFA chapter. Historical/philosophical basis of FFA, organization/structure. Integration with classroom instruction, public relations, recruitment, and administration of FFA chapters.

**AFEE 5220. Special Topics in Agriculture Education and Extension.** (1-3 cr [max 12 cr])  
Content varies by offering.

**AFEE 5231. Agricultural Education Curriculum K-12.** (2 cr; A-F only)  
Philosophy, organization, and administration of instruction in agricultural education programs at the elementary, middle, and high school levels.

**AFEE 5233. Advanced Procedures in Teaching Agricultural Education.** (2 cr; A-F only)  
New developments in methodology; assessment of innovations and procedures; consideration of various levels of instruction.

**AFEE 5235. Advanced Supervised Agricultural Experience Programs.** (2 cr)  
The organization and administration of agricultural experience programs for middle and secondary level students: career exploration, improvement projects, experiments, placement in production/business/community settings, entrepreneurship. Current state and national programs and resource material.

**AFEE 5237. Mentorship for Supervising Agricultural Education Teachers.** (2 cr)  
Professional development training for experienced teachers to serve as mentors for beginning and student teachers of agricultural education. Emphasis on supervision and assessment of teaching performance. Focus on critical period of induction into the teaching profession.

**AFEE 5239. Program Organization and Management in Agricultural Education.** (2 cr)  
Analysis of organization, management, and assessment of agricultural education programs at the middle, high school, and adult levels.

**AFEE 5280. Current Issues for the Beginning Agricultural Education Teacher.** (1-3 cr [max 3 cr])  
Reflection, analysis on current problems and issues confronting beginning teachers of agricultural education. Issues in teaching methods, classroom and program management, discipline, curriculum, FFA and SAE development, school-to-work relationships.

**AFEE 5290. Seminar: Current Issues in Agricultural Education and Extension.** (1-3 cr [max 6 cr])  
Exploration of current issues in agricultural education and extension, strategies of response, implications of response actions, and related leadership roles.

**AFEE 5296. Professional Experience Practicum in Agricultural Education and Extension.** (1-4 cr)  
Observation, study, and experience in agricultural business and industry; identification of educational problems observed in the agricultural industry; evaluation of personal experience.

**AFEE 5331. History, Philosophy, and Systems of Extension.** (3 cr; A-F only)  
History and philosophy of extension; modification and adaptation to worldwide methods and approved practices; extension methodologies; innovative approaches; systems appropriate to development environments.

**AFEE 5341. Global Program Delivery Techniques and Technology of Extension.** (2 cr; A-F only)  
Educational activities, teaching, and communications methods and techniques, from outreach to extension services, with an emphasis on youth and adult education programs in different global settings.

**AFEE 5351. Methods for Change in Developing Countries.** (3 cr; A-F only)  
Strategies and methodologies promoting change in developing countries. Examination of sociological and cultural parameters of improved practices in rural, community, and agricultural development. Project planning, implementation, and evaluation related to change in developing countries.

**AFEE 5361. World Development Problems.** (3 cr; A-F only)  
Introduction to development problems throughout the world. Development in Third World countries. Examples of First World development problems. Interdisciplinary focus on population, health and disease, education, agriculture, industry, finance, politics, and human rights.

**AFEE 5371. Farming Systems Research and Extension.** (3 cr; A-F only)  
Introduction to the theory and practice of linking farming systems, research, and extension. An interdisciplinary and holistic approach to rural development for individuals and communities throughout the world.

**AFEE 5405. Advanced Farm Financial Analysis Methodology and Concepts.** (1 cr)  
Farm financial analysis concepts, whole entity financial analysis issues/tools, enterprise analysis options/methodologies. Evaluation of industry standardization efforts. Analysis of where each option fits.

**AFEE 5407. Application of Advanced Farm Financial Analysis Tools and Methods.** (1 cr)  
Use of advanced farm financial analysis tools/methodology to analyze financial performance of actual farm businesses. Case farms are used to apply whole entity financial analysis tools/concepts and enterprise analysis methodologies.

**AFEE 5993. Directed Study in Agricultural Education and Extension.** (1-9 cr)  
Topics may be chosen to permit study of areas within education or to supplement areas of inquiry not provided in the regular course structure.

**AFEE 5995. Integrating Paper—Master of Education: Agricultural and Extension Education.** (1-4 cr; A-F only)  
Students prepare paper dealing with issues in agricultural education applied to professional responsibilities.

**AFEE 8090. Seminar: Agricultural Education and Extension.** (1-3 cr [max 6 cr]. Prereq—Ag ed grad student)  
Topics on various aspects of agricultural education. Prepare, present, and critique a report.

**AFEE 8094. Research in Agricultural Education and Extension.** (1-6 cr [max 6 cr]; A-F only. Prereq—Ag ed student doing Plan B research, Δ)  
Select problems, prepare bibliographies, analyze and interpret data, and prepare manuscripts on studies.

## Agricultural Engineering Technology (AgET)

*Department of Biosystems and Agricultural Engineering*  
*College of Agricultural, Food and Environmental Sciences*

**AgET 5095. Special Problems in Biosystems and Agricultural Engineering.** (1-5 cr. Prereq—#)  
Individual study project in biosystems and agricultural engineering at advanced level. Application of engineering principles to a specific problem.

**AgET 5203. Environmental Impacts of Food Production.** (3 cr)  
Topics include crop production intensity, animal raising options, food processing waste alternatives, and pest control.

**AgET 5212. Safety and Environmental Health Issues in Plant and Animal Production and Processing.** (3 cr; A-F only. Prereq—Grad student or [jr or sr] in [COAFES or IT or education or public health or nursing])  
Safety/health issues in food production, processing and horticultural work environments using public health, injury control, and health promotion frameworks: regulation, engineering, education. Traumatic injury, occupational illness, ergonomics, pesticide health effects, biotechnology, air contaminants.

**AgET 5999. Special Workshop in Biosystems and Agricultural Engineering.** (1-4 cr. Prereq—#)  
Workshops on a variety of biosystems and agricultural engineering topics offered at locations other than the Twin Cities campus. See *Class Schedule* or department for current offerings.

## Agronomy and Plant Genetics (Agro)

*Department of Agronomy and Plant Genetics*  
*College of Agricultural, Food and Environmental Sciences*

**Agro 5021. Introduction to Plant Breeding.** (3 cr. Prereq—[GCB 3022 or equiv], background in plant science)  
For majors not specializing in plant breeding. How genetics is applied to plant improvement. Emphasizes sustainable-production scenarios.

**Agro 5121. Applied Experimental Design.** (4 cr. Prereq—Stat 5021 or equiv or #)  
Principles of sampling methodologies, experimental design, and statistical analyses. Methods/procedures in generating scientific hypotheses. Organizing, initiating, conducting, and analyzing scientific experiments using experimental designs and statistical procedures.

**Agro 5311. Research Methods in Crop Improvement and Production.** (1 cr; S-N only. Prereq—Applied plant sciences grad)  
Demonstrations and discussions of techniques in crop improvement and/or production research. Presentations integrate biotechnology with traditional breeding methods; production sessions emphasize ecologically sound cropping systems.

**Agro 5321. Ecology of Agricultural Systems.** (3 cr; A-F only. \$Ent 5321. Prereq—[3xxx or above] course in [Agro or AnSc or Ent or Hort or PIPa or Soil] or #)  
Ecological approach to problems in agricultural systems. Formal methodologies of systems inquiry are developed/applied.

**Agro 5999. Special Topics: Workshop in Agronomy.** (1-6 cr [max 6 cr]. Prereq—Jr or sr or grad student)  
Workshops on various topics in agronomy and plant genetics. Presenters/faculty may include guest lecturers/experts. Topics specified in *Class Schedule*.

**Agro 8005. Supervised Classroom or Extension Teaching Experience.** (2 cr; S-N only. Prereq—#)  
Classroom or extension teaching experience in one of the following departments: Agronomy and Plant Genetics; Biosystems and Agricultural Engineering; Horticultural Science; Plant Pathology; or Soil, Water, and Climate. Participation in discussions about effective teaching to strengthen skills and develop personal teaching philosophy.

**Agro 8201. Plant Breeding Principles I.** (3 cr; A-F only. Prereq—Stat 5301 or equiv)  
Principles and current methods involved in breeding agronomic and horticultural crops. Use of genotype/environment data to increase genetic gain, population improvement, parent building, alternative selection strategies, breeding for special traits, and new approaches.

**Agro 8202. Plant Breeding Principles II.** (4 cr. Prereq—8201, Stat 5301, EEB 5033 or #)  
Breeding principles and methods; population concepts, constructing source populations, and varietal development. Use of quantitative genetics in decision making in plant breeding, emphasizing covariance of relatives, genotype by environment interactions, stability analysis, statistical methods of analysis, selection theory and application.

**Agro 8231. Cytogenetics.** (4 cr. Prereq—GCB 5034 or #)  
Genetic principles in relation to the eukaryotic chromosome. Molecular cytogenetics of chromosome structure, replication, pairing, and crossing over. Behavior of deficiencies, duplications, inversions, interchanges. Aneuploidy, autopolyploidy, allopolyploidy, and uses of cytogenetic stocks in molecular and classical genetics and plant breeding.

**Agro 8241. Molecular and Cellular Genetics of Plant Improvement.** (3 cr. Prereq—GCB 5034 or equiv or #)  
Principles of genetic modification of higher plants by application of molecular and cellular biotechnology

approaches. Gene isolation and transfer, tissue culture manipulations, organelle genetics, molecular markers and mapping, and discussions and lab demonstrations of current research on genetic mechanisms related to crop improvement.

**Agro 8270. Graduate Seminar.** (1 cr; A-F only. Prereq—Grad major in [applied plant sci or agro or ent or hort or plnt brdg or plnt path or soil] or #) Reports/discussions of problems and investigational work.

**Agro 8280. Current Topics in Applied Plant Sciences.** (1 cr; S-N only. Prereq—Grad major in agro or applied plant sciences or ent or hort or plnt brdg or plnt path or soil or #) Topics presented by faculty or visiting scientists.

**Agro 8305. Physiological Ecology of Plants in Natural and Managed Ecosystems.** (4 cr; A-F only. Prereq—BioC 3021, [Biol 1001 or Biol 1002], Biol 1009) Introduction to plants and their reactions and responses in managed and natural ecosystems, including carbon and nitrogen allocation, root biology, microbial interaction, secondary metabolism, and plant response to biotic and abiotic stress.

**Agro 8505. Advanced Perspectives in Weed Science.** (2 cr; A-F only. Prereq—Grad major in agro or applied plant sciences or ent or hort or plnt brdg or plnt path or soil or #) Topics concerning the biochemistry and sustainability of chemical and biological weed control methods. Lecture and student-directed discussion.

**Agro 8605. Advanced Management of Agroecosystems.** (3 cr. Prereq—4605 or #) Problem-based learning approach to developing a holistic approach to agroecosystem-based crop management. Field trips combined with classroom discussion and decision-focused case studies. Students conduct research and develop a decision case.

**Agro 8900. Advanced Discussions.** (1-3 cr [max 12 cr]; S-N only. Prereq—#) Special workshops or courses in applied plant sciences.

## Akkadian (Akka)

*Department of Classical and Near Eastern Studies*  
*College of Liberal Arts*

**Akka 5011. Elementary Akkadian I.** (3 cr. Prereq—Adv undergrads with # or grads) Introduction to cuneiform script. Basics of Old Babylonian morphology and syntax. Written drills, readings from Hammurabi laws, foundation inscriptions, annals, religious and epic literature.

**Akka 5012. Elementary Akkadian II.** (3 cr. Prereq—5011) Continuation of 5011. Readings include The Gilgamesh Epic, The Descent of Ishtar, Mari Letters, Annals of Sennacherib and Essarhaddon, Sargon II.

**Akka 5300. Readings in Akkadian.** (3 cr [max 18 cr]. Prereq—5011, 5022) Survey of Akkadian literature, including literary, legal, historiographical, and sacred texts. Topics specified in *Class Schedule*.

## American Indian Studies (AmIn)

*Department of American Indian Studies*  
*College of Liberal Arts*

**AmIn 5107. The Structure of Anishinaabemowin, the Ojibwe Language.** (3 cr; A-F only. Prereq—3104) Analysis of grammatical structures of Anishinaabemowin.

**AmIn 5108. History of Anishinaabemowin, the Ojibwe Language.** (3 cr; A-F only. Prereq—3107 or #) Historical development of Anishinaabemowin.

**AmIn 5109. Literature of Anishinaabe, the Ojibwe Language.** (3 cr; A-F only. Prereq—3107 or 5107 or #) Readings in Anishinaabe oral literature.

**AmIn 5141. American Indian Language Planning.** (3 cr; A-F only. Prereq—3103 or 3123 or #) Planning for maintenance/revitalization of North American indigenous languages. Condition/status of languages. Documentation, cultivation, literacy, education.

**AmIn 5303. American Indians and Photography.** (3 cr) Historical/comparative overview of photos in which American Indian people are central subjects. Primary features of images in American Indian photos. Relationships among those involved in making/viewing photos. Ways in which photos are interpreted. Relation of photos to social contexts in which they are produced and to agencies of those who stand behind their making.

**AmIn 5890. Problems in American Indian History.** (3 cr. Prereq—#) Intensive consideration of topics in American Indian history. Possible topics include social history, Indian history of particular regions, political systems, education, and American Indian policy.

**AmIn 5920. Topics in American Indian Studies.** (2-4 cr [max 4 cr]; A-F only) Intensive examination of a particular topic (e.g., American Indian education, American Indians of the Great Lakes, American Indians of the Southwest, American Indians and the Federal government).

## American Sign Language (ASL)

*Department of Educational Psychology*  
*College of Education and Human Development*

**ASL 5642. Classroom Communication Through ASL.** (1-2 cr [max 5 cr]; S-N only. Prereq—Fluency in ASL, #) American Sign Language (ASL) form/function, vocabulary production, grammatical features needed by professionals working with children, storytelling strategies, technical sign language for classroom teachers. Content progresses in repeated segments.

## American Studies (AmSt)

*Department of American Studies*  
*College of Liberal Arts*

**AmSt 5101. Religion and American Culture.** (3 cr; A-F only) Role of religion in shaping contemporary American cultural pluralism. Institutions and processes, intellectual frameworks, aesthetic and symbol systems that form religious communities and contribute to religious conflicts in U.S. society and culture.

**AmSt 5202. Thought and Practice of American Religions.** (4 cr. Prereq—#) Holidays, festivals, religious arts, organizations, spirituality, ethics, and systems of thought of “civil religion,” “women’s religion,” indigenous American religions, American versions of Christianity, Judaism, Islam, Buddhism, and other world faiths, and their interactions in the United States and worldwide.

**AmSt 5920. Topics in American Studies.** (1-4 cr [max 9 cr]) Topics specified in *Class Schedule*.

**AmSt 8201. Historical Foundations of American Studies.** (3 cr. Prereq—Grad AmSt major) Exposition of American studies as a field of inquiry, including its history, major theoretical framework, and interdisciplinary methodologies.

**AmSt 8202. Theoretical Foundations and Current Practice in American Studies.** (3 cr; A-F only. Prereq—Grad AmSt major or # or Δ) Analysis of central theoretical work in the field and survey of key methodologies.

**AmSt 8239. Gender, Race, Class, Ethnicity, and Sexuality in the United States: Research Strategies.** (3 cr; A-F only) Social, cultural, and artistic modes of self-expression. Intellectual analysis of people in the United States identified as female or male or as members of groups defined by race, ethnicity, class, or sexual orientation.

**AmSt 8240. Gender, Race, Class, Ethnicity, and Sexuality in the United States: Topical Development.** (3 cr [max 9 cr]; A-F only. Prereq—#) Social, cultural, and artistic modes of self-expression and intellectual analysis of people in the United States identified as female or male and/or as members of group defined by race, ethnicity, class, or sexual orientation.

**AmSt 8249. Popular Culture: Research Strategies.** (3 cr; A-F only. Prereq—#) Study of the popular arts in their political and social context. Focuses on issues of race, gender, class, and nationalism.

**AmSt 8250. Popular Culture: Topical Development.** (3 cr [max 9 cr]; A-F only. Prereq—#) Study of the popular arts in their political and social context. Focuses on issues of race, gender, class, and nationalism.

**AmSt 8259. Literature, History, and Culture: Research Strategies.** (3 cr. Prereq—#) Interdisciplinary study of connections between literary expression and history, particularly as they articulate themes in American culture.

**AmSt 8260. Literature, History, and Culture: Topical Development.** (3 cr. Prereq—#) Interdisciplinary study of connections between literary expression and history, particularly as they articulate themes in American culture.

**AmSt 8333. FTE: Master’s.** (1 cr; NGA. Prereq—Master’s student, adviser and DGS consent)

**AmSt 8401. Practicum in American Studies.** (3 cr; A-F only. Prereq—#) Training in teaching undergraduate courses in American studies.

**AmSt 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**AmSt 8520. Seminar: American Art and Material Culture.** (3 cr [max 12 cr]. Prereq—#) Selected topics in American art, popular art, and material culture, with emphasis on methods and techniques of inquiry: creation and use of archives, oral history, sources for pictorial evidence, and current approaches to interpreting both traditional and non-traditional data.

**AmSt 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**AmSt 8777. Thesis Credits: Master’s.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**AmSt 8801. Dissertation Seminar.** (3 cr; S-N only. Prereq—AmSt doctoral student beginning dissertation work) Conceptualizing the research problem for the dissertation and structuring the process of writing a chapter of it.

**AmSt 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

**AmSt 8920. Topics in American Studies.** (3 cr [max 9 cr]; A-F only) Topics specified in *Class Schedule*.

**AmSt 8970. Independent Study in American Studies.** (1-9 cr [max 9 cr]. Prereq-#, Δ)  
Independent study of interdisciplinary aspects of American civilization under guidance of faculty members of various departments.

## Ancient Near Eastern (ANE)

*Department of Classical and Near Eastern Studies  
College of Liberal Arts*

**ANE 5501. Ancient Israel: The Origins of Israel in Biblical Traditions.** (3 cr. Prereq-Knowledge of Hebrew not required)

The foundation of the Hebrew people; traditions of the patriarchal period, development of Israelite religious and legal institutions; Ancient Near Eastern context of Israel's origins.

**ANE 5502. Ancient Israel: From Conquest to Exile.** (3 cr. \$3502, \$ReIA 3502, \$ReIA5502. Prereq-Hebrew not required; 5501 recommended)

Israelite history in context of what is known from Egyptian, Canaanite, and Mesopotamian sources. Focus on issues raised by archaeological data related to Israelite conquest of Canaan.

**ANE 5503. History and Development of Israelite Religion I.** (3 cr)

Survey of the evolution of Israelite religion. Cultic practices, law and religion, prophecy, religion, and historiography. Relationship to surrounding religious systems. Knowledge of Hebrew not required.

**ANE 5504. History and Development of Israelite Religion II.** (3 cr)

Ancient Judaism from the Persian restoration (520 B.C.E.) to Roman times (2nd century C.E.). Religious, cultural, and historical developments are examined to understand Jewish life, work, and worship under a succession of foreign empires: Persian, Greek, and Roman.

**ANE 5701. Studies in Semitic Linguistics and Inscriptions.** (3 cr. Prereq-Adv Hebrew or Adv Arabic or #)

Survey of comparative Semitic linguistics with emphasis on Northwest Semitic. Reading of Phoenician, Moabite, and Judean inscriptions.

**ANE 5713. Introduction to Ugaritic.** (3 cr. Prereq-Adv Hebrew, previous study of biblical texts or #)

Ugaritic alphabetic cuneiform script, morphology, and syntax. Reading of representative samples of Ugaritic literature. Attention to linguistic and cultural issues and links to biblical and other Ancient Near Eastern texts.

**ANE 5993. Directed Studies.** (1-4 cr. Prereq-#, Δ, □)

Guided individual reading or study.

## Anesthesiology (Anes)

*Department of Anesthesiology  
Medical School*

**Anes 5587. Advanced Clinical Physiology I for Nurse Anesthetists.** (3 cr [max 3 cr]; A-F only)

Cellular mechanisms underlying systems physiology. Cellular physiology, physiology of excitable tissues, renal physiology, cardiovascular physiology, hemostasis.

**Anes 5588. Advanced Clinical Physiology II for Nurse Anesthetists.** (3 cr [max 3 cr]; A-F only. Prereq-5587)

Respiratory physiology, acid-base physiology, gastrointestinal physiology, metabolism, endocrinology, reproductive physiology, physiology of pregnancy/labor.

**Anes 5686. Chemistry and Physics for Nurse**

**Anesthetists.** (3 cr; A-F only. Prereq-General chemistry or #)

Chemical equilibrium, organic chemistry, physics of fluids/gases, anesthetic applications.

**Anes 8265. General Anesthesia.** (8 cr)

**Anes 8266. Regional Anesthesia.** (3 cr)

**Anes 8267. Pre and Postanesthetic Evaluation.** (1 cr)

**Anes 8268. Seminar.** (1 cr)

**Anes 8269. Research in Anesthesia.** (1 cr)

**AnSc 5099. Special Workshop in Animal Science.**

(1-6 cr [max 12 cr]; A-F only. Prereq-#)  
Topics vary. See *Class Schedule* or department. Topics may use guest lectures/experts.

## Animal Science (AnSc)

*Department of Animal Science  
College of Agricultural, Food and Environmental Sciences*

**AnSc 5200. Statistical Genetics and Genomics.** (4 cr. Prereq-[Stat 3021 or equiv], [Biol 4003 or equiv])

Linkage analysis for pedigree data with codominant/dominant markers, using allele transmission, maximum likelihood, and disequilibrium. Analysis for radiation hybrid mapping. Parentage testing, marker polymorphism. Experimental design and statistical analysis for mapping quantitative trait loci with additive, dominance, and epistasis effects. Candidate gene approach and genome scan. Marker assisted selection, gene introgression.

**AnSc 8111. Genetic Improvement of Animals.** (3 cr. Prereq-#)

Application of population genetics to livestock breeding; selection index theory and practice; basis of relationships and covariances among relatives; and selection based on multiple sources of information.

**AnSc 8121. Linear Model Methods.** (3 cr. Prereq-Stat 5021)

Techniques and statistical tools for analysis of data. Matrix manipulation, least-squares procedures, correction for environmental factors, estimation of components of variance, and standard errors of estimates.

**AnSc 8131. Molecular Biology Techniques in Animal Science.** (3 cr; A-F only. Prereq-BioC 4332, Biol 4003)

Basic theory and current methodologies of molecular biology and recombinant DNA technology. Lab work includes DNA and RNA hybridization, gene transfer, and polymerase chain reaction techniques. Primarily for students with limited exposure to molecular biology.

**AnSc 8134. Ethical Conduct of Animal Research.** (2 cr; A-F only. Prereq-Grad student or prof school student or #)

Ethical considerations in use of animal subjects in agricultural, veterinary, and biomedical research. Federal, state, and University guidelines relating to proper conduct for acquisition/use of animals for laboratory, observational, epidemiological, and clinical research. Regulatory requirements, bases for what is deemed proper conduct. Societal impact on scientific investigations utilizing animal subjects.

**AnSc 8141. Current Topics in Animal Breeding and Genetics.** (1 cr [max 2 cr]. Prereq-5200 or MVB 5200 or EEB 5033)

Students pursue independent research. Topics vary depending on current research needs.

**AnSc 8194. Research in Animal Genetics.** (1-3 cr. Prereq-#)

Research in quantitative genetics, cytogenetics, molecular genetics, and other areas related to animal breeding.

**AnSc 8211. Animal Growth and Development.** (3 cr. Prereq-#)

Whole body growth of animals, bone, and adipose tissue; structure, function, differentiation, and development of tissues; mode of action of hormones, growth factors, and growth promoters.

**AnSc 8294. Research in Muscle Chemistry and Physiology.** (1-3 cr. Prereq-#)

Research in selected areas.

**AnSc 8311. Animal Bioenergetics.** (3 cr; A-F only.

Prereq-#; BioC 4331 recommended)  
Integrated systems approach to energy metabolism of animals. Application of classical techniques of calorimetry and comparative slaughter, development of systems for expressing energy content of feeds, and techniques for measuring whole body and organ metabolism of specific nutrients. Offered alternate years.

**AnSc 8312. Protein Metabolism.** (3 cr; A-F only. Prereq-BioC 4331)

Basic and applied concepts of protein metabolism in farm animals.

**AnSc 8320. Concepts and Developments in Nutritional Physiology.** (2 cr [max 4 cr]; A-F only. Prereq-#)

Review and critical evaluation of pertinent scientific literature.

**AnSc 8330. Concepts and Developments in Ruminant Nutrition.** (1 cr [max 2 cr]; A-F only. Prereq-#)

Review and critical evaluation of recent research reports.

**AnSc 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**AnSc 8340. Concepts and Developments in Swine Nutrition.** (2 cr [max 4 cr]; A-F only. Prereq-#)

Review and critical evaluation of scientific literature.

**AnSc 8394. Research in Animal Nutrition.** (1-3 cr. Prereq-#)

Research in selected areas: topics and animal species determined by consultation.

**AnSc 8411. Physiology of Reproduction.** (3 cr; A-F only. Prereq-3305 or equiv)

Emphasis is on gametogenesis, conception, and implantation.

**AnSc 8421. Physiology of Fertilization and Gestation.** (3 cr. Prereq-3305 or #)

Physiological events occurring during gametogenesis; capacitation and fertilization; period of the embryo; period of the fetus; and parturition.

**AnSc 8431. Immunoreproduction.** (3 cr. Prereq-3305 or #)

Blood groups and polymorphic proteins affecting reproduction; immunoglobulin formation; antigens of semen, ova, and genital secretions; immunopathology; maternal-fetal incompatibility; and antibodies to hormones.

**AnSc 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**AnSc 8451. Reproductive Endocrinology.** (2 cr; A-F only. Prereq-3305 or 3327 or equiv, BioC 3021)

Hormonal regulation of mammalian reproductive cycles and seasonal patterns; nutritional and stress effects on reproductive endocrinology; mechanism of hormone action.

**AnSc 8494. Research in Animal Physiology.** (1-3 cr. Prereq-#)

Individual research under faculty direction. Topic determined by consultation: a specialized aspect of a thesis problem or an independent problem of mutual interest to graduate student and adviser.

**AnSc 8510. Graduate Seminar.** (1-2 cr [max 12 cr]; S-N only. Prereq-#)

Student presentations of literature, proposals, and research results; instructional guidelines and performance evaluation; preparation of visual material.

**AnSc 8594. Research in Animal Science.** (1-3 cr. Prereq-#)  
Research including experimental studies in disciplines associated with animal production and research, with emphasis on interdisciplinary studies.

**AnSc 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**AnSc 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**AnSc 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

## Anthropology (Anth)

### Department of Anthropology

#### College of Liberal Arts

**Anth 5025W. Cultural Semantics.** (3 cr)  
Understanding cultures and cognitive classification systems through lexical semantics.

**Anth 5027W. Origins of European Civilization.** (3 cr. §3027)  
Early development of European society, from Old Stone Age to Roman period. Principle transformations of European culture with introduction of agriculture, development of metallurgy and trade, and emergence of towns and cities.

**Anth 5029. Philosophical Anthropology.** (3 cr; A-F only. Prereq-Sr or grad or #)  
Advanced survey of traditional problems associated with broad-ranging views on human nature and culture. Specific arguments of relativists, behaviorists, phenomenologists, and others in relation to social life. Structuralist and post-structuralist approaches.

**Anth 5033. Feminist Anthropology.** (3 cr. Prereq-3047 or grad or #)  
Advanced introduction to the development of feminist theory in anthropology. Theoretical and methodological shifts in feminist anthropology and ethnography. Feminist ethnography within the discipline as a whole; current debates concerning the reading and writing of ethnography.

**Anth 5041. Ecological Anthropology.** (3 cr. §3041, §8213. Prereq-Grad or #)  
Concepts, theories, and methods of ecological anthropology (cultural ecology) show how humans interact with the biophysical environment. Compare biological and cultural interactions with the environment; examine adaptive strategies cross-culturally.

**Anth 5045. Urban Anthropology.** (3 cr. Prereq-4003 or grad or #)  
Anthropological approaches to urban life in Western and non-Western settings. Topics include social networks and voluntary organizations; class, ethnicity, gender and power; migration and immigration; urban labor and economics; and urban "problems."

**Anth 5128. Anthropology of Learning.** (3 cr)  
Cross-cultural perspectives in examining educational patterns, and the implicit and explicit cultural assumptions underlying them; methods and approaches to cross-cultural studies in education.

**Anth 5221. Anthropology of Material Culture.** (3 cr; A-F only)  
Material culture as a social creation, studied from multiple perspectives (e.g., social anthropology, archaeology, primatology). Conceptions of how humans articulate with material world they construct.

**Anth 5244. Skeletal Materials for Archaeologists.** (4 cr; A-F only. Prereq-#)  
How anthropologists use fossil bones to answer questions of past human diet, behavior, and environments. Basics of skeletal-element/species identification of humans and large mammals. Project

where students analyze a small assemblage of bones. Emphasizes scientific method, data analysis using computers.

**Anth 5269. Analysis of Stone Tool Technology.** (4 cr; A-F only. Prereq-1001 or 3001 or #)  
Practical lab experience. How to analyze archaeological collections of stone tools to learn about human technological behavior in past. Students analyze archaeological/experimental collections, make stone tools themselves.

**Anth 5980. Topics in Anthropology.** (3 cr [max 3 cr])  
Topics specified in *Class Schedule*.

**Anth 5990. Topics in Archaeology.** (3 cr [max 9 cr]; A-F only. Prereq-#)  
Topics specified in *Class Schedule*.

**Anth 8001. Foundations of Social and Cultural Anthropology.** (5 cr; A-F only. Prereq-Grad anth major or #)  
Introduction to foundational concepts, methods, and ethnographic work in the field. Emphasis on theories that have shaped 20th-century thinking in cultural anthropology; explores connection of these theories to fieldwork and contemporary issues.

**Anth 8002. Foundations of Social and Cultural Anthropology.** (5 cr; A-F only. Prereq-8001)  
Further introduction to important concepts and perspectives in anthropology, with emphasis on past and contemporary American cultural anthropology. Includes recent work in semiotic, psychological, and feminist anthropology.

**Anth 8004. Foundations of Anthropological Archaeology.** (3 cr. Prereq-8001, 8002)  
Theoretical foundations of anthropological archaeology in historical and contemporary perspective.

**Anth 8120. Problems in Culture Change and Applied Anthropology.** (3-6 cr [max 6 cr])  
Comparative studies of change in cultural systems. Impact of global processes on local cultures. Roles of anthropology and anthropologists in policy, planning, implementation, and evaluation.

**Anth 8203. Research Methods in Social and Cultural Anthropology.** (3 cr. Prereq-Grad anth major or #)  
Classic and current issues in research methodology, including positivist, interpretivist, feminist, and postmodernist frameworks. Methodology, in the broadest sense of the concept, is evaluated. Students conduct three research exercises and set up an ethnographic research project.

**Anth 8205. Economic Anthropology.** (3 cr. §4053)  
Theoretical foundations of economic anthropology examined through critical readings of traditional, classical, and contemporary authors. Ethnographic puzzles of material life and issues of ecological degradation, development, market expansion, gender, and transglobal processes.

**Anth 8207. Political and Social Anthropology.** (3 cr)  
Western concepts of politics, power, authority, society, state, and law. Cross-cultural approaches to these concepts in historical perspective. Major theoretical frameworks and current problems and positions in social and political anthropology. Ethnographic classics and new directions.

**Anth 8209. Psychological Anthropology.** (3 cr. §4021)  
Self, emotion, cognitive processes, and child development in cross-cultural perspective.

**Anth 8211. Symbolic Anthropology.** (3 cr. §4019)  
Advanced introduction to semiotic, structuralist, and interpretive approaches in anthropology. Reviews classic foundations and recent developments.

**Anth 8213. Ecological Anthropology.** (3 cr. §5041)  
Seminar on method, theory, and key problems in ecological anthropology and human ecology. Examines approaches in light of human practices, interactions between culture and the environment, global environmental change, and our understanding of human dimensions of ecosystem-based management.

**Anth 8215. Anthropology of Gender.** (3 cr. Prereq-Grad anth major or #)  
Comparative, cross-cultural approach to gender. Focuses on various theories (e.g., feminist, postmodernist, psychoanalytic) of power, gender, authority, and femininity and masculinity. Gender ambiguity and issues of sexuality.

**Anth 8217. Pedagogy.** (3 cr)  
Introduction to role of teaching in academic culture, active learning and critical thinking styles, learning style differences among students, and development of writing assignments, discussion groups, exams, and lectures that help students develop critical, observational, and integrative abilities most crucial to anthropology.

**Anth 8219. Grant Writing.** (2 cr. Prereq-Grad anth majors preparing to submit research grant proposals next academic yr)  
Students draft a research proposal in their area of interest. Seminar involves reading and evaluating proposals, learning about funding and process of submitting proposals, nuts of bolts of composing a proposal, and ethics of research in anthropology.

**Anth 8220. Archaeology Field School.** (3-9 cr [max 9 cr]. Prereq-Grad anth major)  
Advanced archaeological field excavation, survey, and research. Intensive training in excavation techniques, recordation, analysis, and interpretation of archaeological materials.

**Anth 8230. Development and Management of Anthropological Research Projects.** (1 cr [max 4 cr]; A-F only. Prereq-Anth grad student or #)  
Training seminar on research development, coordination, grant management, field/laboratory research management, and fundraising.

**Anth 8244. Skeletal Materials for Archaeologists.** (4 cr; A-F only. Prereq-#)  
How anthropologists use fossil bones to answer questions of past human diet, behavior, and environments. Skeletal element and species identification (of humans, large mammals). Students analyze small assemblage of bones for class project. Emphasizes scientific method, data analysis using computers.

**Anth 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**Anth 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**Anth 8510. Topics in Archaeology.** (3-9 cr [max 9 cr])  
Seminar examines particular aspects of archaeological methods and/or theory. Topics vary according to student and faculty interests.

**Anth 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Anth 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Anth 8810. Topics in Sociocultural Anthropology.** (3-9 cr [max 9 cr])  
Seminar examines particular aspects of method and/or theory. Topics vary according to student and faculty interests.

**Anth 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

**Anth 8991. Independent Study.** (1-18 cr. Prereq-#)  
Under special circumstances and with instructor approval, qualified students may register for a listed course on a tutorial basis.

**Anth 8992. Directed Reading.** (1-18 cr. Prereq-#)

**Anth 8993. Directed Study.** (1-18 cr. Prereq-#)

**Anth 8994. Directed Research.** (1-18 cr. Prereq-#)

# Applied Economics (ApEc)

Department of Applied Economics  
College of Agricultural, Food and  
Environmental Sciences

**ApEc 5031. Methods of Economic Data Analysis.** (3 cr. Prereq—Math 1271, Stat 5021, knowledge of matrix algebra)  
Statistical and econometrics techniques for applied economists. Theory and application of multivariate regression model using data sets from published economic studies. Emphasis on use of statistical technique to understand market behavior.

**ApEc 5151. Applied Microeconomics: Firm and Household.** (2 cr. Prereq—Econ 5151 or #)  
Quantitative techniques for analysis of economic problems of firms and households. Links between quantitative tools and economic analysis developed to understand economic theory and develop research skills. Quantitative tools include regression analysis, mathematical programming, and present value analysis.

**ApEc 5152. Applied Macroeconomics: Income and Employment.** (2 cr. Prereq—Econ 5152 or #)  
Static general equilibrium open economy models and simple business cycle models examine economic growth, business cycles, and fiscal and monetary policy. Input-output analysis and large scale econometric models. Sources and properties of economy and sector-wide data, and empirical applications.

**ApEc 5321. Regional Economic Analysis.** (3 cr. Prereq—3006 or Econ 3102 or #)  
Regional development patterns and role of resources, transportation, and institutional constraints. Trade, migration, and investments in regional growth and change. Regional economic information in investment and location decisions. Evaluation of economic development policies and tools. Economic impact analysis.

**ApEc 5341. State and Local Public Services and Finance.** (3 cr; A-F only. Prereq—3001 or equiv)  
The organization, delivery, economic analysis and finance of state and local public services and functions.

**ApEc 5401. Price Analysis, Futures, and Options Markets.** (3 cr. Prereq—3002 with grade of at least B, [Math 1142 or equiv] or grad student)  
Development/application of price models. Unique market institutions in agriculture that have been developed in response to marketing/pricing problems. Futures/options trading. Hedging, speculative uses of futures/options contracts. Price efficiency, market performance/regulations.

**ApEc 5481. Futures and Options Markets.** (3 cr. \$4481. Prereq—Grad student)  
Economic concepts related to futures/options trading. Hedging, speculation.

**ApEc 5511. Labor Economics.** (3 cr. Prereq—[[3001 or Econ 3101 or PA 5021], [PA 5032 or equiv], grad student] or #)  
Theoretical foundations of labor markets. Intertemporal/household labor supply. Demand for labor, efficiency wages. Human capital theory, unemployment, migration decisions. Analysis of econometric research applied to labor policy issues such as minimum wage, tax policy, social insurance, education.

**ApEc 5551. Food Marketing Economics.** (3 cr; A-F only. \$4451, \$FScN 4451. Prereq—3001 or Econ 3101)  
Economics of food marketing in the United States. Food consumption trends. Consumer food behavior, expenditure, data collection. Consumer utility models, demand forecasting. Food distribution system. Changes in supply chain, industry structure that serves retail food outlets. Individual/group projects.

**ApEc 5581. Human Capital and Household Economics.** (3 cr. Prereq—3001 or Econ 3101 or #)  
Household economics and investment in human capital (e.g., children, education, health and nutrition); labor force participation, lifetime earnings, and nonmarket work; time allocation and substitution of capital for labor in the household in the western and third world.

**ApEc 5611. Economic Aspects of Environmental Management.** (3 cr; A-F only. Prereq—[Sr or grad student] in [biological science or conservation biology or ecology or fisheries or forestry or public affairs or water resources or wildlife conservation] or CLA or #)  
Economist approach to environmental problems such as water/air pollution. Application of supply/demand concepts to evaluation of environmental resources. Methods of evaluation. Analysis of pollution control policies from economic point of view.

**ApEc 5637. Agricultural Law.** (3 cr. Prereq—Sr or grad or #)  
Economic regulation of agriculture. Industrial organization and market structure in agribusiness, public lands and water law, agricultural cooperatives, farm labor, farm finance, crop insurance and disaster assistance, agricultural biotechnology, food and drug law, price and income regulations, and international agricultural marketing.

**ApEc 5651. Economics of Natural Resource and Environmental Policy.** (3 cr. Prereq—[[3001 or Econ 3101], [4611 or Econ 3611 or NRES 3261W]] or #)  
Economic analyses, including project evaluation of current natural resource/environmental issues. Emphasizes intertemporal use of natural resources, natural resource scarcity/adequacy, environmental quality, and mechanisms for pollution control and their implications for public policy.

**ApEc 5711. U.S. Agricultural and Environmental Policy.** (3 cr. Prereq—3001 or Econ 3101)  
U.S. agricultural policy in an open world economy; role of private markets and government in regulating supply and demand; income vs. price support, supply controls, environmental constraints, and export protectionism; functioning of markets; roles of public interest groups and future of American agricultural policy.

**ApEc 5721. Economics of Science and Technology Policy.** (3 cr. Prereq—[[5151 or #5151], PA 5022] or #)  
Economics of technical change, research, and technology. Productivity. Methods for evaluating impacts of R&D. Intellectual property rights.

**ApEc 5731. Economic Growth and International Development.** (3 cr. Prereq—3002 or [Econ 3101, Stat 3022]; Econ 4211 recommended)  
Economics of research/development. Technical change, productivity growth. Impact of technology on institutions. Science/technology policy.

**ApEc 5751. Agricultural Trade and Trade Policy: Issues and Analysis.** (3 cr. Prereq—3001 or Econ 3101 or PA 5021)  
Trade policies of import/export nations, gains from trade, trade negotiations/agreements. Free trade and common market areas. Exchange rate impacts. Primary commodities and market instability. Current trade issues.

**ApEc 5811. Cooperative Organization.** (3 cr. Prereq—3001, 3002 or #)  
Application of economic analysis to the cooperative form of organization. Producer and consumer cooperatives used to examine economic issues such as changing market organization, financing, management incentives, taxation, and antitrust regulations. Cooperatives as a tool for economic development included.

**ApEc 5861. Economics of Agricultural Production.** (3 cr. Prereq—5151 or Econ 5151 or #)  
Production economics applied to agriculture, profitable combination of production factors; comparative advantage and location of production.

**ApEc 5891. Independent Study: Advanced Topics in Farm and Agribusiness Management.** (1-4 cr. Prereq—#)  
Special topics or individual work suited to the needs of particular groups of students.

**ApEc 5991. Special Topics and Independent Study in Applied Economics.** (1-4 cr [max 12 cr]. Prereq—#)  
Special classes, independent study, and supervised reading and research on subjects and problems not covered in regularly offered courses.

**ApEc 8202. Mathematical Optimization in Applied Economics.** (3 cr. Prereq—[5151, Econ 5151] or equiv or #)  
Economic foundations and applications of mathematical and dynamic programming and optimal control. Mathematical optimization concepts; structures and economic interpretations of various models of the firm, consumer, household, sector, and economy. Model building and solution techniques.

**ApEc 8203. Applied Welfare Economics and Public Policy.** (3 cr. Prereq—Calculus, intermediate econ theory)  
Basic concepts underlying measurement of welfare change, problems of market failure and externalities, social welfare functions, and distribution within and across generations. Application of concepts, based on case studies of the environment, returns to research, technical change, and agricultural policy.

**ApEc 8204. Applied Financial Economics.** (3 cr; A-F only. Prereq—Econ 5151 or [Econ 8001, Econ 8002] or #)  
Introduction to major theories of asset pricing under competitive markets, symmetric information. Equilibrium/arbitrage models of financial markets, option pricing models. Applications of asset pricing theory: agricultural markets, financial derivatives, interest rates, agricultural credit.

**ApEc 8205. Applied Game Theory.** (3 cr; A-F only. Prereq—[8101, 8102, 8103, 8104] or [Econ 8001, Econ 8002, Econ 8003, 8004] or #)  
Topics in game theory, application to economic problems. For each topic, important theory/equilibrium concepts are followed by extensive applications. Focuses on static/dynamic games of complete/incomplete information, evolutionary games.

**ApEc 8211. Econometric Analysis I.** (4 cr. Prereq—[[Stat 4102 or Stat 5102], Ph.D. student] or #)  
Classical multiple linear regression, stochastic regressors, heteroscedasticity, autocorrelated disturbances, panel data, discrete dependent variables.

**ApEc 8212. Econometric Analysis II.** (4 cr. Prereq—8211 or equiv or #)  
Second semester of econometrics for Ph.D. students. Specification tests, instrumental variables, heteroscedasticity, panel data, simultaneous equations, bootstrap methods, limited dependent variable models, semiparametric estimation, econometrics of program evaluation, general method of moments, time series, hazard models.

**ApEc 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**ApEc 8401. Consumer Behavior and Policy.** (2 cr; A-F only. Prereq—Econ 5151 or [Econ 8001, Econ 8002] or [Econ 8101, Econ 8102] or #)  
Analytical/empirical treatments of consumer behavior. Household decision making. Demand for quality characteristics. Review of basic consumer theory, policy-related issues, experimental economics, consumer-survey techniques. Types of data available to analyze consumer behavior and household decisions.

**ApEc 8402. Information and Behavioral Economics.** (2 cr; A-F only. Prereq—[8401, Econ 8001, Econ 8002] or [Econ 8101, Econ 8102] or equiv or #)  
New theories of consumer behavior that combine economic and psychological models. Influence of information on consumer choice over time and under uncertainty. Expected, nonexpected utility theory, information economics, bounded rationality, prospect theory, choice over time, and rational addiction with applications to empirical work.

**ApEc 8403. Demand Analysis and Household Economics.** (2 cr; A-F only. Prereq—[8211, 8212, Econ 5151] or [Econ 8001, Econ 8002] or [Econ 8101, Econ 8102] or [Econ 8201, Econ 8202, Econ 8203, Econ 8204] or #) Household/individual behavior. Consumer demand analysis, education, and other issues. Static demand theory/estimation, dynamic demand theory/estimation, equivalence scales, intrahousehold allocation of consumption, analysis of education issues.

**ApEc 8404. Labor Economics and Human Capital.** (2 cr; A-F only. Prereq—[8403, Econ 8001, Econ 8002] or [Econ 8101, Econ 8102] or #) Topics in applied microeconomics related to labor supply and human capital. Focuses on household decisions and resulting outcomes in labor market. Household labor supply. Estimation of labor supply/earnings functions. Theory of human capital, wage structure/determination, and impacts of tax/transfer policies.

**ApEc 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**ApEc 8601. Natural Resource Economics.** (3 cr. Prereq—[5151, 8202, [Econ 5151 or equiv]] or #) Economic analysis of resource use/management. Capital theory, dynamic resource allocation. Applications to renewable/nonrenewable resources. Empirical studies, policy issues.

**ApEc 8602. Economics of the Environment.** (3 cr. Prereq—Econ 8004 or Econ 8104 or #) Economic analysis of environmental management, emphasizing environmental policy. Application of microeconomic theory to problems of market failure, market-based pollution control policies, contingent valuation, hedonic models, option value, and other topics.

**ApEc 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**ApEc 8701. International Economic Development, Growth, and Trade.** (3 cr. Prereq—Econ 8002 or Econ 8102 or #) Development, growth, and trade of developing nations and emerging market economies. Course links stylized characteristics of economic development, economic policy, and political economy using modern economic theory and empirical methods of analysis.

**ApEc 8702. Economic and Trade Policy: Sectoral and Institutional Issues.** (3 cr. Prereq—8230, Econ 8002 or Econ 8102 or #) Sectoral economic activity in the United States; emphasizes changing role of agriculture. Role of macroeconomic forces and trade policy since World War II. Economic and institutional development in the international economy, including the World Trade Organization, regional trade agreements such as NAFTA, and the European Union.

**ApEc 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**ApEc 8793. Master's Paper: Plan B Project.** (1-6 cr [max 6 cr]; S-N only. Prereq—Ag and applied econ MS student)

**ApEc 8801. Production Economics.** (2 cr; A-F only. Prereq—[Econ 8001, Econ 8002, Econ 8003] or [Econ 8101, Econ 8102, Econ 8103] or equiv or #) Aspects of production theory. Axiomatic representations of multi-output technologies. Input, output, and directional distance functions. Cost, revenue, and profit functions and duality. Input/output separability. Jointness/non-jointness in production. Index numbers, measures of efficiency/productivity.

**ApEc 8802. Financial Economics.** (2 cr; A-F only. Prereq—[8211, Econ 5151] or [Econ 8001, Econ 8002] or #) Major theories of asset pricing under assumptions of uncertainty, competitive markets, and symmetric information. Equilibrium/arbitrage models of financial markets with econometric applications. Pricing/use of derivatives.

**ApEc 8803. Marketing Economics.** (2 cr; A-F only. Prereq—[Econ 8001, Econ 8002] or [Econ 8101, Econ 8102] or #) Review of market structure, conduct, and performance. Market interdependency over space/time. Product forms. Issues pertaining to market failures/interventions.

**ApEc 8804. Managerial Economics.** (2 cr; A-F only. Prereq—[8202, Econ 5151] or [Econ 8001, Econ 8002] or [Econ 8101 Econ 8102] or #) Analysis of managerial decisions by organizations and individual entrepreneurs. Application of dynamic programming to investment and resource allocation decisions. Economics of business organization, including boundaries of the firm, mechanisms for vertical coordination, and economic implications of alternative ownership structures.

**ApEc 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

**ApEc 8901. Graduate Seminar: M.S. Program.** (1 cr; S-N only. Prereq—Ag and applied econ MS student) Writing, critiquing, and oral presentation skills for M.S. students. Oral presentation of research proposal for thesis or Plan B project critiqued by peers and committee members.

**ApEc 8902. Graduate Seminar: Ph.D. Program.** (1 cr; S-N only. Prereq—Ag and applied econ PhD student) Faculty, students, and outside speakers present research ideas and results, which participants critique. Topics vary according to interests of the speakers.

**ApEc 8991. Advanced Topics in Applied Economics.** (1-6 cr) Special seminars or individual work on subjects suited to needs of students.

## Applied Plant Sciences (APSc)

### College of Agricultural, Food and Environmental Sciences

**APSc 8123. Research Ethics in the Plant and Environmental Sciences.** (0.5 cr; S-N only. Prereq—Grad student) Ethics training to graduate students enrolled in plant/environmental graduate research programs and fulfill requirement for training in responsible conduct of research. Course meets during first seven weeks of spring semester.

**APSc 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**APSc 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**APSc 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**APSc 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**APSc 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

## Arabic (Arab)

### Department of African American and African Studies

#### College of Liberal Arts

**Arab 5001. Research Methods in Arabic Studies.** (3 cr) Skills and techniques required to deal with medieval and modern works in Arabic literature and Islam. A survey of the most important research bibliographies in Arabic and Islamic studies. Bibliographic references in English and, when appropriate, Arabic.

**Arab 5011. Islam in Africa.** (3 cr) Ideological, doctrinal, and ritual aspects of continental African Islam. Emphasis on various religious brotherhoods and Sufi orders from different African countries in the 20th century. No knowledge of Arabic required.

**Arab 5036. Islam: Religion and Culture.** (3 cr. \$Afro 3036) Religion of Islam, faith, practices, sectarian splintering, expansion outside original home to status of world religion, institutions, status in world societies—Asia, Europe, Americas.

**Arab 5101. Advanced Arabic I.** (3 cr. Prereq—3102 or equiv or #) Advanced readings in classical and modern Arabic. Compositions based on texts.

**Arab 5102. Advanced Arabic II.** (3 cr. Prereq—5101 or #) Readings of Arabic texts. Writing compositions based on texts. Continuation of 5101.

**Arab 5491. Classical Islamic Civilization.** (3 cr. \$Afro 3036) Islamic legacy in the classical age (800-1400), including medical/natural sciences, mathematics, philosophy, literature, and their transmission to Europe.

**Arab 5501. Modern Arabic Poetry in Translation.** (3 cr) Free verse movement and its major trends: post-romantic, social realist, symbolist, resistance, prose poem. Emphasizes leading poets such as al-Mala'ika, al-Sayyab, al-Bayati, and Adunis. Theoretical/critical essays. All readings in English.

**Arab 5502. Arabic Novel in Translation.** (3 cr) The novel as a new genre in Arabic literature. Trends: realist, psychological, existentialist, feminist, post-modernist, fantastic, experimentalist. Emphasizes major writers such as Mahfouz, Ghanem, Salih, Jabra, El Sa'dawi, Munif, and Khouri. Theoretical/critical essays. Cultural/historical context.

**Arab 5503. Arabic Drama in Translation.** (3 cr) Emergence and development of drama as a European-inspired genre in Arabic literature. Emphasizes major trends and playwrights. All readings in English.

**Arab 5505. Survey of the Middle East.** (3 cr. \$Arab 3505, \$Hist 3505, \$MELC 3505) Peoples, lands, and cultures of the Middle East. Historical survey from earliest civilizations to the present.

**Arab 5541. Islam in the Catholic Age: Arab Phase 600 A.D. to 900 A.D.** (3 cr. \$Arab 3541) The rise of Islam in its Arabian setting. Roles of the prophet, the Orthodox and Umayyad Caliphs. Development of the Islamic state and empire. Status of Muslims and non-Muslims.

**Arab 5542. Medieval Islam.** (3 cr. \$Arab 3542) Islamic dynasties, Mamluks and Mongols, and Crusaders and Assassins. Abbasid Caliphate's disintegration and rise of Seljuk Turks.

**Arab 5543. Arabs Under Mamluks and Ottomans: 1300-1920.** (3 cr. \$Arab 3543) Struggle against Crusaders and Mongols. Disintegration and reemergence under Muhammad Ali of Egypt; dynastic struggles in Syria; rise of Young Turks; Arab revolt.

**Arab 5544. Arab World: 1920 to the Present.** (3 cr. \$Arab 3544) Struggle in the Arab world for independence and its course since independence. Emphasis on development, political stability and unity; political structures; the Arab-Israeli conflict.

**Arab 5678. Seminar: African-Arabic Fiction in Translation.** (3 cr) African fiction in Arabic, including works of Barrada, Idris, Mahrouz, al-Matwi, El-Saadawi, and el-Zayat. Emphasizes twentieth century. Tests discussed in historical/cultural context. Theoretical/critical essays. All readings in English.

**Arab 5900. Topics in Arabic Literature and Culture.** (3 cr [max 9 cr]. Prereq—5102 or #)  
Readings and discussion of selected works in Arabic. Topics specified in *Class Schedule*.

**Arab 5992. Directed Readings.** (1-3 cr. Prereq—#)  
Individual research and readings for advanced students.

**Arab 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

## Aramaic (Arm)

*Department of Classical and Near Eastern Studies*  
*College of Liberal Arts*

**Arm 5011. Biblical Aramaic and Old Aramaic Inscriptions.** (3 cr. Prereq—1 yr Hebrew or Arabic or #)  
Biblical Aramaic—grammar, fluency in reading Biblical Aramaic and Old Aramaic inscriptions.

**Arm 5012. Syriac.** (3 cr. Prereq—1 yr Hebrew or Arabic or #)  
Emphasis on fundamentals of grammar and reading Syriac texts fluently.

## Architecture (Arch)

*Department of Architecture*  
*College of Architecture and Landscape Architecture*

**Arch 5123. Architectural Thesis.** (8 cr; A-F only. Prereq—5122, 5241, BA Arch major; students must submit thesis plan in semester before writing thesis)  
Student's choice, study and solution of an architectural problem to demonstrate proficiency in all phases of design.

**Arch 5241. Principles of Design Programming.** (3 cr; A-F only. Prereq—For undergrads 5122, BA Arch major; for grads 8255, M Arch major or #)  
Concepts and techniques of architectural programming, including space and activity analysis, site selection, precedent study, code review, appropriate technology identification, hypothesis formulation and evaluation. Emphasis on conceptual development, research, and analytic drawing.

**Arch 5250. Advanced Topics in Design.** (1-6 cr [max 6 cr]; A-F only. Prereq—Arch or #)  
Advanced topics in design.

**Arch 5281. Undergraduate Architecture Studio I.** (6 cr; A-F only. Prereq—□ or Δ)  
Architectural questions in settlement patterns, architectural elements in their formal organization. Mapping techniques, orthographic projections, analytic drawing, models.

**Arch 5282. Undergraduate Architecture Studio II.** (6 cr; A-F only. Prereq—□ or Δ)  
Exploration of human response to the natural forces of gravity, light, and air and their influence on the organization of material form to create places of human habitation.

**Arch 5283. Undergraduate Architecture Studio III.** (6 cr; A-F only. Prereq—□ or Δ)  
Exploration of selected design issue or topic, its influence on organization of material form to create places of human habitation.

**Arch 5284. Undergraduate Architecture Studio IV.** (4 cr; A-F only. Prereq—□ or Δ)  
Design studio.

**Arch 5291. Accelerated Undergraduate Architecture Studio I.** (6 cr; A-F only. Prereq—#)  
Selected architectural problems developed by faculty to deepen/enrich ideas introduced in required architectural studio sequence.

**Arch 5292. Accelerated Undergraduate Architecture Studio II.** (6 cr; A-F only. Prereq—[5291, accelerated status] or #)  
Architectural problems. Emphasizes development of structures as integral part of design, site planning, design process.

**Arch 5311. Theory of Architectural Representation.** (3 cr; A-F only. Prereq—[5371, 5372, M Arch] or #)  
Integration of emerging computer graphics with photography and architectural graphic conventions. Historical, theoretical, and critical issues of representation. Influence of visual media on architectural field.

**Arch 5313. Visual Communication Techniques in Architecture.** (3 cr; A-F only. Prereq—For undergrads 3301, BA Arch or BED major; for grads M Arch major or #)  
Exploration of delineation, presentation, and design techniques, using various visual media and methods of investigation.

**Arch 5321. Architecture in Watercolor.** (3 cr; A-F only. Prereq—[3301, [Arch or BED]] or M Arch grad student or #)  
Watercolor as a tool in the design process. Survey of foundation principles, techniques, medium, tools, and materials. Exploration of color relationships, mixing, composition, and applications to design.

**Arch 5350. Topics in Architectural Representation.** (1-3 cr [max 9 cr]; A-F only. Prereq—[5321, [Arch major or M Arch major]] or #)  
Selected topics in architectural representation.

**Arch 5351. AutoCAD I.** (3 cr. Prereq—For undergrads 5281, arch major; for grads M Arch major or #; may not be taken for graduate credit)  
Basic concepts, tools, and techniques of computer-aided drawing with current AutoCAD Release. Strategies and techniques for producing dimensioned and annotated drawings suitable for plotting and an introduction to 3-D drawing capabilities. Use of dimension variables, attributes, blocks, symbols, and the creation of customized menus.

**Arch 5352. AutoCAD II.** (3 cr. Prereq—For undergrads 5351, arch major; for grads M Arch major or #; may not be taken for graduate credit)  
Intermediate concepts, tools, and techniques of computer-aided drawing with current AutoCAD Release. Strategies and techniques for producing dimensioned and annotated drawing suitable for plotting. Use of dimension variables, attributes, blocks, symbols, and the creation of customized menus.

**Arch 5361. Topics in Architectural Representation: 3-D Architectural Modeling and Design.** (3 cr; A-F only. Prereq—For undergrads 5281 or 5351, arch major; for grads M Arch major or #)  
Introduction to 3-D studio for architectural modeling, rendering, and animation. Video recording and editing.

**Arch 5371. Computer Methods I.** (1 cr; S-N only. Prereq—¶8251, M Arch major or #)  
Introduction to current techniques, computer programs, and their application to architectural computing.

**Arch 5372. Computer Methods II.** (1 cr. Prereq—5371, ¶8252 and M Arch major or #)  
Current techniques, computer programs, and their application to architectural computing and design.

**Arch 5373. Computer Methods III.** (1 cr; S-N only. Prereq—5372, ¶8253, M Arch major or #)  
Advanced techniques, computer programs, and their application to architectural computing in design, theory, and technology.

**Arch 5374. Computer Methods IV.** (1 cr. Prereq—5373, ¶8254, M Arch major or #)  
Advanced architectural computing applications in design, history, theory, representation, and technology.

**Arch 5381. Introduction to Computer Aided Architectural Design.** (3 cr; A-F only. Prereq—Arch or BED or M Arch or grad student in LA or #)  
2-D drawing, 3-D modeling/animation, printing, plotting. Electronic networking/communications, database management, spreadsheet analysis, land-use analysis, project management.

**Arch 5382. Computer Aided Architectural Design.** (3 cr; A-F only. Prereq—[5381, undergrad, [BA Arch major or BED major]] or M Arch major or graduate LA major or #)  
2-D/3-D CAD, image manipulation. Advanced multimedia visualization techniques for design, including solid modeling, photo-/realistic imaging, animation, video-editing/recording.

**Arch 5410. Topics in Architectural History.** (3 cr [max 12 cr]; A-F only. Prereq—For undergrads 3412, arch major; for grads M Arch major or #)  
Advanced study in architectural history. Readings, research, and seminar reports.

**Arch 5411. Principles of Design Theory.** (3 cr; A-F only. Prereq—M Arch major or #)  
Principles of design and their instrumentation. How and why architecture theory is generated. Types and significance of formal analysis. Theoretical positions and modes of criticism.

**Arch 5423. Gothic Architecture.** (3 cr; A-F only. Prereq—For undergrads 3411, arch major; for grads M Arch major or #)  
History of development of architecture and urban design in Western Europe from 1150 to 1400.

**Arch 5424. Renaissance Architecture.** (3 cr; A-F only. Prereq—For undergrads 3411, arch major; for grads M Arch major or #)  
History of architecture and urban design in Italy from 1400 to 1600. Emphasis on major figures (Brunelleschi, Alberti, Bramante, Palladio) and the evolution of major cities (Rome, Florence, Venice).

**Arch 5425. Baroque Architecture.** (3 cr; A-F only. Prereq—For undergrads 3411, arch major; for grads M Arch major or #)  
Architecture and urban design in Italy from 1600 to 1750. Emphasis on major figures (Bernini, Borromini, Cortona, Guarini) and the evolution of major cities (Rome, Turin).

**Arch 5426. Architecture and Nature: 1500-1750.** (3 cr. Prereq—For undergrads 3411, 3412, arch major; for grads M Arch major or #)  
History of the interaction of architecture and nature in Italy, England, and France in the 16th and 17th centuries. Major monuments, their relationship to theories of architecture and gardening, urban and rural life.

**Arch 5431W. Eighteenth-Century Architecture and the Enlightenment.** (3 cr; A-F only. Prereq—[3411, 3412, undergrad arch major] or M Arch grad student or #)  
Architecture, urban planning, and garden design in Europe from 1700 to 1850.

**Arch 5432. Modern Architecture.** (3 cr; A-F only. Prereq—For undergrads 3412, arch major; for grads M Arch major or #)  
Architecture and urban design in Europe and the United States from the early 19th century to World War II.

**Arch 5434. Contemporary Architecture.** (3 cr; A-F only. Prereq—For undergrads 3412, arch major; for grads M Arch major or #)  
Developments, theories, movements, and trends in architecture and urban design from World War II to the present.

**Arch 5439. History of Architectural Theory.** (3 cr; A-F only. Prereq—For undergrads 3412, arch major; for grads M Arch major or #)  
History of architectural theory from antiquity to the 20th century.

**Arch 5450. Topics in Architectural Theory.** (1-3 cr [max 9 cr]; A-F only. Prereq—Arch major or M Arch major or #)  
Selected topics in architectural theory and criticism.

**Arch 5451. Architecture: Defining the Discipline.** (3 cr; A-F only. Prereq—M Arch major or #)  
Architecture as a discipline: its nature, role, purpose, and meaning discussed within a general, philosophical, and theoretical framework. Investigation and discussion of paradigms defining architectural theory and practice.

**Arch 5452. Architecture: Design, Form, Order, and Meaning.** (3 cr; A-F only. Prereq–M Arch major or #) Architecture and the issue of meaning. Explores fundamental and constituent elements of architectural form and order; their inherent tectonic, phenomenal, experiential, and symbolic characteristics; their potential and implications for the creation and structure of meaningful human places.

**Arch 5454. Semiotics and Deconstruction in Architecture.** (3 cr; A-F only. Prereq–5411, M Arch major or #) Expressive and cultural dimensions of architecture, especially those related to linguistic analogies, knowledge production, and contemporary philosophy. Broad critical perspective of architectural discussion and argumentation addressing current issues.

**Arch 5455. Typology and Architecture: Theories of Analysis and Synthesis.** (3 cr; A-F only. Prereq–5411, M Arch major or #) Theoretical traditions and development of typology's role in architecture. Investigates works of Laugier, Quatremere de Quincy, Viollet-Le Duc, Ledoux, Durand, Camillo Sitte, and Le Corbusier. Recent developments and theoretical positions of neo-rational and contextual arguments for contemporary applications of the idea of type.

**Arch 5458. Architecture and Culture.** (3 cr; A-F only. Prereq–3412, arch major or grad student or #) Architecture as a cultural medium. Relationships among architecture, people, and culture; research findings and design; vernacular and high style architecture. Physiological and symbolic messages; reception theory in architecture; cultural critique and change; implications for architectural practice.

**Arch 5459. Gender and Architecture.** (3 cr. Prereq–Arch or WoSt major or M Arch major or #) Examination of ideas related to gender and architecture, gendered and non-gendered places and practices, and their relations to cultural norms and change.

**Arch 5461. North American Indian Architecture.** (3 cr. Prereq–For undergrads 3412, arch or Amln major; for grads M Arch major or #) Historic and contemporary principles and theories of North American Indian architecture. Study of the culture, technology, environment, art and craft of North American Indians in their settlements and architecture.

**Arch 5501. Architecture and Ecology.** (4 cr; A-F only. Prereq–[5281, LA 3501, arch major] or #) Introduction to theories/practices of ecological approaches to architectural design. Ecological context, implications/opportunities of architecture. Historical/theoretical framework for ecological design thinking. Issues studied at a variety of scales: site/community, building scale, component scale. Fundamental theories, concepts, principles, strategies, and design tools addressed at each scale.

**Arch 5511. Construction Materials in Architecture.** (3 cr; A-F only. Prereq–M Arch or #) Building materials, assemblies, and construction operations shaping building designs. Material properties for design/detailing of building systems, elements, and components. Implications in design applications. Modeling, hands-on building experiences.

**Arch 5512. Building Methods in Architecture.** (3 cr; A-F only. Prereq–5511, M Arch major or #) Analysis of architectural materials, building systems, and construction operations related to enclosure systems design, building infrastructure, and detailing. Application of legal constraints and regulations (e.g., ADA, building codes, life-safety issues) in preparation of drawings, specifications, and construction documents for building design.

**Arch 5513. Environmental Technology I: Thermal Design in Architecture.** (3 cr; A-F only. Prereq–M Arch major or #) Thermal and climatic issues in the design of small and mid-size buildings. Investigations in built and

mechanical methods to modify climate. Evaluation of the impact of design techniques on energy use, the environment, and architectural meaning.

**Arch 5514. Environmental Technology II: Lighting and Acoustic Design.** (3 cr; A-F only. Prereq–M Arch major or #) Principles of daylighting, electric lighting, and acoustic design in architecture. Relationship between luminous and acoustic environments, human comfort and architectural experience. Analytical methods, design process, and modeling of daylighting.

**Arch 5525. Design in Masonry.** (3 cr; A-F only. Prereq–5512, M Arch major or #) Design principles, construction methods, and document production for masonry structures.

**Arch 5539. Daylighting and Architecture Design.** (3 cr; A-F only. Prereq–5514, M Arch major or #) Role of daylighting in architectural design: principles, strategies, energy and environmental issues, psychology of light, color, and integration of electric lighting. Design projects investigate qualitative and quantitative issues through drawing, physical models, and photometric analysis.

**Arch 5542. Building Energy Systems.** (3 cr; A-F only) Functions of building mechanical systems and their integration with other building components. Residential/commercial HVAC systems, alternative energy sources, energy efficiency, structural implications of mechanical systems, indoor air quality, environmental control strategies. Case studies.

**Arch 5550. Topics in Technology.** (1-3 cr [max 6 cr]. Prereq–#) Selected topics in architecture technology, including construction, environmental management, energy performance, lighting, or materials.

**Arch 5561. Building Production Processes.** (3 cr. Prereq–5282, 5501, arch major or BED major or M Arch major or #) Introduction to design-build processes including document production, contract execution, and building project management. Case study and hands-on experiences examine construction industry organization, scheduling, consultant relations, legal and code restraints, contractual stipulations, budget and project resource allocations.

**Arch 5571. Architectural Structures I: Wood and Steel Design.** (3 cr; A-F only. Prereq–M Arch or #) Influence of history/culture on architecture/structure. Structural mechanics, analysis, form finding, and design by experimental, qualitative/intuitive, and quantitative methods. Vector-/form-active structural systems, funicular structures. Bending/compression elements, plates/grids. Tensile architecture, shells. Traditional construction materials.

**Arch 5572. Architectural Structures II: Concrete and Masonry Design.** (3 cr; A-F only. Prereq–5571, M Arch major or #) Overview of advanced materials: reinforced fiberglass, structural glass, and structural tensile fabrics. Impact of construction technology on architecture and methods of integrating knowledge of structural materials and construction methods into the design process.

**Arch 5611. Design in the Digital Age.** (3 cr; A-F only. Prereq–Grad student or upper level undergrad student) Introduction to design, design process. Developing/understanding ways of seeing, thinking, and acting as a designer. Changes in design being wrought by digital technology. Team design project.

**Arch 5621. Professional Practice in Architecture.** (3 cr; A-F only. Prereq–M Arch major or #) Legal, ethical, business, and practical requirements of architectural practice. Contemporary and historical models of contract formation, business principles, accounting, project management, design services, and marketing.

**Arch 5631. Legal Contracts in Architecture.** (3 cr; A-F only. Prereq–M Arch major or #) Legal subject matter relevant to the work of architects and design professionals.

**Arch 5645. Real Estate Development in Architecture.** (3 cr. Prereq–For undergrads BA Arch major; for grads M Arch major or #) Fundamentals of real estate development and investment building. Processes and rules of specialists in development of investment projects. Topics include pro forma value and depreciation, tax shelter, feasibility, market analysis, appraisal equity financing, design, construction, leasing, and property management.

**Arch 5650. Topics in Architectural Practice.** (1-4 cr. Prereq–5621, arch major or 5621, M Arch major or #) Topics in architectural practice, methods of design production, marketing, operation, and relationships among clients, architecture, and society.

**Arch 5670. Topics in Historic Preservation.** (1-3 cr. Prereq–Arch or M Arch major or #) Selected topics in the theory, philosophy, research, and methods of architectural historic preservation.

**Arch 5671. Historic Preservation.** (3 cr. Prereq–3412 or #) Philosophy, theory, and origins of historic preservation. Historic archaeology and research, descriptive analysis, and documentation of historic buildings. Government's role in historic preservation, preservation standards and guidelines, preservation and building codes, neighborhood preservation, preservation advocacy, and future directions for historic preservation. Research on architectural and historical aspects of historic sites using primary and secondary resources and on controversial aspects of preservation.

**Arch 5672. Historic Building Conservation.** (3 cr. Prereq–3412, 5671 or #) Historic building materials, systems, and methods of conservation. Discussion of structural systems, building repair and pathology, introduction of new environmental systems in historic buildings, and conservation of historic interiors. Research on historic building materials and techniques using primary and secondary resources and on documentation of a specific historic site through large-format photography and measured drawings.

**Arch 5673. Historic Building Research and Documentation.** (3 cr. Prereq–3412, 5672 or #) Philosophy, theory, and methods of historic building research, descriptive analysis of buildings, building documentation, historical archaeology, and architectural taxonomy.

**Arch 5711. Design Principles of the Urban Landscape.** (3 cr; A-F only. Prereq–Arch or BED major or M Arch or LA grad major or #) Art and design of creating city, neighborhood, and development plans. Public policies, planning tools and process, and physical models used by design professionals and private and civic institutions to shape the physical environment.

**Arch 5724. Meanings of Place.** (3 cr; A-F only. Prereq–Arch or BED or Geog major or M Arch or LA grad major or #) Analysis of meanings and messages of surroundings, and examination of links between sense of place and feelings of well-being. Exploration of what present-day environments can reveal about the past. Survey of Twin Cities' central district and selected neighborhoods, and other settings inside and outside Minnesota.

**Arch 5750. Topics in Urban Design.** (1-3 cr; A-F only. Prereq–5711, M Arch or LA grad major or #) Special topics in theory and practice of urban design.

**Arch 5993. Directed Study.** (1-4 cr; A-F only. Prereq–# only) Guided individual reading or study.

**Arch 8101. Subjects and Methods in Architecture.** (2 cr; S-N only. Prereq–Grad arch major or #) The discipline of architecture.

**Arch 8250. Advanced Topics in Design.** (1-6 cr [max 6 cr]; A-F only. Prereq–Grad arch major or #)

**Arch 8251. Graduate Architectural Design I.** (6 cr; A-F only. Prereq—Grad arch major or #)  
Fundamental architectural problems involving design as a creative inquiry. Individual and collaborative effort.

**Arch 8252. Graduate Architectural Design II.** (6 cr; A-F only. Prereq—8251, grad arch major or #)  
Fundamental architectural problems involving design as a creative inquiry. Individual and collaborative effort.

**Arch 8253. Graduate Architectural Design III.** (6 cr; A-F only. Prereq—8252, grad arch major or #)  
Fundamental architectural problems involving design as a creative inquiry. Individual and collaborative effort.

**Arch 8254. Graduate Architectural Design IV.** (6 cr; A-F only. Prereq—8253, grad arch major or #)  
Fundamental architectural problems involving design as a creative inquiry. Individual and collaborative effort.

**Arch 8255. Graduate Architectural Design V.** (6 cr; A-F only. Prereq—8254, grad arch major or #)  
Fundamental architectural problems involving design as a creative inquiry. Individual and collaborative effort.

**Arch 8295. Directed Graduate Architectural Design.** (6 cr; A-F only. Prereq—8251, grad arch major or #)

**Arch 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**Arch 8350. Advanced Topics in Representation.** (1-3 cr; A-F only. Prereq—5311, grad arch major or #)  
Theory and practice of visual representation in architecture.

**Arch 8450. Topics in Theory.** (1-3 cr; A-F only. Prereq—5411, grad arch major or #)

**Arch 8494. Directed Research in Architectural History.** (1-3 cr; A-F only. Prereq—Grad arch major or #)

**Arch 8550. Topics in Technology.** (1-3 cr; A-F only. Prereq—Grad arch major or #)

**Arch 8650. Topics in Architectural Practice.** (1-3 cr; A-F only. Prereq—Grad arch major or #)

**Arch 8750. Topics in Urban Design.** (1-3 cr; A-F only. Prereq—Grad arch major or #)

**Arch 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

## Art (Arts)

### Department of Art

#### College of Liberal Arts

**ArtS 5104. The Nature of Abstraction.** (4 cr. Prereq—3102 or #)  
Exploration of abstraction as concept. Studio practice with attention to developing individual work. Emphasizes understanding topics relevant to abstraction. Approached from discipline of painting, open to various material sensibilities.

**ArtS 5105. Advanced Dimensional Painting.** (4 cr. Prereq—3105 or #)  
Illusory space applied to sculptural forms. Practical applications of spatial/painterly concepts. Emphasizes critical/visual judgment. Development of cohesive body of work reflecting interaction of two/three dimensions.

**ArtS 5106. Advanced Drawing: Interpreting the Site.** (4 cr. Prereq—3106 or #)  
Search for personal content as inspired by site. Field trips (2/3 of course) to draw or paint from various metropolitan area locations. Interpretations enhanced by experimentation with new marks/symbols.

**ArtS 5110. Advanced Drawing.** (4 cr [max 12 cr]. Prereq—3101 or 3111 or #)  
Developing personal direction in form/content. Various media. Various aesthetic/conceptual approaches.

**ArtS 5120. Advanced Painting.** (4 cr [max 12 cr]. Prereq—3102 or #)  
Developing personal vision/content through painting. Emphasizes critical thinking, self-evaluation, and independent pursuit of ideas.

**ArtS 5130. Advanced Painting: Watercolor.** (4 cr [max 12 cr]. Prereq—3102 or #)  
Expressive/technical possibilities of transparent watercolor. Emphasizes pictorial structure, color relationships, visual expression. Work from still life, nature, life model, imagination.

**ArtS 5310. Advanced Sculpture: Direct Metal.** (4 cr [max 12 cr]. Prereq—3301 or #)  
Direct metal sculpture in steel, other metals. Studio practice, investigation of historical/contemporary methods/concepts. Development of personal sculpture imagery.

**ArtS 5320. Advanced Sculpture: Spatial Problems.** (4 cr [max 12 cr]. Prereq—3302 or #)  
Sculptural practice outside traditional media/approaches. Installation, theater, public art, architecture as topics for individual investigations into spatial organization.

**ArtS 5330. Advanced Sculpture: Metal Casting.** (4 cr [max 12 cr]. Prereq—3303 or #)  
Metal casting of sculpture in bronze, iron, aluminum, other metals. Studio practice, investigation of historical/contemporary methods/concepts. Development of personal sculptural imagery.

**ArtS 5340. Advanced Sculpture: Carving and Construction.** (4 cr [max 12 cr]. Prereq—3304)  
Carving/construction using wood, other materials. Studio practice, investigation of historical/contemporary methods/concepts. Development of personal sculptural imagery.

**ArtS 5350. Advanced Sculpture: Kinetics.** (4 cr [max 12 cr]. Prereq—3305 or #)  
Studio practice in kinetic sculpture. Historical/contemporary methods/concepts of sculpture produced by motion. Development of personal imagery.

**ArtS 5360. Advanced Performance Art and Installation.** (4 cr [max 12 cr]. Prereq—3306 or #)  
Studio practice in performance art and installation; investigation of historical and contemporary methods and concepts of interdisciplinary expression. Development of personal imagery.

**ArtS 5370. Advanced Sculpture: Traditional Approaches.** (4 cr [max 12 cr]. Prereq—3307 or #)  
Clay figure modeling. Mold making using historical/contemporary systems. Casting in semi-permanent materials. Studio practice, traditional sculptural methods/concepts. Development of personal imagery.

**ArtS 5400. Seminar: Concepts and Practices in Art.** (3 cr [max 6 cr]. Prereq—1001 or #)  
Various ideologies, cultural strategies that influence practice/interpretation of art. Emphasizes diversity of viewpoints. Application of issues in developing final BFA exhibition.

**ArtS 5402. Artists' Books.** (4 cr. Prereq—3402 or #)  
Advanced projects in creation of unique, handmade books using various structures, media, techniques. Critical, historical, theoretical issues surrounding contemporary book arts.

**ArtS 5403. Women's Images and Images of Women.** (3 cr. Prereq—1001 or #)  
Women's place in Western art from the artist's perspective. Women as artists and the imagery they have created. Women as the object of imagery and the social and political attitudes those images convey. Survey of women artists from late-Renaissance through contemporary feminism; relevant issues.

**ArtS 5405. Visual Narrative Structures.** (4 cr. Prereq—[1001, one 1xxx art course] or #)  
Visual/verbal investigation of structures of visual narratives. Contemporary efforts to integrate cogent images in visual texts. Development of methods for personal visual communication of cultural, spiritual, aesthetic, environmental experiences. Historical/cultural focuses. Studio work.

**ArtS 5441. Professional Practices.** (3 cr. Prereq—Grad or #)  
Intensive writing seminar provides a context for theoretical issues, business practices, and professional skills required for career management and development in the visual arts.

**ArtS 5490. Workshop in Art.** (1-4 cr [max 12 cr])  
Selected topics and intensive studio activity. Topics vary yearly.

**ArtS 5510. Advanced Printmaking: Intaglio and Screen.** (4 cr [max 12 cr]. Prereq—3501 or #)  
In-depth research of intaglio, screen printing. Historical/contemporary applications. Development of imagery using color, photo-mechanical, digital processes. Cross-media approaches.

**ArtS 5520. Advanced Printmaking: Relief and Lithography.** (4 cr [max 12 cr]. Prereq—3502 or #)  
Relief printing, lithography for creative expression. Studio practice with stone, metal, wood. Developing personal visual language/aesthetics. Historical/contemporary awareness, evolving technologies/strategies.

**ArtS 5550. Advanced Papermaking.** (4 cr [max 12 cr]. Prereq—3505 or #)  
Distinct expressive qualities of handmade paper, its versatility as contemporary art form. Independent research pursued in consultation with instructor.

**ArtS 5610. Interactivity: Advanced Digital Processes.** (4 cr [max 12 cr]. Prereq—3601 or #)  
Web-/screen-based and installation/performance projects in consultation with instructor. Focuses on individual expression, role of artists/audience, and synthesis of artistic form/content using interactive digital technologies.

**ArtS 5620. Time Arts: Advanced Video.** (4 cr [max 12 cr]. Prereq—3602)  
Individual projects exploring elements of time, cinematic space, narrative, and montage through experimental, documentary, or installation-based video art. Articulation of relationships between conceptual, aesthetic, and artistic process.

**ArtS 5630. Time Arts: Advanced 2-D Animation.** (4 cr [max 12 cr]. Prereq—3603 or #)  
Individual projects and further development of a personal voice and critical thinking in time-based art. Creating digital 2-D animation with emphasis on vector and layer-based raster animation techniques. Compositing 2-D animation with video.

**ArtS 5640. Time Arts: Advanced 3-D Animation.** (4 cr [max 12 cr]. Prereq—3604 or #)  
Advanced exploration of modeled objects in modeled space and time. Compositing of animated images with video images. Individual projects, expansion of personal voice and visual clarity within the framework of 3-D imagery and time-based artwork.

**ArtS 5710. Advanced Photography.** (4 cr [max 12 cr]. Prereq—Two sem of 3xxx photography or #)  
Design/implementation of individual advanced projects. Demonstrations, lectures, critique. Reading, writing, discussion of related articles/exhibitions.

**ArtS 5810. Advanced Ceramics.** (4 cr [max 12 cr]. Prereq—3801, 3802 or #)  
Critical discourse of aesthetics, history, and contemporary issues in clay and criticism. Independent, advanced projects.

**ArtS 5821. Ceramic Materials Analysis.** (4 cr. Prereq—3801 or 3802 or #)  
Ceramic materials, their interrelationships. Advanced investigation of glazes, slip formulation, clay bodies in high/low temperature ranges. Individual interests related to students' aesthetic needs.

**ArtS 5830. Advanced Ceramics: Mold Making.** (4 cr [max 12 cr]. Prereq–3803 or #)  
Advanced mold making for ceramics. Plaster mold fabrication, ceramic production, contemporary methods/concepts. Development of personal visual expression.

**ArtS 5840. Advanced Neon.** (4 cr [max 12 cr]. Prereq–3804 or #)  
Emphasis on the development of personal sculptural sensibility. Studio practice with neon glass tubing and electrical components. A mixed media approach is encouraged.

**ArtS 5990. Independent Study in Art.** (1–4 cr [max 12 cr]. Prereq–Major, #)  
Independent study project designed by student in consultation with instructor.

**ArtS 8100. Drawing and Painting: Theory and Practice.** (3 cr [max 12 cr]. Prereq–Art MFA student)  
Tutorial in drawing and/or painting.

**ArtS 8300. Sculpture: Theory and Analysis.** (3 cr [max 6 cr])  
Theoretical issues of sculpture as understood by practicing sculptors. Research on and discussion of current sculpture in light of historical precedent; personal work relative to contemporary practice.

**ArtS 8333. FTE: Master's.** (1 cr; NGA. Prereq–Master's student, adviser and DGS consent)

**ArtS 8400. Theoretical Constructions in Contemporary Art.** (3 cr [max 6 cr])  
Structure for examining and understanding current critical practice. Evaluation and questions about assumptions of theory in context of current artistic production.

**ArtS 8401. Studio and Pedagogy: Philosophy and Practice.** (3 cr [max 6 cr])  
Orientation to establishing studio practice, introduction of department and community resources, and preparation for teaching. Studio visits and critiques; development of teaching strategies. Required of drawing and painting students.

**ArtS 8410. Studio Critique.** (3 cr [max 6 cr]; A-F only. Prereq–8400)  
Studio based critique to foster critical dialogue about art practice across media/disciplines. Colloquium for ideas/theories that migrate between artistic practices and influence studio work.

**ArtS 8500. Printmaking: Theory and Practice.** (3 cr [max 12 cr])  
Focus on the complexities and multi-disciplinary activities of printmaking. Development of concepts and personally significant imagery leading to thesis work.

**ArtS 8600. Electronic Art: Theory and Practice.** (3 cr [max 12 cr])  
Tutorial. Issues related to creative visual work using the computer and other technologies. Interactivity, robotics, digitally based conceptual art, and time-based art.

**ArtS 8700. Photography: Theory and Practice.** (3 cr [max 12 cr])  
Contemporary issues in the production of photographic images.

**ArtS 8800. Ceramics: Theory and Practice.** (3 cr [max 12 cr]; A-F only)  
Tutorial emphasizing individual goals and directions. Discussion of aesthetics, history, theory, contemporary issues in clay, and criticism.

**ArtS 8990. M.F.A. Creative Thesis.** (1–9 cr [max 18 cr]. Prereq–Art MFA candidate, passed oral/written prelim, #)  
Research/studio work in preparation for thesis exhibition and supporting paper.

## Art History (ArthH)

### Department of Art History

#### College of Liberal Arts

**ArthH 5101. Myths in Art: Cross-Cultural Comparison.** (3 cr; A-F only)  
Relationships of text/image, efficacy of each in conveying meaning. Properties of visual/verbal communication. Ways in which artists convey mythological meanings, how much these ways differ according to place/time. Students prepare/critique visual presentations through Web pages.

**ArthH 5103. Hellenistic and Early Roman Art and Archaeology.** (3 cr. Prereq–Clas/ArthH 3008, jr or #)  
Sculpture, architecture, painting, and topography in developing centers of Hellenistic culture in the eastern Mediterranean, and in Etruscan and Roman towns from 400 B.C. to the beginnings of the Roman Empire.

**ArthH 5108. Greek Architecture.** (3 cr. Prereq–ArthH/Clas 3008, jr or sr or grad, or #)  
Geometric through classical examples of religious and secular architecture and their setting at archaeological sites in Greece, Asia Minor, and Italy.

**ArthH 5111. Prehistoric Art and Archaeology of Greece.** (3 cr. Prereq–Jr or sr or grad student, Greek art/archaeology course or #)  
Artistic and architectural forms of Neolithic period in Aegean area and Cycladic, Minoan, and Mycenaean cultures. Aims and methods of modern field archaeology; the record of human habitation in the Aegean area. Archaeological evidence as a basis for historical reconstruction.

**ArthH 5112. Archaic and Classical Greek Art.** (3 cr. Prereq–Jr or sr or grad or #)  
Sculpture, painting, architecture, and minor arts in Greek lands from the 9th through 5th centuries B.C. Examination of material remains of Greek culture; archaeological problems such as identifying and dating buildings; analysis of methods and techniques.

**ArthH 5120. Field Research in Archaeology.** (3–6 cr [max 6 cr]. Prereq–#)  
Field excavation, survey, and research at archaeological sites in the Mediterranean area. Techniques of excavation and exploration; interpretation of archaeological materials.

**ArthH 5172. House, Villa, Tomb: Roman Art in the Private Sphere.** (3 cr. Prereq–Intro art history course or #)  
The architecture, painting, and sculpture of urban houses, country estates, and tombs in the Roman World. Relationships between public and private spheres, and literary and physical evidence; usefulness of physical evidence in illuminating gender roles.

**ArthH 5182. Art and the State: Public Art in the Roman Empire.** (3 cr. Prereq–Intro art history course or #)  
Origins of Roman public art; use in maintaining community; exploitation by the first Emperor, Augustus; development and diffusion through the later Empire; varying capabilities to adjust to the demands of a Christian Empire.

**ArthH 5234. Gothic Sculpture.** (3 cr. Prereq–Jr or sr or grad or #)  
The origin, character, and development of Gothic sculpture in France, the German empire, and the Netherlands, 1150–1400. Emphasis on French sculpture of the cathedral age and the emergence of a court style in Paris and elsewhere in Europe (e.g. London, Prague).

**ArthH 5252. History of Early Christian Art in Context.** (3–4 cr. Prereq–3xxx ArthH course or #)  
The role played by art in the formation of early Christian and Byzantine communities, and in establishing their relationships with the Pagan world and early Islam.

**ArthH 5301. The Visual Culture of the Atlantic World.** (3 cr; A-F only. Prereq–Grad student or instr consent)  
Visual culture of Atlantic world, from Columbus to American Revolution. Visual objects, practices

considered in context of Europe's colonization of the Americas. Slavery, religious conflict, international commerce, and production of scientific knowledge addressed in terms of their impact upon visual imagery.

**ArthH 5324. 15th-Century Painting in Northern Europe.** (3 cr. Prereq–Jr or sr or grad or #)  
The origin, character, and development of painting in France, the Netherlandish area, and the German Empire during the years 1350 to 1500. Emphasis on the Flemish school (e.g., Van Eyck brothers, Campin, Van der Weyden) and its influences.

**ArthH 5340. Practicum in Archaeological Field and Computer Techniques.** (3 cr. Prereq–One course in ancient art/archaeology or #)  
Methods for excavation of Old/New World sites. Meets at archaeometry/computer lab for part of semester and at selected site in Minnesota for day-long sessions for 9 to 10 weeks.

**ArthH 5347. 17th- and 18th-Century Art of Northern Europe.** (3 cr. Prereq–3011 or grad student or #)  
Seventeenth-century painting in Holland/Belgium (e.g., Rembrandt, Rubens). Seventeenth- and eighteenth-century French architecture, sculpture, and painting (e.g., Versailles, Poussin, Watteau).

**ArthH 5417. Twentieth Century Theory and Criticism.** (3 cr. Prereq–3464 or #)  
Trends in 20th-century art theory, historical methodology, criticism. Key philosophical ideas of modernism/postmodernism: formalism, semiotics, poststructuralism, feminism, Marxism, psychoanalysis, deconstruction.

**ArthH 5431. Age of Revolution: French Painting 1789 to 1870.** (3 cr)  
Major issues and movements in France and leading practitioners: neo-classicism–David; romanticism–Corot, Gericault, Delacroix; landscape and peasant painting–the Barbizon group; realism–Courbet; pre-Impressionism–Monet, Manet, Pissarro. Movements linked with historical changes emphasizing contextualization of monuments.

**ArthH 5454. Design Reform in the Era of Art Nouveau.** (3 cr)  
History of art nouveau in France, Belgium, England, Germany, Austria, Scotland, United States. Innovations in architecture, graphics, decorative arts; continental variants of the style. Major promoters and pioneers of modern design. Critical issues of design reform; texts integrated with principal monuments.

**ArthH 5463. Early 20th-Century Painting and Sculpture.** (3 cr)  
Primary movements of early 20th century: fauvism, German expressionism, cubism, futurism, dadaism, surrealism, non-objective painting, constructivism, Orphism, early abstraction. Framed against postimpressionism and internationalism at turn of century.

**ArthH 5465. American Sculpture: The Public Monument.** (3 cr)  
Case studies in American public sculpture of the 19th and 20th centuries including the 1893 Chicago Fair, the Iwo Jima and Vietnam Veterans Memorials, the Washington Monument, the Lincoln Memorial; careers of Daniel Chester French and Augustus St. Gaudens.

**ArthH 5466. Contemporary Art.** (3 cr. Prereq–3464 or #)  
Survey of the art and important critical literature of the period after 1970. Origins and full development of postmodern and subsequent aesthetic philosophies.

**ArthH 5521. Modernism and Modernity in American Painting: 1876 to 1945.** (3 cr)  
Relationship between modernity and “modernism” in the visual arts between the Centennial Exposition of 1876 and World War II. Artists addressed include the Ash Can School and the Regionalists.

**ArthH 5535. Style, Tradition, and Social Content in American Painting: Colonial Era to 1876.** (3 cr)  
America's colonial, Revolutionary era, and 19th-century painters' responses to the influence of European aesthetics. Key American painting types:

portraiture, rural genre, and landscape from Copley and Gilbert Stuart to the Hudson River School and the chroniclers of the Western frontier.

**Arth 5536. Topical Studies in American Art.** (3 cr)  
Course description varies from year to year, depending on the current research interests of the instructor and the needs and interests of advanced undergraduate and graduate students in modern and American art.

**Arth 5546. American Architecture: 1840 to 1914.** (3 cr)

American architecture from 1840 to 1914, examined in relation to European precedents and American sociohistorical conditions. Critical attention to problems of style, the architectural profession, vernacular vs. "high" architecture, technology, economics, urbanism, and social reform.

**Arth 5655. African American Cinema.** (3 cr)

African American cinematic achievements, from silent films of Oscar Micheaux through contemporary Hollywood and independent films. Class screenings, critical readings.

**Arth 5725. Ceramics in the Far East.** (3 cr)

Selective examination of representative pottery and ceramic wares produced in China, Korea, and Japan from the Neolithic era to modern times. Nearly every major ceramic type is represented.

**Arth 5765. Early Chinese Art.** (3 cr)

Develop a more effective way to understand the unique qualities of an individual work of art. Concentration is on accessible works of art in local private and museum collections.

**Arth 5766. Chinese Painting.** (3 cr)

Major works from the late bronze age to the modern era that illustrate the development of Chinese landscape painting and associated literary traditions.

**Arth 5767. Japanese Painting.** (3 cr)

Japanese pictorial arts from the late tomb period to the modern era; special attention to the development of indigenous traditions.

**Arth 5769. Connoisseurship in Asian Art.** (3 cr)

A selective examination of representative works of art produced in China from the Neolithic era to the Han Dynasty. Major archaeological sites and examples of art in local collections.

**Arth 5775. Formation of Indian Art: 2500 BCE to 300 CE.** (3 cr)

Sculpture/architecture, from Indus Valley civilization through Kushana period.

**Arth 5776. Redefining Tradition: Indian Art, 400 to 1300.** (3 cr)

India's art/architecture, from earliest free-standing temples through 13th century. Focuses on temples, associated sculpture. Mural painting, beginnings of Islamic architecture in India.

**Arth 5777. The Diversity of Traditions: Indian Art 1200 to Present.** (3 cr. Prereq—Art history course or #)

Issues presented by sculpture, architecture and painting in India from the prehistoric Indus Valley civilization to the present day.

**Arth 5781. Age of Empire: The Mughals, Safavids, and Ottomans.** (3 cr)

Artistic developments under the three most powerful Islamic empires of the 16th through 19th centuries: Ottomans of Turkey; Safavids of Iran; Mughals of India. Roles of religion and state will be considered to understand their artistic production.

**Arth 5785. Art of Islamic Iran.** (3 cr)

Architecture, painting, and related arts in Iran from the inception of Islam (7th century) through the 20th century. Understanding the nature of Islam in Persianate cultural settings and how artistic production here compares to the Islamic world.

**Arth 5925. History of Photography as Art.** (3 cr)

Origins and development of photography, with attention to technology and cultural impact. Major aesthetic achievements in photography from its beginning to present.

**Arth 5927. Documentary Cinema.** (4 cr; A-F only)

History of nonfiction filmmaking, from early forms of reportage and birth of documentary to emergence of "film-verite" and "guerrilla television" and work by independents (e.g., Errol Morris, Michael Moore).

**Arth 5940. Topics: Art of the Film.** (3-4 cr)

Topics in film history including individual directors (e.g., Hitchcock, Welles), genres (e.g., westerns, musicals), and other topics (e.g., American independent filmmaking, film noir).

**Arth 5950. Topics: Art History.** (2-4 cr [max 12 cr])

Topics specified in *Class Schedule*.

**Arth 5993. Directed Study.** (1-4 cr [max 12 cr]; A-F only. Prereq—#)

**Arth 5994. Directed Research.** (1-4 cr [max 12 cr]; A-F only. Prereq—#)

**Arth 8001. Art Historiography: Theory and Methods.** (3 cr; A-F only)

Key texts, from Renaissance to present, from western/non-western fields, relating to history/criticism of both art and visual culture. Focuses on recent critical theory, its re-examination of assumptions underlying the discipline.

**Arth 8190. Seminar: Issues in Ancient Art and**

**Archaeology.** (3 cr [max 12 cr]. Prereq—#)

Selected topics, with special attention to current scholarly disputes. Topics specified in *Class Schedule*.

**Arth 8200. Seminar: Medieval Art.** (3 cr [max 12 cr])

Focus on a major art historical theme, artist, period, or genre.

**Arth 8320. Seminar: Issues in Early Modern Visual**

**Culture.** (3 cr; A-F only)

Issues in visual culture of Europe and the Americas, 1500-1750. Topics vary, may include representation of body, collectors/collecting, impact of Reformation, image/book, art/discovery, early modern vision/visuality.

**Arth 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**Arth 8340. Seminar: Baroque Art.** (3 cr [max 12 cr]. Prereq—#)

Topics vary.

**Arth 8400. Seminar: Issues in 19th-Century Art.** (3 cr [max 12 cr]. Prereq—#)

Typical seminars have included symbolism, role of the academy and the avant-garde, surrealism in art and theory, and Franco-American relationships at the turn of the 20th century.

**Arth 8440. Seminar: Issues in Contemporary Art.** (3 cr [max 12 cr]; A-F only. Prereq—#)

Identity politics in contemporary art. Theories of performance/performativity. Nationalism/sexuality in art since 1980s. Discourses of death in postmodernism. Body at turn of 21st century.

**Arth 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**Arth 8520. Seminar: American Art and Material Culture.** (3 cr [max 12 cr]. Prereq—#)

Topics in American art, popular art, and material culture, emphasizing methods and techniques of inquiry: creation and use of archives, oral history, sources for pictorial evidence, and current approaches to interpreting traditional and non-traditional data.

**Arth 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Arth 8710. Seminar: Islamic Art.** (3 cr [max 12 cr]. Prereq—#)

Focus depends on current research interests of the professor and needs and interests of graduate students in Islamic and Asian art history.

**Arth 8720. Seminar: East Asian Art.** (3 cr [max 12 cr]. Prereq—#)

Research focuses on closely defined topic, such as a short period of Chinese art, a restricted subject, or role of a single artist. A substantive research paper is required and participation in the seminar dialogue is expected.

**Arth 8770. Seminar: Art of India.** (3 cr [max 12 cr]. Prereq—3 cr art hist, #)

Selected problems and issues in history of South Asian art. Topic varies by offering.

**Arth 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

**Arth 8920. Seminar: Film History and Criticism.** (3 cr [max 12 cr]. Prereq—#)

Selected topics in film history and theory, including specific directors, genres, movements, periods, and critical issues (e.g., violence).

**Arth 8950. Seminar: Issues in the History of Art.** (3 cr [max 12 cr]. Prereq—3 cr art hist, #)

Theoretical or topical issues; topic varies.

**Arth 8970. Directed Studies.** (1-3 cr [max 12 cr]. Prereq—#)

## Asian Languages and Literatures (ALL)

*Department of Asian Languages and Literatures  
College of Liberal Arts*

**ALL 5900. Topics in Asian Literature.** (1-4 cr [max 16 cr])

Topics specified in *Class Schedule*.

**ALL 5920. Topics in Asian Culture.** (1-4 cr [max 16 cr])

Topics specified in *Class Schedule*.

## Astronomy (Ast)

*Department of Astronomy  
Institute of Technology*

**Ast 5012. The Interstellar Medium.** (4 cr. Prereq—2001, Phys 2601 or #)

Survey of physical processes in the interstellar medium. Dynamic processes, excitation processes, emission and absorption by gas and dust. Hot bubbles, HII regions, molecular clouds.

**Ast 5022. Relativity, Cosmology, and the Universe.**

(4 cr. \$Phys 5022. Prereq—[2001, Phys 2601] or #)  
Large-scale structure/history of universe. Introduction to Newtonian/relativistic world models. Physics of early universe, cosmological tests, formation of galaxies.

**Ast 5201. Methods of Experimental Astrophysics.**

(4 cr. Prereq—Upper div IT or grad or #)  
Contemporary astronomical techniques and instrumentation. Emphasizes data reduction and analysis, including image processing. Students make astronomical observations at O'Brien Observatory and use department's computing facilities for data analysis. Image processing packages include IRAF, AIPS, IDL, MIRA.

**Ast 8001. Radiative Processes in Astrophysics.** (4 cr. Prereq—#)

Introduction to classical/quantum physics of electromagnetic radiation as it applies to astro-physics. Emphasizes radiative processes (e.g., emission, absorption, scattering) in astrophysical contexts (e.g., ordinary stars, ISM, neutron stars, active galaxies).

**Ast 8011. High Energy Astrophysics.** (4 cr. Prereq—#)  
Energetic phenomena in the universe. Radiative processes in high energy regimes; supernovae, pulsars, and X-ray binaries; radio galaxies, quasars, and active galactic nuclei.

**Ast 8021. Stellar Astrophysics.** (4 cr. Prereq-#)  
Stellar structure, evolution, and star formation. Emphasizes contemporary research.

**Ast 8031. Astrophysical Fluid Dynamics.** (4 cr. Prereq-#)  
Contemporary topics. Numerical techniques for modeling astrophysical fluids and plasmas. Supernovae shocks, convection, astrophysical jets, and cloud dynamics.

**Ast 8041. Comparative Planetology.** (4 cr. Prereq-#)  
Overview of current knowledge of the solar system. Formation history of protostellar nebula, physical properties of major planetary bodies/moons. Sun and fossils of epoch of planetary system formation: comets, asteroids, minor bodies.

**Ast 8051. Galactic Astronomy.** (4 cr. Prereq-#)  
Content, structure, evolution, and dynamics of Milky Way Galaxy. Emphasizes recent observations from space-/ground-based telescopes.

**Ast 8061. Radio Astronomy.** (4 cr. Prereq-#)  
Techniques/applications of radio astronomy. Basics of signal-to-noise ratios. Sensitivities/applications of Fourier transform and power spectra. Aperture synthesis, single dish applications. Observing of continuum emission and spectral line emission/absorption, astrophysical examples.

**Ast 8071. Infrared Astronomy.** (4 cr. Prereq-#)  
Techniques/applications of infrared astronomy. Basics of signal-to-noise ratios/sensitivities, challenges of developing infrared instrumentation. Observations of continuum emission (blackbody, free-free, synchrotron). Spectral line emission/absorption, infrared polarization. Astrophysical examples.

**Ast 8081. Cosmology.** (4 cr. Prereq-#)  
Role of gravity in cosmology. Background, recent research advances.

**Ast 8110. Topics in Astrophysics.** (2-4 cr. Prereq-#)

**Ast 8120. Topics in Astrophysics.** (2-4 cr. Prereq-#)

**Ast 8200. Astrophysics Seminar.** (1-3 cr. Prereq-#)

**Ast 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**Ast 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**Ast 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Ast 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Ast 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

**Ast 8990. Research in Astronomy and Astrophysics.** (1-4 cr. Prereq-#)  
Research under supervision of a graduate faculty member.

## Biochemistry (BioC)

**Department of Biochemistry, Molecular Biology, and Biophysics**

**College of Biological Sciences and the Medical School**

**BioC 5001. Biochemistry, Molecular and Cellular Biology.** (5 cr. \$6001. Prereq-Undergrad course in biochemistry, #)

Integrated course in biochemistry, molecular biology, cell biology, and developmental biology.

**BioC 5309. Biocatalysis and Biodegradation.** (3 cr. \$MicE 5309. Prereq-Chemistry through organic chemistry; knowledge of word processing, e-mail, access to World Wide Web, access to college-level science library recommended)

Assess validity of information on biocatalysis and biodegradation; learn fundamentals of microbial catabolic metabolism as it pertains to biodegradation of environmental pollutants; biocatalysis for specialty chemical synthesis; display of this information on the Web.

**BioC 5352. Applied Microbial Biochemistry.** (3 cr. \$MicB 5352. Prereq-Biol/BioC 3021 or BioC 4331 or MicB 4111, MicB 3301 or Biol 3301 or #)  
Biochemistry of microorganisms and enzymes of industrial interest. Heterologous peptide overproduction by microorganisms and yeasts; polymer, antibiotic, organic acid, and amino acid production; genetics of industrially useful microorganisms; biological systems useful for biotransformation and environmental remediation; introduction to fermentation technology.

**BioC 5361. Microbial Genomics and Bioinformatics.** (3 cr. Prereq-College-level courses in [organic chemistry, biochemistry, microbiology])  
Introduction to genomics. Emphasizes microbial genomics. Sequencing methods, sequence analysis, genomics databases, genome mapping, prokaryotic horizontal gene transfer, genomics in biotechnology, intellectual property issues.

**BioC 5401W. Advanced Metabolism and Its Regulation.** (3 cr. Prereq-3021 or 4331 or Biol 3021)  
Underlying principles that determine metabolism of common/unusual compounds in plants, animals, microorganisms. Regulation of carbon, energy flow in whole organisms.

**BioC 5444. Muscle.** (3 cr. \$Phsl 5444. Prereq-Biol/BioC 3021 or BioC 4331 or Phsl 3061 or #)  
Muscle structure/function: molecular mechanism by which force is generated.

**BioC 5446. Membrane Biochemistry.** (2 cr. Prereq-3021 or 4331 or Biol 3021 or #)  
Membrane structure. Mechanisms and physiological roles of channels, pumps, and membrane enzymes.

**BioC 5527. Introduction to Modern Structural Biology.** (4 cr. Prereq-[Intro biochemistry, intro physics] or physical chemistry or #)  
Methods employed in modern structural biology to elucidate macromolecular structures. Primary focus on X-ray diffraction, nuclear magnetic resonance (NMR) spectroscopy and mass spectrometry. Principles underlying structural biology and structure/function relationships.

**BioC 5528. Spectroscopy and Kinetics.** (4 cr. Prereq-Intro physical chemistry or equiv; intro biochemistry recommended)  
Biochemical dynamics from perspectives of kinetics and spectroscopy. Influence of structure, molecular interactions, and chemical transformations on biochemical reactions. Focuses on computational, spectroscopic, and physical methods. Steady-state and transient kinetics. Optical and magnetic resonance spectroscopies.

**BioC 5530. Selected Topics in Molecular Biophysics.** (1-3 cr [max 9 cr]. Prereq-5527 or 5528 or equiv)  
Topics from current literature on biophysics of proteins, nucleic acids, muscle, membranes. Content/instructors vary from one offering to another, on an approximately every other year rotation.

**BioC 5531. Macromolecular Crystallography I: Fundamentals and Techniques.** (1 cr; S-N only. Prereq-[[One organic chemistry or biochemistry course], [two calculus or college physics courses]] or #)  
Macromolecular crystallography for protein structure determination/engineering. Determining macromolecule structure by diffraction.

**BioC 5532. Macromolecular Crystallography II: Techniques and Applications.** (1 cr; S-N only. Prereq-5531)  
Determining structure of macromolecule by diffraction. Using software in macromolecular crystallography.

**BioC 8001. Advanced Biochemistry I: Protein Structure, Function, and Metabolism.** (4-5 cr. Prereq-[One sem biochem, two sems organic chem, one sem physical chem] or #)

Protein structure, methods to determine structure, protein folding, forces stabilizing macromolecular structure, protein engineering, design. Dynamic properties of proteins/enzymes, enzyme substrate complexes, mechanism of enzyme catalysis. Enzymology of metabolic regulation and cell signaling.

**BioC 8002. Molecular Biology and Regulation of Biological Processes.** (4 cr. Prereq-BMBB or MCDB&G grad student or #)  
Structure/stability of nucleic acids, genome organization. Chromosome mechanics, including DNA replication, recombination, and transposable elements. Mechanism/regulation of gene expression, including transcription, processing, and translation. Genetic/enzymatic controls. Cell cycle controls. Regulation of development.

**BioC 8007. Cell Biology and Biochemistry of the Extracellular Matrix.** (3 cr; A-F only. \$MIMP 8007. Prereq-8002 or MIMP 8002 or MIMP 8004 or #)  
Concepts in cell adhesion/tissue composition. Importance of cell adhesion in tissue function/disease. Structure/function/assembly of tissue components. Cellular adhesion mechanisms.

**BioC 8084. Research and Literature Reports.** (1 cr [max 5 cr]; S-N only. Prereq-Grad BMBB major or #)  
Current developments.

**BioC 8184. Graduate Seminar.** (1 cr [max 5 cr]; S-N only. Prereq-Grad BMBB major or DGS consent)  
Reports on recent developments in the field and on research projects in the department.

**BioC 8213. Selected Topics in Molecular Biology.** (4 cr. \$GCD 8213. Prereq-8002 or #)  
Current topics such as DNA replication, recombination and gene conversion, regulation of gene expression, chromatin structure and transcription, developmental gene regulation, organellar gene expression, RNA splicing, initiation/control of translation, animal viruses, transposable elements, somatic recombination, oncogenes.

**BioC 8216. Signal Transduction and Gene Expression.** (4 cr. Prereq-8002 or #)  
Cell signaling, metabolic regulation in development. Prokaryotic/eucaryotic systems used as models for discussion. Literature-based course.

**BioC 8290. Current Research Techniques.** (1-3 cr [max 9 cr]; S-N only. Prereq-Grad BMBB major)  
Research project carried out in laboratory of a staff member.

**BioC 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**BioC 8401. Ethics, Public Policy, and Careers in Molecular and Cellular Biology.** (1 cr [max 2 cr]; S-N only. Prereq-Grad student in [BMBB or MCDB&G])  
Ethics of scientific investigation from viewpoint of western scientific enterprise. Relationship between science, culture, and public policies. Careers in molecular/cellular biology. Nontraditional career tracks. Invited speakers, case studies, small-group discussions, lectures.

**BioC 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**BioC 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**BioC 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**BioC 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

## Bioinformatics (Binf)

*Department of Laboratory Medicine and Pathology  
Medical School*

**Binf 5480. Bioinformatics Journal Club.** (1 cr [max 12 cr]; S-N only)  
Bioinformatics Journal Club.

**Binf 5490. Topics in Bioinformatics.** (1-6 cr [max 12 cr]. Prereq-#)  
Independent or group study in bioinformatics.

## Biology (Biol)

*College of Biological Sciences*

**Biol 5407. Ecology.** (3 cr. \$3407. Prereq-[[1001 or 1009 or equiv], [Math 1142 or Math 1271 or equiv], grad] or #)  
Principles of population growth/interactions and ecosystem function applied to ecological issues, including regulation of human populations, dynamics/impacts of disease, invasions by exotic organisms, habitat fragmentation, and biodiversity. Lab.

**Biol 5409. Evolution.** (3 cr. \$3409. Prereq-[[1001 or 1009], grad] or #)  
Diversity of forms in fossil record and in presently existing biology. Genetic mechanisms of evolution. Examples of ongoing evolution in wild/domesticated populations and in disease-causing organisms. Lab.

**Biol 5511. Teaching the Biological Sciences.** (3 cr; A-F only. Prereq-6 cr in the life sciences)  
Methods and teaching styles used by outstanding university teachers including reviews and critiques from research on teaching. Opportunities for students to practice and evaluate teaching strategies.

**Biol 5910. Special Topics in Biology for Teachers.** (1-4 cr [max 12 cr]. Prereq-BA or BS in science or science education or elementary education or K-12 licensed teacher)  
Courses developed for K-12 teachers depending on topics or subtopics which might include any of the following: plant biology, animal biology, genetics, cell biology, biochemistry, microbiology.

**Biol 5913. Biology for Teachers: Monarchs in the Classroom.** (3 cr. Prereq-[[Elementary or middle school or high school or preservice] teacher or #], application)  
Two-week summer workshop. Week one focuses on monarch butterfly biology taught through fieldwork, labs, lecture, and research projects. A 2- to 3-week break follows, when students raise monarchs, conduct simple experiments. Week two focuses on designing classroom activities/projects based on monarch biology. Follow-up meetings held during academic year.

## Biomedical Engineering (BME)

*Biomedical Engineering  
Institute of Technology*

**BME 5001. Advanced Biomaterials.** (3 cr; A-F only. Prereq-3301 or MatS 3011 or grad student or #)  
Commonly used biomaterials. Chemical/physical aspects. Practical examples from such areas as cardiovascular/orthopedic applications, drug delivery, and cell encapsulation. Methods used for chemical analysis and for physical characterization of biomaterials. Effect of additives, stabilizers, processing conditions, and sterilization methods.

**BME 5041. Tissue Engineering.** (3 cr. Prereq-IT upper div or grad student or med student or #)  
Fundamentals of wound healing and tissue repair; characterization of cell-matrix interactions; case study of engineered tissues, including skin, bone marrow, liver, vessel, and cartilage; regulation of biomaterials and engineered tissues.

**BME 5101. Advanced Bioelectricity/Instrumentation.** (3 cr. Prereq-Phsl 5440, calculus, college physics)  
Instrumentation, computer systems, and processing requirements for clinical physiological signals. Electrode characteristics, signal processing, and interpretation of physiological events by ECG, EEG, and EMG. Measurement of respiration and blood volume/flow.

**BME 5102. Bioelectric Measurements and Therapeutic Devices II.** (3 cr. Prereq-5101)  
Theory and application of electrical stimulation in areas of therapeutic and functional neuromuscular stimulation and pain control, cardiac pacing, defibrillation, tissue healing, and electrotherapy. Safety of electric fields. Electrical tissue impedance measurements.

**BME 5151. Biomedical MEMS.** (4 cr; A-F only. Prereq-Analog circuit principles, basic electromagnetic theory)  
Survey of solid-state biomed transducers. Physical principles of operation and technology implementation of microsensors/microactuators. Physical, chemical, and biomed sensors. Actuators for surgery. Other precision positioning applications, materials, and fabrications. Emphasizes recent advances in biomed microelectromechanical systems.

**BME 5201. Advanced Biomechanics.** (3-4 cr. Prereq-[[IT upper div or grad student], AEM [statics, deformable media] or #)  
Introduction to biomechanics of musculoskeletal system. Anatomy, tissue material properties. Kinematics, dynamics, and control of joint/limb movement. Analysis of forces/motions within joints. Application to injury, disease. Treatment of specific joints, design of orthopedic devices/implants.

**BME 5311. Advanced Biomedical Transport Processes.** (3-4 cr. Prereq-IT upper div or grad student or #; [ChEn 5103 or ME 5342] recommended)  
Introduction to biological fluid, mass, and heat transport. Mass transfer across membranes. Fluid flow in vessels/interstitium. Heat transfer in cells, tissues, and body. Applications to blood oxygenation, respiration, drug delivery, and tissue engineering.

**BME 5351. Cell Engineering.** (3 cr. Prereq-5301 or equiv, 5310 or equiv, 5201 or equiv, IT upper div or grad student or #)  
Survey of engineering approaches to cell-related phenomena important to cell and tissue engineering: receptor/ligand binding, trafficking and signaling processes; applications to cell proliferation, adhesion, and motility; cell-matrix interactions.

**BME 5371. Biomedical Applications of Heat Transfer in Humans.** (3-4 cr. Prereq-Phsl 3061, Phsl 3071, Phsl 5061)  
Overview of physiology underlying thermoregulation in humans, clinical applications of heat transfer in humans, framework for design project.

**BME 5444. Muscles.** (3 cr)  
Muscle structure/function: molecular mechanism by which force is generated.

**BME 5501. Biology for Biomedical Engineers.** (3-4 cr. Prereq-Engineering upper div or grad student)  
Concepts of cell/tissue structure/function. Basic principles of cell biology. Tissue engineering, artificial organs.

**BME 5502. Pathobiology of Medical Devices.** (3 cr; A-F only. Prereq-IT upper division or grad student)  
Biological response to biomaterials presented in context of fundamental principles of cell injury, adaptation, repair, or death. Diversity of medical uses of biomaterials, by organ system. Unique features of specific biological systems in which medical devices are used.

**BME 5910. Special Topics in Biomedical Engineering.** (1-4 cr)  
Special topics.

**BME 5920. Special Topics in Biomedical Engineering.** (2-4 cr)

**BME 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**BME 8401. New Product Design and Business Development.** (4 cr; A-F only. Prereq-[[IT grad student or CSOM grad student], some design experience; 8401, 8402 must be taken same yr)  
Student teams work with IT and CSOM faculty and company representatives to develop a product concept for sponsoring company. Assignments include concept/detail design, manufacturing, marketing, introduction strategy, profit forecasting, production of product prototype.

**BME 8402. New Product Design and Business Development.** (4 cr; A-F only. Prereq-8401)  
Student teams work with IT and CSOM faculty and company representatives to develop a product concept for sponsoring company. Assignments include concept/detail design, manufacturing, marketing, introduction strategy, profit forecasting, production of product prototype.

**BME 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**BME 8601. Biomedical Engineering Seminar.** (1 cr; S-N only)  
Lectures and demonstrations of university and industry research introducing students and faculty to methods and goals of biomedical engineering.

**BME 8602. Biomedical Engineering Seminar.** (1 cr; S-N only)  
Lectures and demonstrations of university and industry research introducing students and faculty to methods and goals of biomedical engineering.

**BME 8630. Biomedical Engineering Graduate Student Seminar.** (1 cr [max 3 cr]; S-N only. Prereq-Grad BME major)  
Student presentations of current thesis research or other areas of biomedical engineering.

**BME 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**BME 8710. Directed Research.** (1-3 cr)

**BME 8720. Internship in Biomedical Engineering.** (3 cr [max 3 cr]; S-N only. Prereq-Grad BME major)  
Supervised lab or industrial experience unrelated to student's normal academic or employment experience.

**BME 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**BME 8820. Plan B Project.** (3 cr [max 3 cr]. Prereq-BME MS student)  
Project chosen by student and adviser to satisfy M.S. Plan B project requirement. Written report required.

**BME 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

**BME 8900. Special Topics in Biomedical Engineering.** (1-4 cr; A-F only)  
Topics in biomedical engineering.

**BME 8910. Independent Study.** (1-3 cr [max 3 cr]. Prereq-Grad BME major)  
Research or study of a topic determined by interests of student in consultation with faculty supervisor. Requires approval by faculty supervisor and director of graduate studies.

## Biomedical Science (BMS)

*Medical School*

**BMS 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**BMS 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**BMSc 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer; 24 cr required)

**BMSc 8990. Research: Biomedical Sciences.** (1-7 cr [max 42 cr]; S-N only. Prereq–Enrollment in MD/PhD program)

Content determined by interest of student in consultation with staff.

## Biophysical Sciences (BPhy)

*School of Physics and Astronomy*

*Institute of Technology and Medical School*

**BPhy 5138. Research Seminar.** (1 cr [max 4 cr]; S-N only)

Topics introduce techniques/goals of biophysical sciences and medical physics. Lectures/demonstrations.

**BPhy 5139. Seminar and Journal Club.** (1 cr [max 2 cr]; S-N only)

Current research/topics related to goals/methods of biophysical sciences and medical physics. Lectures/discussions.

**BPhy 5170. Basic Radiological Physics.** (3 cr. Prereq–#)

Theoretical/experimental aspects of radiological physics. Physical properties of various ionizing radiations, interactions of ionizing radiations with matter, methods of radiation dose measurement.

**BPhy 5171. Medical and Health Physics of Imaging I.** (3 cr. Prereq–5170 or #)

Physics of diagnostic imaging: specification/quantification of image quality, X-ray production, image receptors, magnetic resonance imaging, radiation exposure and protection. Special imaging techniques, including mammography, computed tomography, and direct digital image capture.

**BPhy 5172. Radiation Biology.** (3 cr. Prereq–5170 or #)

Effects of ionizing radiation on cells, tissues, and organisms. Biochemical/physiological bases of radiation effects. Biological rationale for radiation therapy practices.

**BPhy 5173. Medical and Health Physics of Radiation Therapy.** (3 cr. Prereq–5170 or #)

Measurements of radiation quality, output, and depth dose distributions for clinical use. Treatment parameter calculation. Beam modification and shaping. Treatment planning for fixed field and rotational therapy in external beam, intracavitary, and interstitial therapy. Computer applications in treatment planning. Principles/criteria for radiation protection.

**BPhy 5174. Medical and Health Physics of Imaging II.** (3 cr. Prereq–5170 or #)

Physics of diagnostic imaging. Ultrasound, theoretical/experimental applications of radionuclides in medicine and biology. Counting statistics and imaging systems associated with radiopharmaceuticals, radiation dosimetry, and safety in nuclear medicine.

**BPhy 8147. Advanced Physics of Magnetic Resonance Imaging (MRI).** (3 cr. Prereq–5174 or #)

NMR (nuclear magnetic resonance) and MRI physics, spatial selection and encoding, imaging hardware and system engineering. Imaging sequences, associated contrast/resolution. Recent developments in MRI.

**BPhy 8148. Advanced Digital Imaging Science.** (3 cr. Prereq–5171 or #)

Role of digital image science in medical imaging. Measurement of image quality, digital radiography. Image reconstruction for CT, SPECT, PET, and MRI. 3D image processing, image registration/visualization. Picture archiving, communications systems.

**BPhy 8293. Directed Study in Biophysical Sciences and Medical Physics.** (1-12 cr [max 12 cr]. Prereq–#)

Individualized study under faculty direction.

**BPhy 8294. Directed Research in Biophysical Sciences and Medical Physics.** (1-12 cr [max 12 cr]. Prereq–#)

Individualized research under faculty direction.

**BPhy 8333. FTE: Master's.** (1 cr; NGA. Prereq–Master's student, adviser and DGS consent)

**BPhy 8444. FTE: Doctoral.** (1 cr; NGA. Prereq–Doctoral student, adviser and DGS consent)

**BPhy 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq–Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**BPhy 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq–Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**BPhy 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer; 24 cr required)

## Biosystems and Agricultural Engineering (BAE)

*Institute of Technology and College of Agricultural, Food and Environmental Sciences*

**BAE 5095. Special Problems.** (1-5 cr. Prereq–#)

Advanced individual-study project. Application of engineering principles to specific problem.

**BAE 5513. Watershed Engineering.** (3 cr. Prereq–3023, upper div IT)

Application of engineering principles to managing surface runoff from agricultural, range, and urban watersheds. Design of facilities and selection of land use practices for controlling surface runoff to mitigate problems of flooding and degradation of surface-water quality.

**BAE 8001. Seminar.** (1 cr; S-N only. Prereq–#)

Presentation and discussions on current research topics, research philosophy and principles, proposal writing, and professional presentations.

**BAE 8002. Research Seminar I.** (1 cr [max 2 cr]; S-N only. Prereq–8001 or #8001 or equiv)

Organization/critique of seminars on new developments in biosystems and agricultural engineering.

**BAE 8003. Research Seminar II.** (1 cr [max 2 cr]; S-N only. Prereq–8002 or equiv)

Moderate and critique seminars in biosystems and agricultural engineering.

**BAE 8005. Supervised Classroom or Extension Teaching Experience.** (2 cr; S-N only. \$Agro 8005, \$Hort 8005, \$PIPa 8005, \$Soil 8000. Prereq–#)

Teaching experience is offered in the following departments: Biosystems and Agricultural Engineering; Agronomy and Plant Genetics; Horticultural Science; Soil, Water, and Climate; Plant Pathology. Discussions about effective teaching to strengthen skills and develop a personal teaching philosophy.

**BAE 8013. Parameter Estimation in Biosystems and Agricultural Engineering.** (3 cr; A-F only. Prereq–Stat 3021 or equiv, computer programming course)

Procedures for estimating parameter values and parameter uncertainty from experimental data. Values and interpretation of linear and nonlinear models using ordinary and weighted least-square methods. Design of experiments. Application to biosystems and agricultural engineering problems.

**BAE 8094. Advanced Problems and Research.** (2-6 cr. Prereq–5095)

**BAE 8303. Machinery Modeling.** (3 cr. Prereq–AEM 2021, CE 3502)

Machinery systems modeling using multibody dynamics simulation software (MBS). Students review models presented in the literature and report on limitations of modeling approaches used. Models are developed in the students' areas of interest.

**BAE 8333. FTE: Master's.** (1 cr; NGA. Prereq–Master's student, adviser and DGS consent)

**BAE 8444. FTE: Doctoral.** (1 cr; NGA. Prereq–Doctoral student, adviser and DGS consent)

**BAE 8513. Hydrologic Modeling of Small Watersheds.** (3 cr. Prereq–CE 3502, hydrology course)

Study and representation of hydrologic processes by mathematical models: stochastic meteorological variables, infiltration, overland flow, return flow, evapotranspiration, and channel flows. Approaches for model calibration and evaluation.

**BAE 8523. Coupled Heat, Moisture, and Chemical Transport in Porous Media.** (3 cr; A-F only. Prereq–CSci 5301 or equiv, Math 5512-5513 or equiv, Soil 5232 or equiv, computer programming)

Series of five projects to develop computer programs to solve governing equations.

**BAE 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq–Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**BAE 8703. Managing Water in Food and Biological Systems.** (3 cr. Prereq–Chem 3501 or FScN 5451 or Mats 3011 or #)

Qualitative and quantitative analysis of water in foods and biological materials using NMR and MRI. Water and chemical reactivity, microbial activity, physiochemical properties and changes, and structural properties and changes in foods and biological materials.

**BAE 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq–Max 18 cr per semester or summer; 10 cr total required [Plan A only].)

**BAE 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer; 24 cr required)

## Business Administration (BA)

*Curtis L. Carlson School of Management*

**BA 8444. FTE: Doctoral.** (1 cr; NGA. Prereq–Doctoral student, adviser and DGS consent)

**BA 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq–Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**BA 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer; 24 cr required)

## Business and Industry Education (BIE)

*Department of Work, Community, and Family Education*

*College of Education and Human Development*

**BIE 5001. Teaching Marketing Promotion.** (3 cr; A-F only)

Materials, methods, and approaches to teaching marketing promotion. Covers the basic elements of the marketing mix: advertising, promotion, public relations, direct selling, visual merchandising, and direct marketing.

**BIE 5011. Introduction to Computer Applications.** (3 cr)

Instructional uses of computers and representative business/marketing education applications, including word processing, databases, spreadsheets, and graphics.

**BIE 5012. Advanced Word Processing.** (3 cr. Prereq–5011 or equiv)

Develop/apply solution methods for office problems using word processing software including advanced editing, printing, and desktop publishing capabilities.

**BIE 5013. Spreadsheet Analysis Using Computers.** (3 cr. Prereq–5011 or equiv)  
Using spreadsheets to analyze data, monitor business records, and create models.

**BIE 5014. Database Computer Applications.** (3 cr. Prereq–5011 or equiv)  
Business needs for computerized databases. Using database software to develop, maintain, and prepare reports.

**BIE 5015. Integrated Computer Applications in Business and Marketing Education.** (3 cr. Prereq–[5011, 5012, 5013, 5014] or equiv)  
Realistic business computer problems requiring integration of two or more application packages. Pedagogical issues of learning/teaching advanced computer applications.

**BIE 5080. Special Topics in Business and Industry Education.** (1-4 cr [max 4 cr])  
Content varies by offering.

**BIE 5101. Technological Problem Solving.** (3 cr; A-F only. Prereq–3111, 3112, 3121, 3122)  
Capstone technology education course in which students research problems relative to various technological systems and develop solution(s) to the identified problems.

**BIE 5151. Technical Development: Specialized.** (1-12 cr [max 12 cr]; A-F only. Prereq–#)  
Students select/study technical processes/principles based on subjects they plan to teach, integrate specialized technical instruction in advanced/emerging areas.

**BIE 5321. Vocational Guidance in Business and Industry Education.** (2 cr; A-F only)  
Self assessment, use of occupational and labor market information, job seeking skills, work and work satisfaction. For industrial teachers and trainers in school and industry settings.

**BIE 5325. Foundations of Industrial Education.** (3 cr)  
Social, economic, psychological, philosophical, legislative, and pedagogical foundations of industrial education in the United States. Comparison with selected foreign countries. Analysis of contemporary trends against backdrop of early foundations.

**BIE 5344. Facilities Management in Business and Industry.** (3 cr; A-F only. Prereq–3112)  
Planning, evaluating, and managing industrial education shop and lab facilities.

**BIE 5365. Curriculum Development in Technology Education.** (3 cr)  
Conceptualization and derivation of content for the K-12 technology curriculum. Comparison of U.S. approaches to technology curriculum with selected countries.

**BIE 5440. Business and Industry Observation and Seminar.** (1-3 cr [max 6 cr])  
Current operating practices and career opportunities in business and industry. Planned experiences in work environments and related seminars.

**BIE 5452. Methods of Teaching Business and Marketing Concepts.** (3 cr; A-F only)  
Recent research/developments in teaching business concepts related to economics, business organization/management, business law, entrepreneurship, marketing, international business, information systems, accounting, risk management, and personal finance.

**BIE 5457. Methods of Teaching Business Employment and Marketing Employment.** (3 cr; A-F only)  
Recent research/developments in teaching for business employment. Administrative support positions, accounting/information processing, marketing, sales, computer operations, other occupations using desktop computing.

**BIE 5463. Methods in Teaching Keyboarding and Word Processing.** (2 cr; A-F only)  
Implementing keyboarding and word processing; effective teaching strategies; expected learner outcomes; evaluation methods; selecting hardware; instructional materials (including print, software, Internet); organizing and managing labs.

**BIE 5475. Curriculum Development for Business and Marketing Education.** (3 cr; A-F only)  
Introduction to conceptual models for design/delivery of business/marketing education programs in secondary/postsecondary schools, in adult education settings, and in business/industry. Preparing programs of instruction for secondary/postsecondary level. Making decisions regarding course content.

**BIE 5596. Occupational Experience in Business and Industry.** (1-10 cr [max 10 cr]; S-N only. Prereq–#)  
Observation/employment in business/industry to develop technical/occupational competencies. Includes 100 clock hours of supervised work experience per credit.

**BIE 5597. Internship: Business and Industry Education.** (1-8 cr [max 12 cr]; S-N only. Prereq–#)  
Practical experience in business or industry as a professional educator or supervisor. Requires an integrative paper.

**BIE 5605. Critical Issues in Business and Industry.** (3 cr)  
Identification and analysis of major current issues in business and industry education.

**BIE 5624. Sales Training.** (3 cr; A-F only)  
Training competent customer service employees as part of a marketing strategy. Explore training strategies using the appropriate instructional methods for different settings and situations.

**BIE 5625. Technical Skills Training.** (3 cr)  
Analyze technical skills and training practices in business and industry; systems and process analysis; trouble-shooting of work behavior; design methods and developing training materials.

**BIE 5626. Customer Service Training.** (3 cr; A-F only)  
Overview of customer service strategies used by successful organizations and training practices used to develop customer-oriented personnel.

**BIE 5627. Management and Supervisory Development.** (3 cr)  
Problems, practices, programs, and methodologies relating to the training and development of managers and supervisors, including needed competencies, needs assessment, delivery modes, and evaluation.

**BIE 5628. Multimedia Presentations in Business.** (3 cr. Prereq–5011 or equiv)  
Designing, creating, and presenting information using multimedia resources in business settings.

**BIE 5662. Computer Training in School and Industry Settings.** (3 cr. Prereq–5011 or equiv)  
Alternative teaching practices for business applications software: word processors, spreadsheets, graphics, desktop publishing, databases, and communications; public school and industry settings.

**BIE 5796. Field Based Projects in Business and Industry.** (1-4 cr [max 4 cr]; S-N only)  
Curricular, instructional, developmental, or evaluative problems and projects applicable to local school or business and industry situations.

**BIE 5801. The Business of Tourism.** (3 cr; A-F only)  
Introduction to major theories, concepts, skills, and techniques influencing tourism business/industry.

**BIE 5802. Education and Human Resource Development Through Tourism.** (3 cr; A-F only)  
Policies/practices of education and human resource development in tourism industry.

**BIE 5803. Tourism Studies Capstone Seminar.** (3 cr; S-N only. Prereq–Tourism studies major)  
Students present, critique, and discuss implications of supporting programs for tourism.

**BIE 5993. Directed Study in Business and Industry.** (1-4 cr [max 4 cr])  
In-depth individual inquiry in the content areas related to business and industry.

**BIE 8995. Research Problems: Business and Industry.** (3-6 cr [max 6 cr]; S-N only. Prereq–Adviser approval)  
Individual research in business and industry education.

## Business Law (BLaw)

### Department of Accounting

#### Curtis L. Carlson School of Management

**BLaw 5078. Partnerships and Corporations.** (2 cr)  
Partnership and corporate forms of business entities, including methods of creating the relationships and the study of law used to regulate and control these organizations and their members.

**BLaw 5088. Law of Personal Property, Real Property, and Commercial Paper.** (2 cr)  
Basic concepts of personal property, including rights of possessors, bailees, and finders and holders of security interests. Real property law. Transfers of ownership, control of and encumbering such interests. The law of paper (negotiable instruments).

## Center for Spirituality and Healing (CSpH)

### Health Sciences

**CSpH 5000. Explorations in Complementary Therapies and Healing Practices.** (1-4 cr [max 12 cr]. Prereq–Jr or sr or grad student or #)  
Research/practice, delivery of complementary therapies, regulatory issues.

**CSpH 5101. Introduction to Complementary Healing Practices.** (3 cr. Prereq–Jr or sr or grad student or #)  
Cultural contexts of healing traditions. Complementary therapies presented by practitioners, including traditional Chinese medicine, meditation, mind-body healing, spiritual practices, energy healing, naturopathy, herbalism, movement therapies, homeopathy, manual therapies, and nutrition.

**CSpH 5102. Art of Healing: Self as Healer.** (1 cr. Prereq–Jr or sr or grad student or #)  
Introduction to individual transformational journey as part of health science education. Students become aware of their responsibility/resources to facilitate development of the self. Research data, experience of self that is part psychoneuroimmunology, mind-body-spirit approaches. Lecture, scientific literature, meditation, imagery, drawing, group interaction.

**CSpH 5111. Ways of Thinking About Health.** (2 cr. Prereq–Jr or sr or grad student or #)  
Diverse healing traditions of selected cultures. Use of herbal medicines as essential component of social structure. Links between nature, humans, and indigenous healers. Use of foods as healing medicines in India, China, and ancient Greece. Connection between spirituality and healing powers in indigenous/modern cultures. Rise of scientific traditions, their influence on ways of thinking about healing.

**CSpH 5201. Spirituality and Resilience.** (2 cr. Prereq–Jr or sr or grad student or #)  
Links between resilience and spirituality. Applications of resilience/health realization model to students' personal/professional lives. Review of literature, theory, and research.

**CSpH 5211. Peacemaking and Spirituality: A Journey Toward Healing and Strength.** (3 cr; A-F only. Prereq–Jr or sr or grad student or #)  
Influence of spirituality on resolving conflict, making peace in intense interpersonal/intrapersonal conflicts in multiple health care, social work settings.

**CSpH 5215. Forgiveness and Healing: A Journey Toward Wholeness.** (2 cr. Prereq–Jr or sr or grad student or #)  
Impact of forgiveness on process of inter-/intra-personal healing. Forgiveness/healing in health care and social work settings from multiple spiritual/secular traditions.

**CSpH 5221. Significant Spiritual Texts of the 20th Century.** (2 cr. Prereq–Jr or sr or grad student or #) Diverse “spiritual classics” (i.e., elements of western canon that have proven over time to be resources of values). Resources of meaning for inner-life healers. How to establish a personal library for life-long journey of spiritual development.

**CSpH 5225. Meditation: Integrating Body and Mind.** (2 cr; A-F only. Prereq–Jr or sr or grad student or #) Meditation as a physical, emotional, intellectual, and spiritual inquiry. Students examine a variety of texts and develop ability to enter a state of calm, meditative awareness.

**CSpH 5301. Cultures, Faith Traditions, and Health Care.** (2 cr; A-F only. Prereq–Jr or sr or grad student or #) Culturally/spiritually based health care practices of selected native/immigrant populations in Minnesota. Clinical implications. Personal/professional conflicts for delivery of competent care to culturally diverse groups by those trained in Western health care.

**CSpH 5311. Introduction to Traditional Chinese Medicine.** (2 cr; A-F only. Prereq–Jr or sr or grad student or #) Philosophical roots of Shamanism, Confucianism, Taoism, and Buddhism. Influence of these philosophies on Chinese medicine. Evolution of concepts of the tao, Yin-Yang, microcosm, macrocosm. Development of herbal medicine, Tui Na, Qi Gong, acupuncture, moxibustion. Traditional Chinese medicine etiology of disease, physiology, diagnosis, therapy, disease prevention, ethics, psychology, cosmology.

**CSpH 5315. Traditional Tibetan Medicine: Ethics, Spirituality, and Healing.** (2 cr. Prereq–Jr or sr or grad student or #) Ethics, spirituality, and healing from perspective of traditional Tibetan medicine. Belief that illness results from imbalance and that treating illness requires correcting underlying imbalance. How to apply these principles, integrate them into clinical practice, and consult with a traditional Tibetan doctor.

**CSpH 5321. Introduction to International Health.** (2 cr. Prereq–Jr or sr or grad student or #) Primary public health problems, priorities, and interventions in developing countries. Issues related to culture/indigenous health systems and of concern to health care providers who work abroad or with refugee communities in countries of resettlement.

**CSpH 5325. Latinos: Culture and Health Perspective.** (3 cr. Prereq–Jr or sr or grad student or #) How Latino world view (cosmovision) affects health and compares with U.S. perspective. Differences in perception of time, family involvement, community “belonging,” gender roles, and communication styles. Folkloric beliefs. Specific issues such as AIDS, pregnancy, women’s issues, pharmacy, and nutrition. Health issues of workers. Cultural competency.

**CSpH 5401. People, Plants, and Drugs: Introduction to Ethnopharmacology.** (3 cr. Prereq–Jr or sr or grad student or #) Biologically active substances used in traditional cultures. Ethnopharmacology’s past, current, and potential contributions to human knowledge. Concrete examples.

**CSpH 5411. Dietary Supplements: Regulatory, Scientific, and Cultural Perspectives.** (3 cr. Prereq–Jr or sr or grad student or #) Concepts/principles of dietary supplements, RDA, dose-response, risk assessment. Laws/regulations concerning dietary supplements. Vitamin/mineral supplements. Philosophy/use of botanicals/nutraceuticals and common herbal supplements in western medicine. Use of supplements and evidence-based recommendations as influenced by culture.

**CSpH 5421. Botanical Medicines in Complementary Healthcare.** (3 cr. Prereq–Jr or sr or grad student or #) Widely-used botanical medicines from biomedical perspective. Alternative therapeutic systems presented according to bodily systems/processes. Evidence for therapeutic use. Botanical characteristics, traditional uses, chemical properties, dosage, hazards/safety issues, quality control.

**CSpH 5501. Clinical Aromatherapy I.** (2 cr. Prereq–Jr or sr or grad student or #) Controlled use of essential plant oils for specific, measurable physiological/psychological therapeutic outcomes. History, scientific basis, practice issues, use of 19 essential oils in clinical practice.

**CSpH 5502. Clinical Aromatherapy II.** (2 cr. Prereq–5501) Additional applications of clinical aromatherapy, including chemical basis for therapeutic effects, clinical use of 14 essential oils.

**CSpH 5511. Interdisciplinary Palliative Care: An Experiential Course in a Community Setting.** (2 cr) Multidisciplinary student teams partner with interdisciplinary community hospice teams in delivery of care to patients in a variety of settings. Series of seminars employs self-analysis/case studies.

**CSpH 5521. Therapeutic Landscapes.** (3 cr. Prereq–[Jr or sr or grad student] in [health sciences or therapeutic recreation or horticulture or landscape architecture] or health professional or #) Principles of therapeutic design for specific population requirements. Therapeutic landscape design. Incorporates interdisciplinary interaction between horticulture, landscape architecture, and health science departments.

**CSpH 5533. Introduction to Energy Healing.** (2 cr. Prereq–Jr or sr or grad student or #) Healing techniques (Therapeutic Touch, Reiki, acupuncture, reflexology, magnets, homeopathy) that use energetic systems in the body to enhance the body’s ability to heal. Scientific theories. Students interact with practitioners and have the opportunity to experience feeling “energy.”

**CSpH 5541. Integrative Psychotherapy.** (3 cr. Prereq–5102, [grad student or #]) In depth, experiential-based training. Support for students to practice integrative psychotherapy, mindfulness meditation, and related mind/body approaches to clinical work. Multiple client/patient populations, issues, and settings.

**CSpH 5555. Introduction to Body and Movement-based Therapies.** (2 cr. Prereq–Jr or sr or grad student or #) Theories/approaches of selected somatic therapies, including dance, movement, and body-based therapies. Historic/theoretical perspectives on use of movement, dance, and somatic re-patterning. Demonstrations of techniques. Application of techniques to specific populations/settings.

**CSpH 5601. Music, Health, and Healing.** (2 cr. Prereq–Jr or sr or grad student or #) Music therapy, music medicine, music psychotherapy. Techniques/interventions. Hypotheses/rationale related to interventions. Related research.

**CSpH 5611. Healthy Humor.** (1 cr. Prereq–Jr or sr or grad student or #) Use of humor to enhance communication, treatment, and relationships with patients. How to create a positive work environment and outlook. Physiologic effects/benefits of humor/laughter. Humor and spirituality. Connection between positive outlook and health.

**CSpH 8100. Special Topics in Complementary Therapy and Healing Practices.** (1-6 cr [max 12 cr]) Critiquing research on complementary therapies (e.g., design, outcome measures). Synthesizing research findings for a therapy. Hypothesizing future directions for research on complementary therapies.

**CSpH 8101. Critiquing and Synthesizing Complementary and Alternative Medicine (CAM) Research.** (1 cr)

Seminar. Students critically evaluate peer-reviewed literature in CAM research. Emphasizes identifying strengths/weaknesses of published research and synthesizing findings from multiple studies.

**CSpH 8191. Independent Study in Complementary Therapies and Healing Practices.** (1-6 cr. Prereq–Grad student in CSpH minor or #)

Students propose area for individual study with faculty guidance. Students write proposal, which includes outcome objectives and work plan. Faculty member directs student’s work and evaluates project.

## Central Asian Studies (CAS)

*Institute of Linguistics, ESL, and Slavic Languages and Literatures*

*College of Liberal Arts*

**CAS 5311. Medieval Sages.** (3 cr. \$MELC 5311. Prereq–Background in Iranian, Central Asian, or Islamic studies recommended) Study and discussion of the intellectual life of the region from the rise of the Ghaznavids (A.D. 1000) to the fall of the Timurids (A.D. 1500). Ibn Sina (Avicenna), al-Biruni, al-Ghazali, Rumi, Sa’di, and Firdowsi are among the sages whose lives are examined.

**CAS 5526. Islam and Communism.** (3 cr. \$3526, \$MELC 5526) Development of medieval Islamic culture in Transoxiana; formation of Sufi orders; rise and development of Communist ideology; introduction of socialist principles into Central Asia; clash of Islamic principles with Communist dicta; Pan-Islamism; Pan-Turkism.

**CAS 5532. Russia and Central Asia.** (3 cr. \$3532, \$MELC 5532) Rise and fall of the Mongol Empire, formation of the Chaghatai Khanate and the Golden Horde. Russian expansion into Central Asia and rivalry with Britain. Russia and the Central Asian republics during and after the Soviet period.

**CAS 5601. Persian Fiction in Translation.** (3 cr. \$3601, \$MELC 3601, \$MELC 5601) Impact of westernization on Iran, from 1920s to present. Materials produced by Iranian writers, film makers, and intellectuals. Internal/external forces that bind contemporary Iranian society to world civilization. Works of Hedayat (especially *Blind Owl*), Chubak, Al-i Ahmad, Daneshvar, and Behrangi are analyzed/interpreted.

**CAS 5602. Persian Poetry in Translation.** (3 cr. \$3602, \$MELC 5602) Major poetic works of Iran dealing with life at the medieval courts, Sufic poetry, and “new” poetry are studied. Rudaki, Khayyam, Rumi, Hafiz, Yushij, and Farrukhzad are among the poets whose works are examined.

**CAS 5994. Directed Research.** (1-10 cr. Prereq–#, Δ, □)

# Chemical Engineering (ChEn)

Department of Chemical Engineering and  
Materials Science  
Institute of Technology

**ChEn 5103. Porous Media.** (3 cr; A-F only. \$MatS 8219. Prereq-4003, 4102)

Geometry and topology of porous materials. Fundamentals of flow, transport, and deformation. One-phase and two-phase Darcy flows, convective dispersion in microporous materials. Relations of macroscopic properties and behavior to underlying microscopic structures and mechanisms. Nanoporous materials. Examples from nature and technology.

**ChEn 5104. Coating Process Fundamentals.** (2 cr; A-F only. Prereq-4003, 4102, #)

Basic process functions. Viscous flow and rheology. Capillarity, wetting, electrostatic effects, phase change, colloidal transformations, mass/heat transfer in drying, kinetics in curing. Stress and property development in solidification. Illustrations drawn from theoretical modeling, flow visualization, and stopped-process microscopy.

**ChEn 5221. Introduction to Polymer Chemistry.** (3 cr; A-F only. Prereq-[3502, Chem 2302] or #)

Condensation, radical, ionic, emulsion, ring-opening, metal-catalyzed polymerizations. Chain conformation, solution thermodynamics, molecular weight characterization, physical properties.

**ChEn 5302. Chemical Reaction Engineering and Catalysis.** (3 cr; A-F only. Prereq-ChEn 4102)

Continuous and batch reactors, heat management, catalytic reactions and reactors, nonideal flow in reactors, polymerization, solids processing, multiphase reactors. Fundamentals and mechanisms of catalytic reactions. Industrial examples in petroleum/chemical industries.

**ChEn 5531. Electrochemical Engineering.** (3 cr. Prereq-[MatS 3011 or #], [upper div IT or grad student]) Fundamentals of electrochemical engineering.

Electrochemical mass transfer electrokinetics, thermodynamics of electrochemical cells, modern sensors. Formation of thin films and microstructured materials. Computer-based problems.

**ChEn 5595. Special Topics.** (1-4 cr. Prereq-#)

New or experimental special topics.

**ChEn 5751. Biochemical Engineering.** (3 cr; A-F only. Prereq-4002, #4003, #4102)

Chemical engineering principles applied to analysis/design of complex cellular/enzyme processes. Quantitative framework for design of cells for production of proteins, synthesis of antibodies with mammalian cells, or degradation of toxic compounds in contaminated soil.

**ChEn 5752. Quantitative Biology for Engineers.** (3 cr; A-F only. Prereq-Engineering background, #)

Biological fundamentals of biotechnology. Structural basis of biological systems. Communication between cells/environment. Gene expression. Proteins and their functional classes. Metabolic pathways and their reactions. From gene/genome to physiology. Genomics/proteomics as technologies. Biotechnology and society: ethics, law, public policy. Biotechnology-based commercial enterprises.

**ChEn 5753. (Biological) Biomedical Transport Processes.** (3 cr. \$ME 5381, \$BME 5310. Prereq-4003 or ME 3322)

Introduction to fluid, mass, and heat transport in biological systems. Mass transfer across membranes, fluid flow in capillaries, interstitium, veins and arteries. Heat transfer in single cells and tissues. Whole organ and body heat transfer issues. Blood flow and oxygenation. Heat and mass transfer in respiratory system. Biotransport issues in artificial organs, membrane oxygenators, and drug delivery applications.

**ChEn 5754. Food Processing Technology.** (3 cr; A-F only. Prereq-ChEn 4002)

Introduction to food processing as it interfaces with engineering. Case studies. Engineering economics and practical design problems in food processing. Heat transfer; freezing, conduction (unsteady state); thermal processing; extruder design; protein processing; order-of-magnitude estimating; and economic concepts such as ROI, discounted cash flow, and capital estimating.

**ChEn 5759. Principles of Mass Transfer in Engineering and Biological Engineering.** (2 cr; A-F only. Prereq-ChEn 4002)

Principles of mass transfer in gases, liquids, biological and macromolecular solutions, gels, solids, membranes, and capillaries. Porous solids interaction between mass transfer and chemical reaction. Applications in biological, environmental, mineral, and chemical engineering systems.

**ChEn 5771. Colloids and Dispersions.** (3 cr; A-F only. Prereq-Physical chemistry)

Preparation, stability, coagulation kinetics or colloidal solutions. DLVO theory, electrokinetic phenomena. Properties of micelles, other microstructures.

**ChEn 8101. Fluid Mechanics I: Change, Deformation, Equations of Flow.** (3 cr; A-F only. Prereq-4002 or #)

Equations of change of mass, momentum, angular momentum, etc. Kinematics of deformation and convective transport. Applications to fluid statics and dynamics of Newtonian fluids. Examples of exact solutions of Navier-Stokes equations and useful simplifications.

**ChEn 8102. Principles and Applications of Rheology.** (3 cr; A-F only. Prereq-8101)

Deformation and flow of non-Newtonian and viscoelastic fluids, plastic materials, and perfectly elastic solids. Phenomenological and molecular interpretation of rheology of elastomers, polymer melts and polymer solutions, application of rheology to polymer processing.

**ChEn 8103. Fluid Mechanics III: Porous Media.** (3 cr; A-F only. \$MatS 8219)

Geometry and topology of porous materials. Fundamentals of flow, transport, and deformation. One- and two-phase Darcy flows, convective dispersion in microporous materials. Relations of macroscopic properties and behavior to underlying microscopic structures and mechanisms. Nanoporous materials.

**ChEn 8104. Coating Process Fundamentals.** (3 cr; A-F only. Prereq-#)

Basic process functions; viscous flow and rheology, capillarity, and wetting; electrostatic effects; phase change, colloidal transformations, mass and heat transfer in drying; kinetics in curing; stress and property development in solidification. Requires independent study and a report.

**ChEn 8201. Applied Mathematics I: Linear Analysis.** (3 cr; A-F only. Prereq-#)

Integrated approach to solving linear mathematical problems (linear algebraic equations and linear ordinary and partial differential equations) using theoretical and numerical analysis based on linear operator theory. Appropriate for first-year engineering graduate students.

**ChEn 8202. Applied Mathematics II: Nonlinear Analysis.** (3 cr; A-F only. Prereq-#)

Nonlinear mathematical problems (nonlinear ordinary and partial differential equations) using theoretical and numerical analysis. Appropriate for students who have had a graduate-level course in linear analysis.

**ChEn 8301. Physical Rate Processes I: Transport.** (3 cr; A-F only. Prereq-#)

Survey of mass transfer, dilute and concentrated diffusion, Brownian motion. Diffusion coefficients in polymers, of electrolytes, and at critical points. Multicomponent diffusion. Mass transfer correlations and predictions. Mass transfer coupled with chemical reaction.

**ChEn 8302. Physical Rate Processes II: Mass Transfer.** (3 cr; A-F only. Prereq-8301, #)

Applications of mass transfer. Membranes, including gas separation and reverse osmosis; controlled drug release; dispersion, including examples of pollution modeling; adsorption and chromatography; coupled heat and mass transfer, including cooling towers; double-diffusive effects.

**ChEn 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**ChEn 8401. Physical and Chemical Thermodynamics.** (3 cr; A-F only. Prereq-#)

Principles of classical thermodynamics and an introduction to nonequilibrium thermodynamics, with applications in chemical engineering and materials science. Background should include undergraduate engineering or chemistry courses in thermodynamics.

**ChEn 8402. Statistical Thermodynamics and Kinetics.** (3 cr; A-F only. Prereq-Physical chem or statistical mechanics course)

Introduction to statistical mechanical description of equilibrium and non-equilibrium properties of matter, emphasizing fluids and classical statistical mechanics.

**ChEn 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**ChEn 8501. Chemical Rate Processes: Analysis of Chemical Reactors.** (3 cr; A-F only. Prereq-#)

Design of reactors for heat management and with catalytic processes through detailed analysis of steady state and transient behavior. Polymerization, combustion, solids processing, and environmental modeling; design of multiphase reactors. Primarily for graduate students who have had a course in chemical reactor engineering.

**ChEn 8502. Process Control.** (3 cr; A-F only. Prereq-4601 or equiv)

For linear systems: stability, controllability, observability, pole-placement via state feedback state observers, output feedback, and robustness of control systems. For nonlinear systems: solution properties, stability analysis, singular perturbations, feedback linearization via state feedback, and direct synthesis via output feedback.

**ChEn 8503. Chemical Rate Processes: Homogeneous Reactions.** (3 cr; A-F only. Prereq-Chemical rate processes course)

Description and characterization of chemically reacting systems. Theories of elementary reactions. Experimental methods for investigating elementary reactions. Applications of chemical kinetics to complex reactions, such as combustion, flames, and the atmosphere.

**ChEn 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**ChEn 8752. Quantitative Biology for Engineers.** (3 cr; A-F only. Prereq-Grad student, engineering background, #)

Structural basis of biological systems. Communication between cells and environment. Gene expression. Proteins, their functional classes. Metabolic pathways, their reactions. From gene/genome to physiology. Biological fundamentals of biotechnology. Genomics/proteomics as technologies. Biotechnology and society: ethics, law, public policy. Biotechnology-based commercial enterprises. Readings, two reports, final presentation.

**ChEn 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**ChEn 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

**ChEn 8900. Seminar.** (1 cr; S-N only)

Presentation and discussion of papers concerning newer developments in chemical engineering, materials science, and related fields.

**ChEn 8901. Seminar.** (1 cr [max 9 cr])

Presentation and discussion of papers concerning the newer developments in chemical engineering.

**ChEn 8902. Seminar on Finite Element Methods of Computer-Aided Analysis.** (1 cr; A-F only)

Survey of the fundamentals of the finite element method as applied mathematics. Develop ability to construct basic finite element codes and put them into successful operation.

**ChEn 8993. Directed Study.** (1-12 cr)**ChEn 8994. Directed Research.** (1-12 cr)**ChEn 8995. Special Topics.** (1-4 cr)

New or experimental courses offered by department or visiting faculty.

## Chemical Physics (ChPh)

### Institute of Technology

**ChPh 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**ChPh 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**ChPh 8602. Chemical Physics Seminar.** (1 cr. Prereq—Grad chem physics major or #)

Weekly seminar series on modern chemical physics and related topics.

**ChPh 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**ChPh 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**ChPh 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

## Chemistry (Chem)

### Department of Chemistry Institute of Technology

**Chem 5011. Mechanisms of Chemical Reactions.** (3 cr. Prereq—2302 or equiv)

Reaction mechanisms and methods of study. Mechanistic concepts. Gas phase reactions. "Electron pushing" mechanisms in organic and enzymatic reactions. Kinetic schemes and other strategies.

**Chem 5021. Computational Chemistry.** (3 cr. Prereq—3502 or equiv)

Theoretical methods for study of molecular structure, bonding, and reactivity. Ab initio and semi-empirical calculations of molecular electronic structure. Theoretical determination of molecular electronic structure and spectra; relation to experimental techniques. Molecular mechanics. Structure determination for large systems. Molecular properties and reactivity. Computational tools. Critical assessment of methods and theoretical work in the literature. Lab.

**Chem 5201. Materials Chemistry.** (3 cr. Prereq—[3502 or equiv], 4701 or #)

Crystal systems/unit cells, phase diagrams, defects/interfaces, optical/dielectric properties, electrical/thermal conductivity, X-ray diffraction, thin film analysis, electronic structure, polarons/phonons, solid state chemistry, liquid/molecular crystals, polymers, magnetic/optical materials, porous materials, ceramics, piezoelectric materials, biomedical materials, catalysts.

**Chem 5210. Materials Characterization.** (4 cr; A-F only. Prereq—Graduate student or #)

Modern tools/techniques for both bulk- and thin-film characterization. Topics may include ion-solid interactions, Rutherford back scattering, secondary ion mass spectrometry, solid-state NMR, X-ray

photoelectron spectroscopy, small-angle X-ray/neutron scattering, transmission/scanning electron/probe microscopy, near-field scanning optical microscopy, porosimetry, adsorption techniques, and ellipsometry.

**Chem 5221. Introduction to Polymer Chemistry.** (3 cr. \$MatS 5221. Prereq—[2302, 3501] or #)

Condensation, radical, ionic, emulsion, ring-opening, metal-catalyzed polymerizations. Chain conformation, solution thermodynamics, molecular weight characterization, physical properties.

**Chem 5223W. Polymer Laboratory.** (2 cr. \$MatS 5223. Prereq—[5221 or 8211] or #)

Synthesis, characterization, and physical properties of polymers. Free radical, condensation, emulsion, anionic polymerization. Infrared spectroscopy/gel permeation chromatography. Viscoelasticity, rubber elasticity, crystallization.

**Chem 5245. Introduction to Drug Design.** (3 cr; A-F only. Prereq—2302 or equiv)

Concepts that govern design/discovery of drugs. Physical, bioorganic, medicinal chemical principles applied to explain rational design and mechanism of action drugs.

**Chem 5311. Chemistry of Industry.** (3 cr. Prereq—Chem sr or grad student or #)

Industrial and polymer chemistry technology. Relation of basic properties to industrial utility. Economics, social problems, industrial environment.

**Chem 5321. Organic Synthesis.** (3 cr. Prereq—[2302 or equiv], #)

Fundamental concepts, reactions, reagents, structural/stereochemical issues, and mechanistic skills for organic chemistry.

**Chem 5322. Advanced Organic Chemistry.** (3 cr. Prereq—2302 or equiv)

Topics vary, including natural products, heterocycles, asymmetric synthesis, organometallic chemistry, and polymer chemistry. (See instructor for details.)

**Chem 5352. Physical Organic Chemistry.** (3 cr. Prereq—2302, [5011 or 8011])

Fundamental concepts and mechanistic tools for analysis of organic reaction mechanisms. Solvation, reactive intermediates, gas phase chemistry, photochemistry or strained-ring chemistry or both.

**Chem 5361. Interpretation of Organic Spectra.** (3 cr. Prereq—2302 or equiv)

Application of nuclear magnetic resonance, mass, ultraviolet, and infrared spectral analyses to organic structural problems.

**Chem 5412. Enzyme Mechanisms.** (3 cr. Prereq—2302 or equiv)

Enzyme classification with examples from current literature; strategies to decipher enzyme mechanisms; chemical approaches to control enzyme catalysis.

**Chem 5413. Nucleic Acids.** (3 cr. Prereq—2302 or equiv)

Chemistry and biology of nucleic acids. Structure, thermodynamics, reactivity, DNA repair, chemical oligonucleotide synthesis, antisense approaches, ribozymes, techniques for nucleic acid research, interactions with small molecules and proteins.

**Chem 5541. Dynamics.** (3 cr. Prereq—Undergrad physical chem course, #)

Hamilton's/Lagrange's equations of motion. Normal modes and molecular rotation. Langevin equation and Brownian motion. Time correlation functions, collision theory, cross-sections, energy transfer. Molecular forces and potential energy surfaces. Classical electrostatics.

**Chem 5551. Quantum Mechanics I.** (3 cr. Prereq—Undergrad physical chem course, #)

Review of classical mechanics. Postulates of quantum mechanics, with applications to determination of single particle bound state energies and scattering cross-sections in central field potentials. Density operator formalism, with applications to description of two-level systems, two-particle systems, entanglement, and Bell inequality.

**Chem 5715. Physical Inorganic Chemistry.** (3 cr.

Prereq—4701 or equiv, chem major or #) Physical methods (e.g., IR, UV-VIS, ESR, Mossbauer and mass spectroscopy, magnetic measurements, X-ray diffraction) and concepts applied to inorganic and organometallic systems.

**Chem 5725. Organometallic Chemistry.** (3 cr. Prereq—4701 or equiv, chem major or #)

Synthesis, reactions, structures, and other properties of main group and transition metal organometallic compounds; electronic and structural theory, emphasizing their use as stoichiometric and homogeneous catalytic reagents in organic and inorganic systems.

**Chem 5735. Bioinorganic Chemistry.** (3 cr. Prereq—4701 or equiv, chem grad or #)

Role of metal ions in biology. Emphasizes structure, function, and spectroscopy of metalloproteins and their synthetic analogs.

**Chem 5745. Advanced Inorganic Chemistry.** (3 cr. Prereq—4701, chem major, #)

Topics in main group and transition metal chemistry. Emphasizes synthesis, structure, physical properties, and chemical reactivity.

**Chem 5755. X-Ray Crystallography.** (4 cr; A-F only. Prereq—Chem grad student or #)

Essentials of crystallography as applied to modern, single crystal X-ray diffraction methods. Practical training in use of instrumentation in X-ray crystallography facility in Department of Chemistry. Data collection, correction/refinement, structure solutions, generation of publication materials, use of Cambridge Crystallographic Structure Database.

**Chem 8011. Mechanisms of Chemical Reactions.** (4 cr. Prereq—2302 or equiv)

Reaction mechanisms and methods of study. Mechanistic concepts in chemistry. Gas phase reactions to mechanisms, "electron pushing" mechanisms in organic reactions, mechanism of enzymatic reactions. Kinetic schemes and other strategies to investigate mechanisms.

**Chem 8021. Computational Chemistry.** (4 cr. Prereq—3502 or equiv)

Modern theoretical (classical and quantum) methods used in study of molecular structure, bonding, and reactivity. Concepts and practical applications. Determination of spectra; relationship to experimental techniques. Molecular mechanics. Critical assessment of reliability of methods with emphasis on understanding the literature.

**Chem 8066. Professional Conduct of Chemical Research.** (1 cr; S-N only. Prereq—Chem grad student)

Builds sensitivity to ethical issues in chemical research. Readings/case studies, small-group/large-group discussion, summarizing comments from instructors/guests/panels having special expertise. Weekly seminar.

**Chem 8081. M.S. Plan B Project I.** (1-4 cr; A-F only. Prereq—Grad chem major)

Satisfies project requirement for Plan B master's degree. May appear on M.S. degree program, but does not count toward 14-credit minimum in major field. Topic arranged by student adviser; written report required. 8081 required; 8082 optional.

**Chem 8082. M.S. Plan B Project II.** (1-4 cr; A-F only. Prereq—Grad chem major)

Satisfies project requirement for Plan B master's degree. May appear on M.S. degree program, but does not count toward 14-credit minimum in major field. Topic arranged by student adviser; written report required. 8081 required; 8082 optional.

**Chem 8151. Analytical Separations and Chemical Equilibria.** (4 cr. Prereq—#)

Advanced treatment of principles of analytical chemistry, chemical equilibria, and dynamics. Chromatographic and other modern analytical scale separation techniques. Emphasizes column dynamics and retention mechanisms.

**Chem 8152. Analytical Spectroscopy.** (4 cr.)

Prereq–Grad chem major or #)

Survey of analytical spectroscopic methods. Design/application of spectroscopic instruments, including signal generation, acquisition, and interpretation. May include nuclear magnetic resonance, electron paramagnetic resonance, infrared and ultraviolet/visible spectroscopy, and mass spectrometry.

**Chem 8153. Extracting Signal From Noise.** (5 cr; A-F only.)

Prereq–[4101 or equiv], differential equations course)

Use of analog/digital electronics and computational methods in experiments. Passive circuits, operational amplifiers, filters, oscillators and Laplace transform techniques in analysis, domain conversion for data acquisition/control, statistics, experimental design. Introduction to chemometrics, Fourier analysis, convolution/deconvolution, curve fitting.

**Chem 8155. Advanced Electroanalytical Chemistry.** (2 cr.)

Prereq–8151)

Polarography, galvanostatic and potentiostatic methodology, coulometry, linear scan and cyclic voltammetry and pulse methods.

**Chem 8157. Bioanalytical Chemistry.** (2 cr; A-F only.)

Prereq–4101 or equiv, BioC 3021 or equiv)

Theory and practical aspects of analytical methods used in determination and characterization of biologically important materials. Enzymatic and kinetic methods in study of proteins, carbohydrates, lipids, and nucleic acids.

**Chem 8159. Nuclear Magnetic Resonance Spectroscopy.** (4 cr.)

Prereq–Sem of organic chem)

Detailed understanding of relaxation processes, chemical exchange, quadrupolar effects, NOW, 2D NMR, NMR hardware, and solid state NMR. NMR imaging and Pulsed Field Gradient (PFG) NMR are discussed.

**Chem 8180. Special Topics in Analytical Chemistry.** (2-4 cr.)

Prereq–Grad chem major or #)

Topics (and availability) vary by year depending on instructor and development of the field.

**Chem 8201. Materials Chemistry.** (4 cr; A-F only.)

Prereq–[4701, 3502] or #)

Crystal systems/unit cells, phase diagrams, defects/interfaces, optical/dielectric properties, electrical/thermal conductivity, X-ray diffraction, thin film analysis, electronic structure, polarons/phonons, solid state chemistry, liquid/molecular crystals, polymers, magnetic/optical materials, porous materials, ceramics, piezoelectric materials, biomedical materials, catalysts.

**Chem 8211. Physical Chemistry of Polymers.** (4 cr.)

MatS 8211; Prereq–Undergrad physical chem course or #)

Introduction to polymer physical chemistry. Chain conformations; thermodynamics of polymer solutions, blends, and copolymers; light, neutron, and X-ray scattering; dynamics in dilute solution and polymer characterization; dynamics of melts and viscoelasticity; rubber elasticity, networks, and gels; glass transition; crystallization.

**Chem 8221. Introduction to Polymer Chemistry.** (4 cr.)

MatS 5221. Prereq–[2302, 3501] or #)

Condensation, radical, ionic, emulsion, ring-opening, metal-catalyzed polymerizations. Chain conformation, solution thermodynamics, molecular weight characterization, physical properties.

**Chem 8280. Special Topics in Materials Chemistry.** (2-4 cr.)

Prereq–Grad chem major or #)

Topics (and availability) vary by year depending on instructor and development of the field.

**Chem 8321. Organic Synthesis.** (4 cr.)

Prereq–2302 or equiv)

Core course; fundamental concepts, reactions, reagents, structural and stereochemical issues, and mechanistic skills necessary for understanding organic chemistry.

**Chem 8322. Advanced Organic Chemistry.** (4 cr.)

Prereq–2302 or equiv)

Modern studies. Topics, which vary by year, include natural products, heterocycles, asymmetric synthesis, organometallic chemistry, and polymer chemistry.

**Chem 8333. FTE: Master's.** (1 cr; NGA.)

Prereq–Master's student, adviser and DGS consent)

**Chem 8352. Physical Organic Chemistry.** (4 cr.)

Prereq–5011 or 8011 or 2302 or equiv)

Fundamental concepts and mechanistic tools for understanding/analyzing organic reaction mechanisms. Solvation, reactive intermediates, gas phase chemistry, photochemistry, strained-ring chemistry.

**Chem 8361. Interpretation of Organic Spectra.** (4 cr.)

Prereq–2302 or equiv)

Practical application of nuclear magnetic resonance, mass, ultraviolet, and infrared spectral analyses to solution of organic structural problems.

**Chem 8380. Special Topics in Organic Chemistry.** (2-4 cr.)

Prereq–Grad chem major or #)

Topics (and availability) vary by year depending on instructor and development of the field.

**Chem 8411. Bioorganic Chemistry.** (4 cr.)

Prereq–2302 or equiv)

Chemistry of amino acids, peptides, proteins, lipids, carbohydrates, and nucleic acids; structure, nomenclature, synthesis, and reactivity; an overview of techniques used to characterize these biomolecules.

**Chem 8412. Enzyme Mechanisms.** (4 cr.)

Prereq–2302 or equiv)

Enzyme classification with representative examples from current literature; strategies used to decipher enzyme mechanisms; chemical approaches for control of enzyme catalysis.

**Chem 8413. Nucleic Acids.** (4 cr.)

Prereq–2302 or equiv)

Chemistry and biology of nucleic acids: structure, thermodynamics, reactivity, DNA repair, chemical oligonucleotide synthesis, antisense approaches, ribozymes, overview of techniques used in nucleic acid research, interactions with small molecules and proteins.

**Chem 8444. FTE: Doctoral.** (1 cr; NGA.)

Prereq–Doctoral student, adviser and DGS consent)

**Chem 8480. Special Topics in Biological Chemistry.** (2-4 cr.)

Prereq–Grad chem major or #)

Topics (and availability) vary by year depending on instructor and development of the field.

**Chem 8541. Dynamics.** (4 cr.)

Prereq–Undergrad physical chem course)

Hamilton's/Lagrange's equations of motion. Normal modes and molecular rotation. Langevin equation and Brownian motion. Time correlation functions, collision theory, cross-sections, energy transfer. Molecular forces and potential energy surfaces. Classical electrostatics.

**Chem 8551. Quantum Mechanics I.** (4 cr.)

Prereq–Undergrad physical chem course)

Review of classical mechanics. Postulates of quantum mechanics with applications to determination of single particle bound state energies and scattering cross-sections in central field potentials. Density operator formalism with applications to description of two level systems, two particle systems, entanglement, and Bell inequality.

**Chem 8552. Quantum Mechanics II.** (4 cr.)

Prereq–8551)

Rotational/point-group symmetries. Perturbation, variation, semi-classical approximation. Hamiltonian of charged particles in electromagnetic fields (Landau levels, Aharonov-Bohm effect, atomic hyperfine interactions). Time-dependent perturbation (radiative, non-radiative transitions). Quantization of electromagnetic field and multiphoton processes. Identical particles. Hartree-Fock, density-functional, and second-quantization.

**Chem 8561. Thermodynamics, Statistical Mechanics, and Reaction Dynamics I.** (4 cr.)

Prereq–Undergrad physical chem course)

Two-part sequence. Thermodynamics, equilibrium statistical mechanics, ensemble theory, partition functions. Applications, including ideal gases/crystals. Theories of simple liquids, Monte Carlo, and molecular dynamics simulations. Reaction dynamics from microscopic viewpoint.

**Chem 8562. Thermodynamics, Statistical Mechanics, and Reaction Dynamics II.** (4 cr.)

Prereq–8561)

Two-part sequence. Thermodynamics, equilibrium statistical mechanics, ensemble theory, partition functions. Applications, including ideal gases/crystals. Theories of simple liquids, Monte Carlo, and molecular dynamics simulations. Reaction dynamics from microscopic viewpoint.

**Chem 8580. Special Topics in Physical Chemistry.** (2-4 cr.)

Prereq–Grad chem major or #)

Topics (and availability) vary depending on instructor and development of the field.

**Chem 8601. Seminar: Modern Problems in Chemistry.** (1 cr; S-N only.)

Prereq–Grad chem major or #)

Weekly seminar series on modern chemical topics.

**Chem 8602. Seminar Presentation: Modern Problems in Chemistry.** (1 cr; A-F only.)

Prereq–Grad chem major or #)

Weekly seminar series on modern chemical topics presented by students.

**Chem 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA.)

Prereq–Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Chem 8700. Advanced Concepts in Medicinal Chemistry: Combinatorial Methods in Chemical Biology.** (2 cr; A-F only.)

Prereq–[2302 or equiv], [BioC 4331 or equiv])

Principles of current combinatorial methods for generation of biological/chemical libraries. Emphasizes utility in biology and in drug design. Material is drawn from primary literature.

**Chem 8715. Physical Inorganic Chemistry.** (4 cr.)

Prereq–4701 or equiv, grad chem major or #)

Physical methods and concepts applied to inorganic and organometallic systems, including many of the following methods: NMR, IR, UV-VIS, ESR, Mössbauer and mass spectroscopy, magnetic measurements, X-ray diffraction.

**Chem 8725. Organometallic Chemistry.** (4 cr.)

Prereq–4701 or equiv, grad chem major or #)

Synthesis, reactions, structures, and other important properties of main group and transition metal organometallic compounds; treatment in terms of modern electronic and structural theory; emphasis on their use as stoichiometric and homogeneous catalytic reagents in organic and inorganic systems.

**Chem 8735. Bioinorganic Chemistry.** (4 cr.)

Prereq–4701 or equiv, grad chem major or #)

Survey of role of metal ions in biology; emphasizes structure, function, and spectroscopy of metalloproteins and their synthetic analogs.

**Chem 8745. Advanced Inorganic Chemistry.** (4 cr.)

Prereq–8715, grad chem major or #)

Survey of topics in main group and transition metal chemistry; emphasizes synthesis, structure, physical properties, and chemical reactivity.

**Chem 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA.)

Prereq–Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Chem 8780. Special Topics in Inorganic Chemistry.** (2-4 cr.)

Prereq–Grad chem major or #)

Topics (and availability) vary by year depending on instructor and development of the field.

**Chem 8880. Special Topics in Chemistry.** (2-4 cr.)

Prereq–Grad chem major or #)

Topics (and availability) vary depending on instructor and development of the field.

**Chem 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA.)

Prereq–Max 18 cr per semester or summer; 24 cr required)

## Chicano Studies (Chic)

Department of Chicano Studies

College of Liberal Arts

**Chic 5114. International Perspectives: U.S.-Mexico Border Cultures.** (3 cr. \$3114. Prereq-Grad)  
The relations of Mexico and the United States from an international perspective with central focus on the cultural interchange in the borderlands between them; using both literary and historical materials.

**Chic 5310. Chicanas/os and the Law.** (3 cr)  
Surveys the status of Chicanas and Chicanos in the law. A wide realm of case law and articles introduce key issues. Examines history, inequality, education, employment, affirmative action, criminal law, immigration, housing, and environmental racism.

**Chic 5402. Chicanas: Women and Work.** (3 cr. Prereq-Sr, #)  
Chicanas and their various relationships to family and community; local, national, and global work forces. Exploration of larger questions and issues related to the growing integration of the world's systems of production.

**Chic 5403. Chicana/Latina Feminisms.** (3 cr. Prereq-Sr, #)  
The historical and social development of Chicana and Latina feminisms in general and their various specific types. Includes women activists who do not self-identify as "feminists," but are fighting for equality.

**Chic 5505. Indigenous Women and Land Issues.** (3 cr)  
Legal experience of indigenous women defending their land and property interests. Encompasses a social ecology approach to their land struggles, including cultural and legal histories of Native Americans, Mexicanas, and Chicanas.

**Chic 5601. Migrant and Seasonal Agricultural Labor.** (2 cr)  
Surveys the agricultural workforce with a focus on legal theory. While its approach is interdisciplinary, its emphasis is on the legal construct. A wide realm of case law and articles address several key issues confronting agricultural laborers.

**Chic 5701. History of Ancient Mexico.** (3 cr)

**Chic 5702. Literature of Ancient and Colonial Mexico.** (3 cr. Prereq-Chicano studies sr, #)  
Analysis and contextualization of ancient and colonial Mexican literature such as Popol Vuh, Rabinal Achi, Chilam Balam, Codex Mendoza, Juan Ruiz de Alarcon, and Sor Juana Ines de la Cruz.

**Chic 5901. Chicana(o) Studies: Theory and Methodology.** (3 cr)  
Focus on theory and methodology of Chicano studies scholarship in social sciences and humanity.

**Chic 5920. Topics in Chicana(o) Studies.** (3 cr. Prereq-Sr or grad student)  
Multidisciplinary themes in Chicano studies. Issues of current interest.

**Chic 5921. Chicano Studies Topics: Women and the Law.** (3 cr)  
Surveys the status of women in the law. Wide realm of legal issues impacting women, with primary focus on Chicanas and Native American women. Historical, political, economic, social, and legal issues affecting women.

**Chic 5993. Directed Studies.** (1-3 cr [max 16 cr]. Prereq-#)  
Guided individual reading, research, and study for completion of the requirements for a senior paper or honors thesis.

## Child and Adolescent Psychiatry (CAPy)

Department of Psychiatry

Medical School

**CAPy 5620. Disruptive Behavioral Disorders I: Attention Deficit Hyperactivity Disorder Throughout the Life Span.** (1 cr)

**CAPy 5621. Workshop: Eating Disorders in Children and Adolescents.** (1 cr)

**CAPy 5623. Treatment Interventions With Anxiety and Depression in Children and Adolescents.** (1 cr)  
Characteristics of depression and suicidal behavior in children/adolescents. Methods of crisis intervention, treatment, and prevention.

**CAPy 5624. Eating Disorders in Children and Adolescents: Medical and Psychological Perspectives.** (1 cr; A-F only)  
Clinical characteristics of anorexia, bulimia nervosa in children/adolescents. Etiological factors, multidimensional treatment approaches.

**CAPy 5627. Workshop: Disruptive Behavioral Disorders II.** (1 cr)

**CAPy 5628. Workshop: Developmental Disorders: Perspectives on Etiology, Assessment and Treatment.** (1 cr)

**CAPy 5629. Disruptive Behavioral Disorders IV: Medication and Behavioral Therapies.** (1 cr)

**CAPy 5630. Workshop: Psychotherapy in Children and Adolescents.** (1 cr)

**CAPy 5631. Workshop: Developmental Neuropsychiatry.** (1 cr)

**CAPy 5632. Workshop: Competence Enhancement Training Programs for Children with Disruptive Behavior.** (1 cr)

**CAPy 5633. Assessment of Anxiety and Depressive Disorders in Children and Adolescents.** (1 cr)  
Various manifestations of anxiety in children. Separation anxiety, obsessive-compulsive disorders, specific phobias, generalized anxiety. Developmental patterns of childhood fears/anxiety. Cognitive-behavioral and psychosocial interventions.

**CAPy 5634. Workshop: Developmental Dyslexia: Theory, Research, and Clinical Differentiation.** (1 cr)

**CAPy 5635. Workshop: Disruptive Behavioral Disorders V.** (1 cr)  
Theoretical basis, therapy outcome research literature related to CBT. Problem-solving techniques, verbal self-instruction training, attributional retraining, stress inoculation procedures. Procedures applied to common problems experienced by disruptive children/adolescents. Anger/frustration management, conflict resolution, interpersonal problem-solving, self-esteem enhancement, negative thought/feeling management.

**CAPy 5636. Workshop: Disruptive Behavioral Disorders III.** (1 cr)

**CAPy 5638. Workshop: Prevention Science II.** (1 cr)

**CAPy 5639. Workshop: Behavior Problems in Preschool Children.** (1 cr)

**CAPy 5641. Workshop: Prevention Science I—Risk Factors, Protective Factors, and Models of Disorder.** (1 cr)

**CAPy 5643. Workshop: Multicultural Issues in Assessment and Treatment of Children With Psychiatric Problems.** (1 cr)

**CAPy 5644. Workshop: Child Abuse/Neglect and Childhood Psychopathology—Implications for Assessment/Treatment.** (1 cr)  
Types of abuse/neglect. Effects of abuse on children's psychological development. Child, parent/family, and social factors that place children at risk for abuse/neglect. Assessment/intervention approaches for working with abused children and their families.

**CAPy 5645. Workshop: Innovative Methods in Psychotherapy.** (1 cr)

**CAPy 5646. Workshop: Methods of Measurement and Assessment in Psychopathology.** (1 cr)

**CAPy 5647. Workshop: Prevention Science III.** (1 cr)  
Behaviors/mechanisms related to peer rejection. Social skills interventions for promoting positive relationships and for building meaningful friendships.

**CAPy 5648. Workshop: Prevention Science IV.** (1 cr)

**CAPy 5649. Workshop: Personality and Social Development.** (3 cr)

**CAPy 5650. Disruptive Behavioral Disorders VI: Behavioral Management Interventions.** (1 cr)  
Applied behavioral analysis and its application in treating children's aggressive, hyperactive, and oppositional behavior. Contingency management techniques for home/school. Behavior treatment augmentations to improve parent psychological well-being.

**CAPy 5652. Summer Practicum on Cognitive-Behavioral Therapies for Children and Adolescents.** (1 cr)

Problem-solving techniques, verbal self-instruction training, attributional retraining. Stress inoculation procedures applied to common problems experienced by disruptive children/adolescents. Anger/frustration management, conflict resolution, interpersonal problem-solving, self-esteem enhancement, negative feeling/thought management. Lectures, readings, supervised field experience. Take-home exam.

**CAPy 5653. Introduction to Play Therapy.** (1 cr)  
Play explored from normal developmental perspective. Play as powerful modality in treatment of mental health problems in children and in families. Play Therapy with adults. Case Studies, group participation.

**CAPy 5654. Summer Practicum in Prevention Science II: Building Friendships and Peer Relationship Skills.** (1 cr; A-F only. Prereq-#)  
Behaviors/mechanisms related to peer rejection. Social skills interventions for promoting positive relationships and building meaningful friendships. Assignment worked out with instructor. Final exam.

**CAPy 5660. ADHD Throughout the Life Span: Perspectives on Diagnosis, Assessment, and Developmental Course.** (1 cr)  
ADHD, from its earliest presentation to its later adult manifestations. Clinical depression, diagnostic criteria. Disorders that commonly coexist with ADHD. Standard assessment procedures for making a diagnosis. Developmental changes in clinical procedures.

**CAPy 5661. Aggression, Disruption, and Oppositional Behavior in Children and Adolescents.** (1 cr)  
Principles of applied behavioral analysis. Specific behavioral programs adapted for treatment of children's aggressive, disruptive, and oppositional behavior. Applications to home/school settings.

**CAPy 5662. Prevention of Violence and Antisocial Behavior in Children and Adolescents: Concepts, Principles.** (1 cr)  
Description/epidemiology of antisocial behavior in children/adolescents. Developmental theories of antisocial behavior. Application of principles/methods of prevention science.

**CAPy 5663. Building Friendships and Peer Relationship Skills: Interventions for Socially Rejected Children.** (1 cr)  
Basic milestones in social development. Behaviors/mechanisms leading to peer acceptance/rejection during childhood. Strategies for promoting social skill acquisition. Behavioral, social-cognitive, and emotional-regulation intervention approaches.

**CAPy 5665. Principles and Profiles of Child and Adolescent Psychopathology.** (1 cr)  
Normal/abnormal development in children/adolescents.

**CAPy 5666. Aggression and Conduct Problems in Children and Adolescents.** (1 cr)  
Characteristics, developmental course, and associated risk factors in children with aggression/conduct problems. Developmental pathways of aggression/conduct problems. Biological, parent/family, social/peer, and contextual (e.g., neighborhood, school, societal) causes/correlates. Development of resilience in children who face risk factors. Developmentally-focused, multi-systemic model of intervention.

**CAPy 5667. Child-Focused Interventions for Aggression and Conduct Problems in Children and Adolescents.** (1 cr)  
Practices of intervention for practitioners who work in school, community, clinical, and other service delivery sectors where children with aggression/conduct problems end up being served. Overview of problems. Three areas of child-focused interventions.

**CAPy 5668. Parent and Family Interventions for Aggression and Conduct Problems in Children and Adolescents.** (1 cr)  
Practices/intervention for school, community, clinical, and service delivery sectors where children with aggression/conduct problems are served. Overview of problems. Five areas of parent/family and contextually-focused interventions. Strategies for engaging families in intervention. Ideas for reducing barriers and making interventions culturally compatible.

**CAPy 5669. Attention Deficit Hyperactivity Disorder Throughout the Life Span: Current Perspectives on Treatment.** (1 cr)  
Standard medication, psychosocial, and educational interventions. Recent advances in long-acting stimulant medications. Setting up behavioral programs in home/school. Educational accommodations in school. Coaching. Cognitive-behavioral/neuro-biofeedback therapies.

**CAPy 5670. Preventing Violence and Antisocial Behavior in Children and Adolescents: Interventions, Practices.** (1 cr)  
Community-/school-based intervention programs aimed at preventing antisocial behavior.

## Child Psychology (CPsy)

*Institute of Child Development*

*College of Education and Human Development*

**CPsy 8301. Developmental Psychology: Cognitive Processes.** (4 cr. Prereq–Doctoral student or #)  
Perceptual, motor, cognitive and language development, and biological bases of each. Conceptual framework of research issues.

**CPsy 8302. Developmental Psychology: Social and Emotional Processes.** (4 cr. Prereq–Doctoral student or #)  
Normative issues and individual differences in social development from infancy through adolescence, with special reference to developmental psychopathology; life span considerations.

**CPsy 8304. Research Methods in Child Psychology.** (3 cr. Prereq–Doctoral student or #)  
Review of principal research methods and designs in developmental psychology and consideration of special issues concerning research, including scientific integrity.

**CPsy 8311. Seminar: History of Child Development.** (2 cr; S-N only. Prereq–CPsy doctoral student or #)  
History of developmental psychology and child development movement in context of classic studies. Presentations by students/instructor.

**CPsy 8321. Seminar: Current Issues in Teaching Developmental Psychology.** (1 cr [max 2 cr]. Prereq–CPsy doctoral student or #)  
Problems/issues in teaching introductory child psychology.

**CPsy 8333. FTE: Master's.** (1 cr; NGA. Prereq–Master's student, adviser and DGS consent)

**CPsy 8360. Seminar: Developmental Psychology.** (1-3 cr [max 21 cr]. Prereq–Doctoral student)  
Intensive study in the following topics. Section 1: ethology of child behavior. Section 2: language development. Section 3: perceptual development. Section 4: social development. Section 5: cognitive development. Section 6: developmental neuropsychobiology. Section 7: applied child development.

**CPsy 8444. FTE: Doctoral.** (1 cr; NGA. Prereq–Doctoral student, adviser and DGS consent)

**CPsy 8606. Advanced Developmental Psychopathology.** (3 cr. Prereq–Doctoral student or #)  
Alternative formulation of childhood disorders, emphasizing competency training rather than medical nosology.

**CPsy 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq–Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**CPsy 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq–Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**CPsy 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer; 24 cr required)

**CPsy 8980. Research Seminar in Child Psychology.** (1-3 cr [max 15 cr]. Prereq–Doctoral student)  
Participation in organized research group in developmental psychology.

**CPsy 8993. Directed Study in Child Psychology.** (1-4 cr. Prereq–Doctoral student or #)

**CPsy 8994. Research Problems in Child Psychology.** (1-6 cr [max 15 cr]. Prereq–Doctoral student or #)  
Individual empirical investigation.

**CPsy 8996. Directed Field Experiences in Child Psychology.** (1-6 cr [max 6 cr]; S-N only. Prereq–Doctoral student, #)  
Emphasizes field experiences focusing on intellectual and/or social development of children as individuals or members of groups; may include interactions with children in natural settings, or research on applied topics or with atypical populations.

## Chinese (Chn)

*Department of Asian Languages and Literatures*

*College of Liberal Arts*

**Chn 5011. Research Methods.** (4 cr. Prereq–3032 or 3112)  
Introduction to the sources and approaches of research in language and literature.

**Chn 5015. Chinese Philosophical/Historical Texts.** (4 cr. Prereq–3112)  
Readings from major texts in Chinese philosophical and historical traditions.

**Chn 5018. Chinese Religious Texts.** (4 cr. Prereq–3112)  
Traditional Chinese religious systems through selected texts.

**Chn 5040. Readings in Chinese Text.** (2-4 cr [max 12 cr]; A-F only. Prereq–3032 or equiv or #)  
Students read authentic materials of various types to increase reading/speaking ability. Topics specified in *Class Schedule*.

**Chn 5120. Topics in Chinese Linguistics.** (4 cr [max 8 cr]. Prereq–4121 or 4125)  
Studies of the structure and change in the Chinese language.

**Chn 5230. Topics in 20th-Century Chinese Literature.** (4 cr [max 8 cr]. Prereq–3032)  
Studies of representative literary works from May 4, 1919 to the present.

**Chn 5240. Topics in Chinese Poetry.** (4 cr [max 8 cr]. Prereq–3112)  
Selected major Chinese poets and poetic forms.

**Chn 5242W. Chinese Classical Drama and Theatre.** (4 cr)  
A multimedia course on traditional Chinese theatre.

**Chn 5250. Topics in Chinese Fiction.** (4 cr [max 8 cr]. Prereq–3032 or 3112)  
Studies of traditional and modern Chinese fiction.

**Chn 5260. Topics in Pre-modern Chinese Prose.** (4 cr [max 8 cr]. Prereq–3112)  
Studies of representative Chinese prose writings of the pre-modern period.

**Chn 5393. Directed Study.** (1-5 cr [max 18 cr]. Prereq–#, Δ, □)  
Guided individual reading or study.

**Chn 8320. Seminar in Chinese Linguistics.** (4 cr. Prereq–5120 or #)  
Emphasizes examining relevant theoretical models for selected issues in analysis of structure and history of Chinese language.

**Chn 8333. FTE: Master's.** (1 cr; NGA. Prereq–Master's student, adviser and DGS consent)

**Chn 8430. Seminar in 20th-Century Chinese Literature.** (4 cr. Prereq–#)  
In-depth study of life, time, and works of one major 20th-century author, or conceptualization and critical examination of one central issue that engaged the passion of 20th-century Chinese writers, as presented in their works.

**Chn 8440. Seminar in Chinese Poetry and Poetics.** (4 cr. Prereq–#)  
In-depth study of life, time, works, and poetic tradition of one major Chinese poet, or theory and development of one poetic genre.

**Chn 8444. FTE: Doctoral.** (1 cr; NGA. Prereq–Doctoral student, adviser and DGS consent)

**Chn 8450. Seminar in Chinese Fiction and Narrative Theory.** (4 cr; A-F only. Prereq–5105 or equiv or #)  
Important issues in Chinese narrative theory; complex relationship between development of Chinese fiction and that of Chinese narrative theory.

**Chn 8494. Directed Research.** (1-5 cr [max 16 cr])

**Chn 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq–Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Chn 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq–Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Chn 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer; 24 cr required)

## Civil Engineering (CE)

*Department of Civil Engineering*

*Institute of Technology*

**CE 5094. Civil Engineering Research.** (1-4 cr [max 4 cr]. Prereq–#)  
Research or independent study in concrete, structural steel, soils, hydraulics, hydrology/municipal, environmental, or transportation problems. Investigations, reports, tests, designs.

**CE 5170. Internet Based Study.** (1-5 cr [max 15 cr]; A-F only. Prereq–Upper div IT)  
Internet based teaching with bi-weekly exercises on topic of concern.

**CE 5180. Special Topics.** (1-4 cr [max 4 cr]; A-F only. Prereq–#)  
Topics vary depending on faculty and student interests.

**CE 5211. Traffic Engineering.** (3 cr. Prereq–3201, Stat 3021 or equiv)  
Principles of vehicle and driver performance as they apply to the safe and efficient operation of highways. Design and use of traffic control devices. Capacity and level of service. Trip generation and traffic impact analysis. Safety and traffic studies.

**CE 5212. Urban Transportation Planning.** (3 cr.

Prereq–3201 or equiv)

Techniques of analysis and planning for transportation services; demand-supply interactions; evaluating transportation alternatives; travel demand forecasting; integrated model systems; citizen participation in decision-making.

**CE 5214. Transportation Systems Analysis.** (3 cr.

Prereq–3201)

Systems approach, its application to transportation engineering/planning. Prediction of flows and level of service. Production functions, cost optimization, utility theory, demand modeling, transportation network analysis, equilibrium assignment, decision analysis, multidimensional evaluation of transportation projects.

**CE 5231. Pavement Management and Rehabilitation.**

(3 cr. Prereq–Upper div IT or grad, CE 4231 or #)

Concepts and practices in monitoring, maintaining, and rehabilitating flexible and rigid pavement systems. Manual and automated means of pavement assessment, structural and functional definitions of pavement performance, decision-making processes, and optimization.

**CE 5232. Advanced Portland Cement Concrete.** (3 cr.

Prereq–Upper div IT or Grad, CE 4232 or #)

Advanced topics in cement chemistry and selection of materials for and design of portland cement concrete mixtures. Lab assignments pertaining to mixture design and short-term and long-term behavior. Use of admixtures and fiber reinforcement. Effects of proportionment of standard materials.

**CE 5233. Advanced Bituminous Materials.** (3 cr.

Prereq–Upper div IT or grad, CE 3402 or #)

Advanced topics in selection and design of bituminous materials. Asphalt cement, rheology, emulsions, chip seals, hot-mix asphalt design, viscoelastic characterization. Lab assignments pertaining to rheology, mixture design and viscoelastic behavior.

**CE 5311. Experimental Geomechanics.** (3 cr; A-F only.

Prereq–Upper div IT or grad, 4301, GeoE 4301 or #)

Machine stiffness, closed-loop testing. Small-strain theory. Measurement of deformation: strain gages, LVDTs, accelerometers, and associated circuits. Direct and indirect testing. Material behavior: experiments on anisotropic, damaged, and fluid-filled solids.

**CE 5321. Geomechanics.** (3 cr; A-F only. Prereq–Upper

div IT or grad, 4301 or GeoE 4301)

Elasticity theory and solution of elastic boundary value problems. Wave propagation in unbounded elastic media. Elements of fracture mechanics and applications. Elements of poroelasticity and applications.

**CE 5331. Geomechanics Modeling.** (3 cr; A-F only.

Prereq–Upper div IT or grad, 4301 or #)

Soil and rock response in triaxial testing; drained and undrained behavior; elastic and plastic properties. Modeling stresses, strains, and failure in geomechanics problems.

**CE 5341. Wave Methods for Nondestructive Testing.**

(4 cr; A-F only. §GeoE 5341. Prereq–[AEM 2021, AEM 3031] or #)

Introduction to contemporary methods for nondestructive characterization of objects of civil infrastructure (e.g., highways, bridges, geotechnical sites). Imaging technologies based on propagation of elastic waves such as ultrasonic/resonant frequency methods, seismic surveys, and acoustic emission monitoring. Lecture, lab.

**CE 5351. Advanced Mathematics for Civil Engineers.**

(3 cr; A-F only. Prereq–[[Math 2263 or Math 2374 or equiv], [sr or grad student] in civil engineering]) or #)

Emphasizes skills relevant for civil engineers. Mathematical principles explained in an engineering setting. Applications from various areas in civil engineering.

**CE 5411. Applied Structural Mechanics.** (3 cr; A-F only.

Prereq–[Grade of at least C- in 4401, [upper div IT or grad student]] or #)

Principal stresses and failure criteria in 3 dimensions. Introduction to plane elasticity, energy methods, torsion of beams, and bending of unsymmetrical beams.

**CE 5412. Prestressed Concrete Design.** (3 cr; A-F only.

Prereq–[Grade of at least C- in 4401, [upper div IT or grad student]] or #; 4412 recommended)

Design of prestressed concrete structures. Time dependent effects, behavior, flexure, shear, torsion, deflections, continuous systems.

**CE 5413. Masonry Structures.** (3 cr; A-F only.

Prereq–[Grade of at least C- in 3401, [upper div IT or grad student]] or #; 4401 recommended)

Masonry materials and their production. Mortars, grouts. Design of unreinforced, reinforced, and prestressed masonry structural systems. Walls, columns, lintels, arches. Codes/specifications, testing, inspection.

**CE 5541. Environmental Water Chemistry.** (3 cr;

A-F only. Prereq–3501, Chem 1021, Chem 1022)

Introduction to water chemistry. Physical chemical principles, geochemical processes controlling chemical composition of waters, behavior of contaminants that affect the suitability of water for beneficial uses.

**CE 5542. Experimental Methods in Environmental****Engineering.** (3 cr; A-F only. Prereq–3501, Chem 1021, Chem 1022)

Tools necessary to conduct research in environmental engineering and chemistry. Theory of operation of analytical equipment. Sampling and data handling methods, statistical analyses, experimental design, laboratory safety. Lecture, laboratory.

**CE 5551. Environmental Microbiology Laboratory.**

(4 cr; A-F only. Prereq–3501, [upper div or grad] student)

Role of microorganisms in environmental bioremediation, pollution control, water/wastewater treatment, biogeochemistry, and human health. Basic microbiological techniques: isolation, identification/enumeration of bacteria, BOD, biodegradation kinetics, disinfection. Lecture, lab.

**CE 5581. Water Resources: Individuals and****Institutions.** (3 cr; A-F only)

Control of water resources by natural system functions, user actions, and influence of social, economic, and political institutions. Water resource policy in the United States. Case studies (e.g., flood/drought management).

**CE 5591. Environmental Law for Engineers.** (3 cr;

A-F only. Prereq–Upper div IT or grad or #)

Environmental regulatory law relevant to civil and environmental engineering; specific provisions of federal statutory and regulatory laws such as NEPA, CWA, RCRA, CAA, and CERCLA.

**CE 8022. Numerical Methods for Free and Moving****Boundary Problems.** (3 cr; A-F only. Prereq–8401 or #)

Examples of free and moving boundary problems: metal solidification, filling, polymer molding, flow in porous media, ground freezing. Solutions: analytical, fixed finite difference, fixed finite element, front tracking schemes, general deforming finite element methods.

**CE 8094. Civil Engineering Research.** (1–4 cr [max 12

cr]. Prereq–#)

Research or independent study in concrete, structural steel, soils, hydraulics, hydrology, and municipal, environmental, or transportation problems. Investigations, reports, tests, or designs.

**CE 8200. Seminar: Transportation.** (1 cr [max 3 cr];

S-N only)

Content depends on instructor and student. Sample topics: traffic safety, traffic flow theory, transportation materials, transportation planning, transportation economics.

**CE 8211. Theory of Traffic Flow.** (4 cr)

Definitions/measurements of basic traffic flow parameters, fundamental relationships. Macroscopic continuum and microscopic traffic flow models. Shockwaves and applications. Flow, speed, headway, and other statistical distributions of traffic parameters. Gap availability/acceptance. Simulation of traffic flow. Traffic control theory, queuing theory, applications.

**CE 8212. Advanced Travel Demand Modeling and****Supply Analysis.** (3 cr. Prereq–5211 or equiv, Stat 3021)

Application of random utility theory to model travel demand; deterministic and stochastic trip assignment; network design problems; transportation planning software.

**CE 8213. Advanced Transportation Technologies****Seminar.** (1 cr; S-N only)

Advantaged technologies specifically related to transportation. Topics drawn from core science/technology areas of human factors, intelligent vehicles, traffic modeling/management, sensing, communications, and controls.

**CE 8214. Transportation Economics.** (3 cr; A-F only)

Application of microeconomic theory to transportation. Demand/demand estimation, cost/cost estimation, pricing/investment, regulation/deregulation. Urban/intercity passenger transportation, freight transportation.

**CE 8215. Stochastic Transportation Modeling.** (3 cr.

Prereq–8210 or 8211, Stat 5021 or equiv)

Random variables and estimation; time-series models, linear systems and Kalman filtering; discrete-time Markov processes and dynamic travel demand models; continuous-time Markov processes and traffic flow.

**CE 8216. Urban Traffic Operations.** (3 cr)

Capacity analysis techniques for urban streets, optimal traffic signal timing, coordination, real time control. Traffic signal hardware, including detectors/controllers. Operational techniques for traffic management. Use of computer program packages in traffic engineering practice. Freeway operations/control.

**CE 8231. Advanced Pavement Engineering.** (3 cr.

Prereq–4231 or #)

Advanced concepts in pavement analysis and design; computation of stresses and strains in flexible and rigid pavement systems; review of Boussinesq theory, Burmeister model, and Westergaard model; load transfer in rigid pavements; temperature induced stresses; mechanics of drainage.

**CE 8233. Advanced Bituminous Materials****Characterization.** (3 cr. Prereq–[3402, grad student] or #)

Applications of viscoelasticity, rheology, elastoplasticity, and fracture mechanics to bituminous materials characterization. Lectures, discussions of advanced research reading assignments, laboratory assignments.

**CE 8300. Seminar: Geomechanics.** (1–3 cr [max 4 cr];

S-N only)

Presentations on various topics.

**CE 8301. Fracture of Geomaterials.** (3 cr; A-F only.

Prereq–IT grad student, 5321, GeoE 5321 or #)

Crack tip stress and displacement fields; stress intensity factors. Energy principles of fracture; compliance method. Process zone models. J integral. Mixed-mode fracture. Behavior of cracked solids. Numerical and experimental approaches.

**CE 8302. Soil/Rock Plasticity and Limit Analysis.** (4 cr;

A-F only. Prereq–IT grad student, 4301 or #)

Plasticity of soils and rocks. Yield conditions, flow rules. Theorems of limit analysis. Static solutions, method of characteristics. Kinematic solutions, hodograph. Energy balance. Applications to soil/rock engineering problems.

**CE 8311. Advanced Rock Mechanics.** (3 cr; A-F only.

Prereq–IT grad student, 4311 or GeoE 4311 or #)

Stress transformations; principal stresses and directions. Friction and behavior of rock joints; stability of frictional sliding. Elastic waves; acoustic emission and seismic measurements. Fragmentation and rock breakage.

**CE 8321. Thermoporoelasticity.** (4 cr; A-F only. Prereq-IT grad student, 5321 or GeoE 5321 or #) Micro-mechanical description of porous media. Thermodynamics foundations. Linear theory of thermoporoelasticity: constitutive, transport, and balance laws; field equations. Determination of material constants. Singular solutions. Methods of solution: integral transform, method of singularities, finite and boundary element method.

**CE 8322. Storage and Flow of Granular Materials.** (3 cr; A-F only. Prereq-IT grad student, 4301 or #) Plasticity of granular media. Static and dynamic method of slices. Storage and flow of granular materials in bins and hoppers. Stress concentrations, arching, piping. Experiments on granular material properties and flow.

**CE 8331. Modeling Geomechanical Processes.** (3 cr; A-F only. Prereq-IT grad student, 5321 or GeoE 5321) Data-limited nature of problems in geomechanics. Dimensional analysis. Regimes of solution. Similarity of solutions. Elements of fracture mechanics, elastoplasticity, poroelasticity. Applications to stability of underground excavations, fluid flow in fracture, tool-rock interaction, hydraulic fracturing.

**CE 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**CE 8336. Boundary Element Methods I.** (3 cr; A-F only. Prereq-IT grad student) Introduction to boundary element methods for elastostatics; stress discontinuity, displacement discontinuity, and direct boundary integral methods. Derivation of basic mathematical solutions from the theory of elasticity. Applications in geomechanics.

**CE 8337. Boundary Element Methods II.** (3 cr; A-F only. Prereq-8336, GeoE 8336 or #) Transient and nonlinear problems.

**CE 8351. Advanced Groundwater Mechanics I.** (3 cr; A-F only. Prereq-4351 or GeoE 4351, IT grad student or #) Solute transport; shallow flow in leaky aquifers; complex variable methods in groundwater flow. Analytic element method: potentials for line sinks, line doublets, line dipoles, area sinks, and special analytic elements; singular Cauchy integrals; analytic elements in domains with closed boundaries.

**CE 8352. Advanced Groundwater Mechanics II.** (3 cr; A-F only. Prereq-4351, IT grad student or #) Applying complex methods, including conformal mapping, in groundwater mechanics; solving problems with free boundaries using the hodograph method; drains in aquifers with free boundaries; superposition of solutions with drains; singular Cauchy integrals; boundary elements.

**CE 8361. Engineering Model Fitting.** (3 cr; A-F only. Prereq-IT grad student or #) Parameter estimation and inverse modeling for civil and geological engineering. Formulating engineering model fitting problems; comparing and selecting various fit criteria; implementing numerical algorithms; analyzing and interpreting results using both statistical and qualitative tools; designing future measurement plans.

**CE 8400. Seminar: Structures.** (1 cr [max 3 cr]; S-N only) Content depends on instructor and student. Sample topics: theory of elasticity, optimization, reliability, wave propagation, soil dynamics, experimental equipment, wind forces on structures, structural failures, modern construction practices.

**CE 8401. Fundamentals of Finite Element Method.** (3 cr; A-F only. Prereq-4411 or #) Elements of calculus of variations; weak and strong formulations of linear continuum and structural problems. Isoparametric elements and numerical integration. Basic concepts of error analysis and convergence. Analysis of plates and shells. Introduction to mixed methods and time dependent problems.

**CE 8402. Nonlinear Finite Element Analysis.** (3 cr; A-F only. Prereq-8401 or #; offered alt yrs) Large strains and work conjugate stresses. Equilibrium and principle of virtual work for nonlinear problems. Nonlinear elasticity and plasticity. Finite element discretization and nonlinear algebraic equations. Linearization and solution algorithms for nonlinear problems. Structural stability.

**CE 8411. Plate Structures.** (3 cr; A-F only. Prereq-5411 or #; offered alt yrs) Analysis of plate structures based on the small-deflection elastic Kirchhoff-Love theory. Classical and numerical analysis methods. Skew and orthotropic plate structures. Elements of large deflection theory and stability of plates.

**CE 8412. Shell Structures.** (3 cr; A-F only. Prereq-IT grad or #) Static analysis of thin elastic shells based on Love's postulates. Membrane and bending theories. Thermal stresses in cylinders. Buckling of shells of revolution. Offered alternate years.

**CE 8421. Structural Dynamics.** (3 cr; A-F only. Prereq-[3401, AEM 2012] or #; 14411 recommended) Response of discrete/continuous systems to dynamic loading. Formulation/solution of problems of one or more degrees of freedom. Modal analysis. Numerical integration and transform techniques. Response of dynamic systems to base motion using response spectrum methods.

**CE 8422. Earthquake Engineering.** (3 cr; A-F only. Prereq-8421 or #) Introduction to earthquake engineering; response spectra; energy absorption capacity of structures; estimation of damping; earthquake resistant design; seismic design codes; base isolation; soil-structure interaction. Blast resistant design. Wind effects on structures.

**CE 8431. Structural Stability.** (3 cr; A-F only. Prereq-IT grad student or #) Classification of discrete/continuous conservative/nonconservative systems. Buckling analysis of, e.g., structural members, frameworks, and plates by classical/numerical methods. Offered alternate years.

**CE 8432. Analysis of Thin-Walled Members.** (3 cr; A-F only. Prereq-5411 or #; offered alt yrs) Analysis of thin-walled structural members based on Vlasov theory and its modifications. Members with open and closed cross sections. Second-order effects and buckling. Influence of inelastic material behavior on buckling.

**CE 8441. Plastic Design of Steel Structures.** (3 cr; A-F only. Prereq-4413 or #; offered alt yrs) Plastic analysis and design of structures with applications to grillages, continuous beams, portal and gable frames. Collapse mechanisms and plastic deformations. Minimum weight design.

**CE 8442. Nonlinear Analysis of Structural Systems.** (3 cr; A-F only. Prereq-4411, 4413 or #; offered alt yrs) Advanced theory and computational techniques for analyzing complex structural building systems. Using comprehensive geometric and material nonlinear analysis for designing steel and composite structures.

**CE 8443. Fatigue and Fracture of Steel Structures.** (3 cr; A-F only. Prereq-4401 or #; offered alternate years) Fracture mechanics, ductile fracture, ferrous metallurgy, welding, S-N curves of steel structures. Emphasizes design/materials selection, evaluation, and repair of existing structures. Case studies such as fracture of steel structures during earthquakes, fatigue of large vehicle frames, and fatigue of bridge structures.

**CE 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**CE 8451. Behavior of Reinforced Concrete Structures.** (3 cr; A-F only. Prereq-4412 or #) Advanced topics; experimental and theoretical background to design code provisions. Moment-curvature analysis of members. Shear; torsion; disturbed regions. Beam column joints; shear walls. Effects of earthquake loading. Limit analysis.

**CE 8461. Structural Reliability.** (3 cr; A-F only. Prereq-[4412, 4413] or #) Structural design standards/methods. Uncertainties in structural design. Basic probabilistic concepts, statistical distributions. Resistance/load statistics. First-/second-order reliability methods, systems reliability. Development of probability-based design codes. Offered alternate years.

**CE 8490. Special Topics.** (1-3 cr [max 3 cr]; A-F only. Prereq-#) Topics vary depending on faculty and student interests.

**CE 8500. Environmental Seminar.** (1 cr [max 3 cr]; S-N only. Prereq-Grad CE major or #) Broad coverage of topics in environmental engineering and science. Speakers consist primarily of graduate students in these areas, but presentations may also be given by University faculty and guest speakers.

**CE 8501. Environmental Fluid Mechanics I.** (4 cr; A-F only. Prereq-3502 or equiv or #) Basic laws of mass, energy, and momentum transport in environmental fluid flow. Exact and approximate solutions for viscous flow. Irrotational flow; gravity waves. Similitude and inspectional analysis. Laminar boundary layers and slender flows. Application to engineering and environmental problems.

**CE 8502. Environmental Fluid Mechanics II.** (4 cr; A-F only. Prereq-8501 or #) Reynolds equations. Developed and developing turbulent boundary layers and slender flows, and their interaction with inviscid flow. Jets, plumes, wakes and shear layers. Statistical description of turbulence; data analysis.

**CE 8503. Environmental Mass Transport.** (4 cr; A-F only. Prereq-3502, 3501 or equiv or #) Principles of intraphase and interfacial chemical transport and fate in the environment, specifically the processes of diffusion, dispersion, and convection. Application to surface water and atmospheric mixing, dispersion in groundwater, and transport between these media.

**CE 8504. Theory of Unit Operations.** (4 cr; A-F only. Prereq-4541, 4531) Theoretical basis, design, and operation of chemical and physical processes used in treating and controlling water quality, including adsorption, ion exchange, sedimentation, thickening, filtration, gas transfer, coagulation, flocculation, membrane processes, and disinfection.

**CE 8505. Biological Processes.** (3 cr; A-F only. Prereq-4502, 4501 or #) Theoretical principles underlying chemical and biological wastewater treatment processes, including aerobic and anaerobic treatment for organic carbon and nutrient removal. Mathematical models of microbial growth kinetics and mass transport in suspended growth and attached film applications are developed.

**CE 8506. Stochastic Hydrology.** (4 cr; A-F only. Prereq-Stat 3021 or equiv or #) Analysis and synthesis of hydrologic series and systems; derived distributions; uncertainty and risk analysis; flood frequency analysis; multivariate time series analysis; correlation and spectral analysis; series of long-range dependence; linear estimation; geostatistics; sampling networks; hydrologic forecasting.

**CE 8507. Advanced Methods in Hydrology.** (4 cr; A-F only. Prereq-8506) Notions of scale-invariance, scaling, and multiscaling in geophysical processes; methods of multiscale analysis; wavelet transforms; time-frequency-scale analysis and fractal analysis. Applications in atmospheric, hydrologic, and geomorphologic processes.

**CE 8508. Ecofluid Dynamics.** (4 cr; A-F only. Prereq-3502 or equiv) Theoretical principles underlying environmental fluid dynamics of biochemical processes in lakes, rivers, wetlands, coastal ocean. Emphasizes small-scale fluid motion, dominant flux path, growth kinetics, thin layers, microstructure measurements.

**CE 8511. Mechanics of Sediment Transport.** (3 cr; A-F only. Prereq–3502 and 4501 or #)  
Particle motion in fluids. Criteria for incipient motion. Formulations for bedload and suspended load. Bedform mechanics and hydraulic resistance relations. Channel stability, aggradation and degradation, alluvial stream morphology.

**CE 8541. Aquatic Chemistry.** (3 cr; A-F only. Prereq–4541 or #)

Advanced course on water chemistry; physical chemical principles and geochemical processes controlling the chemical composition of natural waters, soil- and sediment-water interactions. Emphasizes behavior of inorganic contaminants in natural waters and engineered systems and dissolved natural organic matter.

**CE 8542. Chemistry of Organic Pollutants in Environmental Systems.** (3 cr; A-F only. Prereq–[4541, 5541] or #)

Structural characteristics and physico-chemical properties of organic contaminants in aquatic systems. Emphasizes PCBs, PAHs, dioxins, insecticides, herbicides, and chlorinated solvents. Factors affecting their transport/transformation. Structure- and property-activity relationships, their use in predicting organic chemical behavior.

**CE 8551. Environmental Microbiology: Molecular Theory and Methods.** (4 cr; A-F only. Prereq–5551 or #)

Introduction to microbial genetics and molecular phylogeny. Application of nucleic-acid techniques in environmental microbiology and microbial ecology.

**CE 8552. Groundwater Microbiology: Laboratory.** (4 cr; A-F only. Prereq–Grad CE major or #, exposure to basic environ engr and microbiol)

Subsurface microbial ecology, biogeochemical cycling, metabolic classification of subsurface bacteria, modeling bacterial transport, diagnosis of microbial induced fouling (MIF) events, bioremediation of contaminated aquifers. Lectures and four lab hours per week.

**CE 8553. Biofilms.** (3 cr; A-F only. Prereq–4551 or #)  
Science/engineering concepts to investigate formation/function of biofilms. Properties/composition of biofilms, transport/transformation processes in biofilms, communication in biofilms, mathematical modeling. Applications in environmental engineering.

**CE 8561. Analysis and Modeling of Aquatic Environments I.** (3 cr; A-F only. Prereq–One sem grad work or #)

Introduction to hydrologic transport and water quality simulation in natural water systems. Deterministic, process-oriented water quality model development. Mixed cell models, advection, turbulent diffusion/dispersion. Chemical/biological kinetics in water quality models. Application of water quality models to management problems.

**CE 8562. Analysis and Modeling of Aquatic Environments II.** (3 cr [max 6 cr]. Prereq–One sem grad work or #)

Models for transport/transformation of pollutants, nutrients, particulates, ecosystems, etc., from recently completed theses, articles, or research in progress. Students review assigned recent papers, make presentations, and analyze a topic of their choice.

**CE 8563. Industrial Waste Treatment.** (3 cr; A-F only. Prereq–3501, 4501, 4502, or equiv or #)

Introduction to industrial waste treatment. Individual industries, emphasizing constituents of the waste-stream and how best to recycle, recover, or reduce wastes. Cost concerns and regulations. Field trips to various industries to gain first-hand knowledge of processes involved in treatment.

**CE 8571. Hydraulic Measurements.** (3 cr; A-F only. Prereq–3502 or #)

Lab and field methods and instruments for measuring hydraulic pressure, velocity, and discharge.

**CE 8572. Computational Environmental Fluid Dynamics.** (4 cr; A-F only. Prereq–Grad student in IT or COAFES or #)

Finite difference methods, their application to solution of one-/two-dimensional problems in environmental fluid dynamics. Stability, convergence, consistency, and accuracy of numerical schemes. Navier-Stokes equations, their physical meaning, and their numerical solution. Turbulence modeling: RANS and LES.

**CE 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq–Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**CE 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq–Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**CE 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer; 24 cr required)

## Classical Civilization (CICv)

*Department of Classical and Near Eastern Studies*

*College of Liberal Arts*

**CICv 5120. Field Research in Archaeology.** (3 cr)

Field excavation, survey, and research at archaeological sites in Minnesota. Techniques of excavation/exploration. Interpretation of archaeological materials.

## Classics (Clas)

*Department of Classical and Near Eastern Studies*

*College of Liberal Arts*

**Clas 5001. Classical Lyric and Satire.** (3 cr. Prereq–[3001, two literature courses or #)  
Greek and Roman lyric poetry; Roman satire.

**Clas 5013. Roman Law and Society.** (3 cr)  
Survey of Roman law from social and historical perspectives. Basic concepts of Roman private law and legal procedure.

**Clas 5051. Before Herodotus: History and Historiography of Mesopotamia and the Ancient Near East.** (3 cr; A-F only. Prereq–Prev coursework in Ancient Near Eastern history recommended)  
Historical method/sources for Ancient Near Eastern history. Seminar. Emphasizes historical tradition and historiographic texts of Mesopotamia and neighboring regions of Ancient Near East. Secondary emphasis on their relationship to the works of classical historians such as Herodotus. Use of these sources in modern historiography of Ancient Near East.

**Clas 5070. Topics in Ancient Religion.** (3 cr. Prereq–RelA 3071 or 3072 or 3073 or 5071 or 5072 or 5073 or any RelS course or #)  
Study of a specific aspect of religion in Classical and Near Eastern antiquity such as healing cults, magic and divination, Gnosticism, or prophecy and authority. Topics specified in *Class Schedule*.

**Clas 5071. Greek and Hellenistic Religions.** (3 cr. §3071)  
Greek religion from the Bronze Age to Hellenistic times. Sources include literature, art, and archaeology. Homer and Olympian deities; ritual performance; prayer and sacrifice; temple architecture; death and the afterlife; mystery cults; philosophical religion; Near Eastern salvation religions. Meets with 3071.

**Clas 5072. The New Testament.** (3 cr. §3072)  
Early Jesus movement in its cultural and historical setting. Origins in Judaism; traditions about Jesus. Apostle Paul, his controversies and interpreters. Questions of authority, religious practice, and structure; emergence of the canon of scripture.

Contemporary methods of New Testament study; biblical writings as history and narrative. Meets with 3072.

**Clas 5073. Roman Religion and Early Christianity.** (3 cr. §3073)  
Etruscan, Republican religion. Appeal of non-Roman cults. Ruler worship. Christians in Asia Minor, Egypt, and the West. Popular piety, Christian and non-Christian. Rabbinic Judaism. Varieties of Christianity in 2nd and 3rd centuries. Influence of Greco-Roman culture on emerging church. Constantine and Julian. Meets with 3073.

**Clas 5080. New Testament Proseminar.** (3 cr. Prereq–1082 or 3072 or equiv)  
Study of some specific aspect of the New Testament and related literature. The class is organized as a discussion seminar. Topics specified in *Class Schedule*.

**Clas 5081. Classical Epic in Translation.** (3 cr. §3081W)  
Homer's Iliad and Odyssey. Virgil's Aeneid. Cultural context of epic. Development of the hero. Epic style. Poetics of epic.

**Clas 5082W. Greek Tragedy in Translation.** (3 cr. §3082)  
Origins of tragedy. Ancient theatres. Selected plays of Aeschylus, Sophocles, and Euripides.

**Clas 5083. Ancient Comedy.** (3 cr. §3083)  
Greek/Roman comic drama (e.g., Aristophanes, Menander, Plautus, Terence).

**Clas 5085. Greek Philosophy: The Pre-Socratics to Plato.** (3 cr)  
Fragments of the pre-Socratics and Sophists and selected dialogues of Plato.

**Clas 5088. Archaeology in Biblical Lands I: Old Testament Period.** (3 cr. §3088)  
Archaeological data relevant to the Old Testament; major sites in the Holy Land and other areas of the Mediterranean and Near East. Evidence of pottery, inscriptions, manuscripts, and coins. Excavation methods. Archaeology as a tool for study of ancient religions. Meets with 3088.

**Clas 5089. Archaeology in Biblical Lands II: New Testament Period.** (3 cr. §3089)  
Archaeological data relevant to Jewish scriptures and New Testament; major sites in the Holy Land and other areas of the Mediterranean and Near East. Evidence of pottery, inscriptions, manuscripts, and coins. Excavation methods. Archaeology as a tool for study of ancient religions. Meets with 3089.

**Clas 5103. Hellenistic and Early Roman Art and Archaeology.** (3 cr. Prereq–Jr, Clas/Arth 3008 or #)  
Sculpture, architecture, painting, and topography in developing centers of Hellenistic culture in eastern Mediterranean and in Etruscan and Roman towns from 400 B.C. to the beginnings of the Roman Empire.

**Clas 5108. Greek Architecture.** (3 cr. Prereq–Jr, Clas/Arth 3008 or #)  
Geometric through classical examples of religious and secular architecture and their setting at archaeological sites in Greece, Asia Minor and Italy.

**Clas 5111. Prehistoric Art and Archaeology of Greek.** (3 cr. Prereq–Jr, Greek art or archaeology course or #)  
Artistic and architectural forms of Neolithic period in Aegean area and Cycladic, Minoan, and Mycenaean cultures. Aims and methods of modern field archaeology; the record of human habitation in the Aegean area. Archaeological evidence as a basis for historical reconstruction.

**Clas 5112. Archaic and Classical Greek Art.** (3 cr. Prereq–Jr, Clas/Arth 5111)  
Sculpture, painting, architecture and minor arts in Greek lands from the 9th through 5th centuries B.C. Examination of material remains of Greek culture; archaeological problems such as identifying and dating buildings; analysis of methods and techniques. Emphasis on Periclean Athens.

**Clas 5120. Field Research in Archaeology.** (3 cr.

Prereq-#)  
Field excavation, survey, and research at archaeological sites in the Mediterranean area. Techniques of excavation and exploration; interpretation of archaeological materials.

**Clas 5145. Advanced Greek and Roman Mythology.**

(3 cr. \$3145. Prereq-1042 or #)  
Different theoretical approaches to Greek/Roman mythology.

**Clas 5172. House, Villa, Tomb: Roman Art in the Private Sphere.** (3 cr. Prereq-Intro art history course or #)

The architecture, painting, and sculpture of urban houses, country estates, and tombs in the Roman world. Relationships between public and private spheres, and literary and physical evidence; usefulness of the physical evidence in illuminating gender roles.

**Clas 5182. Art and the State: Public Art in the Roman Empire.** (3 cr. Prereq-Intro art history course or #)

Origins of Roman public art; use in maintaining community; exploitation by the first emperor, Augustus; development and diffusion through the later empire; varying capabilities to adjust to the demands of a Christian Empire.

**Clas 5251. Archaeology of Herodian Israel.** (3 cr; A-F only. Prereq-One course in [archaeology or ancient history] or grad student)

Archaeological sites in Israel dating to era of Herod the Great (37-4 BC). Palaces and religious edifices. Remains from Jewish/gentile settlements throughout the kingdom. Course readings consist of contemporary literary sources and excavation reports.

**Clas 5252. History of Early Christian Art in Context.**

(3-4 cr. Prereq-3xxx art history course or #)  
Role played by art in the formation of early Christian and Byzantine communities, and in establishing their relationships with the Pagan world and early Islam.

**Clas 5340. Practicum in Archaeological Field and Computer Techniques.** (3 cr. \$3340. Prereq-CICv major or ancient art and archaeology course or #)

Methods used for excavation of Old and New World sites. Meets at archaeometry/computer lab for part of the semester and at a selected site in Minnesota for day-long sessions for 9 to 10 weeks. Meets with 3340.

**Clas 5794. Introduction to Classical and Near Eastern Studies.** (1 cr; S-N only. Prereq-Grad major or minor or #)

Introduction to core research materials and reference materials in the various disciplines which make up classical studies.

**Clas 5940. Topics in Classical Literature.** (3 cr [max 9 cr]. \$3940. Prereq-Two literature courses or #)

Additional work for graduate credit. Topics specified in *Class Schedule*. Meets with 3940.

**Clas 5950. Aspects of Classical Culture.** (1-3 cr. \$3950)

Topics specified in *Class Schedule*. Meets with 3950.

**Clas 5993. Directed Studies.** (1-4 cr [max 12 cr].

Prereq-#, Δ, □)  
Guided individual reading or study.

**Clas 5994. Directed Research.** (1-12 cr. Prereq-#, Δ, □)

**Clas 5996. Directed Instruction.** (1-12 cr. Prereq-#, Δ, □)

**Clas 8190. Seminar: Issues in Ancient Art and Archaeology.** (3 cr [max 12 cr]. Prereq-#)

Selected issues, with special attention to current scholarly disputes. Topics specified in *Class Schedule*.

**Clas 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**Clas 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**Clas 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Clas 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required (Plan A only))

**Clas 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

**Clas 8950. Topics in Classical Studies.** (3 cr [max 12 cr])

Topics such as slavery, women in antiquity, pagans and Jews, the taboo, and modern study of myth.

## Clinical Laboratory Science (CLS)

### Department of Laboratory Medicine and Pathology

#### Medical School

**CLS 5064. Introduction to Clinical**

**Immunohematology.** (2 cr; A-F only. Prereq-#)  
Principles of blood grouping, antibody identification, compatibility testing, serology, and immunology.

**CLS 5065. Introduction to Clinical**

**Immunohematology: Laboratory.** (2 cr; A-F only. Prereq-#)  
Exercises illustrating techniques in blood grouping, antibody identification, compatibility testing, and detection of antibodies by serological and immunological methods.

**CLS 5090. Special Laboratory Methods.** (1-2 cr;

A-F only. Prereq-#)  
Assignment on an individual basis to one of a variety of special areas of experience in the clinical lab.

**CLS 5100. Virology, Mycology, and Parasitology for**

**Medical Technologists.** (2 cr; A-F only. Prereq-Microbiology course with lab, biochem course)  
Lab diagnosis of viral, fungal, and parasitic infections. Lecture.

**CLS 5104. Principles of Diagnostic Microbiology:**

**Lecture.** (2 cr; A-F only. Prereq-One microbiology course with lab, one biochemistry course, #)  
Current techniques used in lab diagnosis of infectious disease. Isolating/identifying bacteria and yeasts. Antimicrobial susceptibility testing. Lecture.

**CLS 5105. Principles of Diagnostic Microbiology:**

**Laboratory.** (2 cr; A-F only. Prereq-One microbiology course with lab, one biochemistry course, #)  
Current techniques used in lab diagnosis of infectious disease. Isolating/identifying bacteria/yeasts. Antimicrobial testing. Laboratory.

**CLS 5120. Seminar: Clinical Laboratory Science.** (1 cr

[max 3 cr]; S-N only. Prereq-#)  
Current literature. Presentation/discussion of research.

**CLS 5121. Journal Presentations.** (1 cr [max 2 cr]; S-N

only. Prereq-1st yr CLS grad student)  
Critical analysis, evaluation, discussion of current journal articles in student's specialty area.

**CLS 5125. Practicum Teaching.** (1-2 cr; A-F only.

Prereq-#)  
Supervised teaching experience, develop skills using instructional materials, tests, and measurements.

**CLS 5127. Introduction to Management and**

**Education I.** (1 cr; A-F only. Prereq-#)

**CLS 5129. Elements of Laboratory Administration.**

(2 cr; A-F only. Prereq-#)  
Leadership styles, employee selection and evaluation, communications, motivation, morale, discipline, job descriptions, record keeping, budgets, cost accounting, purchasing, product evaluation, lab safety, labor relations, government regulations.

**CLS 5130. Practicum in Laboratory Administration.**

(2 cr; A-F only. Prereq-#)  
Supervised experience and assignment of specific problems related to lab service and management in health care institutions.

**CLS 5135. Advanced Clinical Microbiology.** (3 cr.

Prereq-#)  
Observation, study, and practice in special problems, advanced techniques, and methodology.

**CLS 5140. Techniques for Teaching.** (2 cr; A-F only.

Prereq-#)  
Developing objectives, classroom activities, and evaluation criteria for medical technology education.

**CLS 5155. Advanced Clinical Hematology.** (3 cr.

Prereq-#)  
Observation, study, and practice in special problems, advanced techniques, and methodology.

**CLS 5165. Advanced Clinical Immunohematology.**

(3 cr. Prereq-#)  
Observation, study, and practice in special problems, advanced techniques, and methodology.

**CLS 5175. Advanced Clinical Chemistry.** (3 cr. Prereq-#)

Observation, study, and practice in special problems, advanced techniques, and methodology.

**CLS 5251. Hematology I: Basic Techniques.** (3 cr;

A-F only. Prereq-#)  
Theory and application of basic principles and techniques in clinical hematology and hemostasis. Lecture and lab.

**CLS 5252. Hematology II: Morphology and**

**Correlation.** (2 cr; A-F only. Prereq-5251 or MedT 4251)  
Fundamentals of blood and bone marrow examination emphasizing microscopic identification of immature and abnormal cells. Clinical correlation of lab findings in hematology and hemostasis. Lecture and lab.

**CLS 5253. Hemostasis.** (1 cr; A-F only. Prereq-5251 or

MedT 4251)  
Theory and application of specific concepts and techniques in hemostasis and coagulation. Lecture and lab.

**CLS 5310. Clinical Chemistry I: Lecture.** (2 cr; A-F only.

Prereq-Organic chem course with lab; biochem course, #)  
Principles and theory of clinical chemistry for assessing renal and metabolic disease/dysfunction, electrolyte balance, and acid-base balance. Principles and processes for quality management in the clinical lab.

**CLS 5311. Clinical Chemistry I: Laboratory**

**Applications.** (2 cr; A-F only. Prereq-One organic chemistry course with laboratory; one biochemistry course, #)  
Application of clinical chemistry principles and laboratory techniques in the analysis of urine, plasma, and body fluids. Emphasis on laboratory tests to evaluate renal function, electrolytes, and acid-base balance. Introduction to principles and processes for managing test quality. Laboratory.

**CLS 5320. Clinical Chemistry II: Lecture.** (2 cr; A-F only.

Prereq-Organic chem course with lab, biochem course, 5310 or MedT 4310, #)

Principles and theory of clinical chemistry for assessing metabolic disease/dysfunction involving hormones, enzymes, lipids/lipoproteins, cardiac function, liver, and digestive tracts. Emphasis on measurement methods and physiological significance.

**CLS 5321. Clinical Chemistry II: Laboratory**

**Applications.** (2 cr; A-F only. Prereq-Organic chem course with lab, biochem course, 5310 or MedT 4310, #)  
Application of clinical chemistry principles and lab techniques in analyzing serum, plasma, and urine. Focus on tests to evaluate selected disorders. Developing lab and instrumentation use skills with emphasis on quality control and technique.

**CLS 5768. Advanced Hematology.** (5-10 cr [max 30 cr].

Prereq-#)  
Practical experience collecting bone marrow from patients. Diagnosing hematological diseases by evaluating and interpreting cells from clinical specimens of bone marrow, peripheral blood, and, if applicable, lymph nodes.

**CLS 5864. Research Seminar.** (1 cr [max 10 cr]; S-N only.

Prereq-#)  
Departmental research seminar series.

**CLS 5865. Departmental Seminar.** (1 cr [max 10 cr];

S-N only. Prereq-#)  
Departmental clinical lab research seminar series.

**CLS 8193. Advanced Topics in Clinical Chemistry.** (2 cr. Prereq-#)  
Includes use of molecular approaches to diagnosis and risk assessment of selected diseases.

**CLS 8194. Research on Clinical Laboratory Problems.** (1-3 cr. Prereq-#)  
Individual research project in a selected area.

**CLS 8293. Educational Administration in Medical Technology.** (2 cr. Prereq-#)  
Responsibilities of administration to students, faculty, and educational community. Curriculum planning, accreditation, staffing, student selection, finances. Sample administrative problems and decisions used as practice vehicles.

**CLS 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**CLS 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

## Cognitive Science (CgSc)

### College of Liberal Arts

**CgSc 8000. Philosophy of Cognitive Science.** (3 cr. Prereq-Grad cog sci minor or #)  
Philosophical framework for analyzing cognitive sciences. Recent developments in metaphysics and epistemology. Nature of scientific theories, methodologies of cognitive sciences, relations among cognitive sciences, relation of cognitive science to epistemology and various philosophical problems.

**CgSc 8001. Proseminar in Cognitive Science.** (2 cr; S-N only. Prereq-Grad cog sci minor or #)  
Survey of major topics, including theoretical assumptions, methods, and samples of current research.

**CgSc 8360. Seminar: Topics in Cognitive Science.** (1-3 cr [max 6 cr]. Prereq-Grad cog sci minor or #)  
Lectures and in-depth discussion on a topic.

## Communication Disorders (CDis)

### Department of Communication Disorders

#### College of Liberal Arts

**CDis 5304. Phonetics.** (3 cr. §3304)  
Phonetic analysis, transcription of speech. Articulatory correlates of speech sounds. Extensive practice transcribing. Emphasizes narrow transcription of normal adult English, special populations in Speech-Language Pathology. Non-English IPA sounds needed for special populations.

**CDis 5401. Counseling and Professional Issues.** (2 cr. Prereq-4501 or 4601 or 4801 or #)  
Basic counseling principles and current professional issues in communication disorders. Application of counseling theory to clinical practice. Analysis of regulation, practice, and future direction of communication disorders.

**CDis 5501. Fluency Disorders.** (3 cr. Prereq-4501 or #)  
Description, nature, and treatment of fluency disorders in children and adults. Involvement in therapeutic and research activities.

**CDis 5502. Voice and Cleft Palate.** (3 cr. Prereq-[3305, 4301, 4501] or #)  
Normal/disordered aspects of voice and resonance. Organic/functional voice disorders, laryngectomy, cleft palate. Nature and clinical management of these disorders.

**CDis 5503. Motor Speech Disorders.** (3 cr. Prereq-3305, 4301, 4501 or #)  
Dysarthria, speech-production disorders resulting from neurologic disorders or lesions, and apraxia of speech, a disorder of the volitional control of speech. Nature and management of motor speech disorders in adults and children.

**CDis 5504. Dysphagia.** (3 cr. Prereq-3305, 4301, 4501, or #)  
Normal and disordered aspects of swallowing. The nature, etiologies, evaluation, and management of swallowing disorders will be covered.

**CDis 5602. Fluency and Phonological Disorders.** (3 cr. Prereq-[3304, 4601] or #)  
Theory/research related to nature, assessment, and treatment of phonological disorders in children.

**CDis 5603. Language and Cognitive Disorders in Children.** (3 cr. Prereq-[3303, grad student] or #)  
Language assessment, teaching procedures used with children/adolescents. Procedures apply to children who face language disabilities such as developmental delays, autism, learning disabilities.

**CDis 5604. Language Assessment and Intervention: School Age Children.** (3 cr. Prereq-4601 or #)  
Strategies, models and service-delivery options in assessment and intervention for school-age children with language impairments. Emphasis on practical applications for speech-language pathologists.

**CDis 5605. Language and Cognitive Disorders in Adults.** (3 cr. Prereq-3302, 4301, 4601 or #)  
Neurogenic communicative and cognitive disorders in adults, including aphasia, right-hemisphere syndrome, traumatic brain injury, and dementia. Consideration of neurologic substrates, assessment and diagnosis, and clinical intervention.

**CDis 5606. Introduction to Augmentative and Alternative Communication.** (3 cr. Prereq-4501, 4601 or #)  
Description of the range of augmentative and alternative communication applications for persons with developmental and acquired disabilities.

**CDis 5607. Electronic Communication Aids.** (3 cr. Prereq-5606 or #)  
Operational procedures for dedicated augmentative communication aids and related software applications. Design and implement assessment and intervention strategies relevant to dynamic and fixed display devices. Troubleshoot common technical difficulties encountered by individuals using electronic communication aids.

**CDis 5801. Audiologic Assessment I.** (3 cr. Prereq-4801 or #)  
Basic audiometric battery including pure tones, speech, masking, and immittance in adults; industrial audiology and otoacoustic emissions.

**CDis 5802. Hearing Aids I.** (3 cr. Prereq-3305, 4801 or #)  
Survey of modern hearing aids including history of development, electroacoustic functions, clinic and laboratory measurement techniques, sound field acoustics, techniques for selection.

**CDis 5803. Hearing Loss in Children: Diagnosis.** (3 cr. Prereq-4801 or #)  
Behavioral, physiological approaches to assessment and identification, development of the auditory mechanism, etiologies of hearing losses in infants, children, selection of sensory aids, principles of case management with children and families.

**CDis 5810. Laboratory Module in Audiology.** (1-2 cr [max 5 cr]. Prereq-4801 or #)  
Intensive study of clinical methods in audiology. Supplements didactic courses in audiology curriculum. Laboratory study, individually or in small groups.

**CDis 5900. Topics: Communication Disorders.** (1-3 cr)  
Topics listed in communication disorders office.

**CDis 5993. Directed Study.** (1-12 cr [max 18 cr]. Prereq-#)  
Directed readings and preparation of reports on selected topics.

**CDis 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**CDis 8410. Seminar: Research.** (3 cr [max 12 cr])  
Advanced study exploring application of experimental and quasi-experimental research designs used in single-subject and group research.

**CDis 8420. Seminar: Teaching.** (3 cr [max 9 cr]. Prereq-Grad com dis major)  
Advanced study to prepare doctoral students for careers in undergraduate and graduate teaching.

**CDis 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**CDis 8501. Interdisciplinary Management in Cleft Palate and Craniofacial Disorders.** (3 cr. Prereq-3305, 4501 or #)  
Communication problems associated with cleft palate and craniofacial disorders within interdisciplinary context; structural bases for speech problems, and physical and behavioral approaches to speech treatment; interdisciplinary medical and dental concerns and management.

**CDis 8530. Seminar: Speech.** (3 cr [max 12 cr])  
Advanced study and analysis of research in speech science and speech pathology.

**CDis 8602. Traumatic Brain Injury.** (3 cr. Prereq-[3302, 4301, 4601] or #)  
Survey of communicative/cognitive disorders in adults who have traumatic brain injuries. Demographics, neuropathologic substrates, assessment/diagnosis, clinical applications.

**CDis 8630. Seminar: Language.** (3 cr [max 12 cr])  
Advanced study and analysis of research in language acquisition, language science, and language disorders.

**CDis 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**CDis 8720. Clinical Education in Speech-Language Pathology.** (1-8 cr [max 24 cr]; S-N only. Prereq-Grad com dis major)  
Clinical experience.

**CDis 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**CDis 8801. Audiologic Assessment II.** (3 cr. Prereq-5801 or #)  
Auditory brainstem response and balance function in adults. Case studies and development of clinical protocols allowing for integration of topics from both courses in this sequence.

**CDis 8802. Hearing Aids II.** (3 cr. Prereq-5802 or #)  
Instrumentation and methods for fitting and evaluating personal hearing aids; ear impression techniques and materials; repair and modification of hearing aids.

**CDis 8803. Signals and Systems in Audiology.** (3 cr. Prereq-3305, 3306, 4801 or #)  
Introduction to electronics, digital signal processing, and calibration of instruments used to assess hearing. Lab sessions on such topics as sound-field calibration, earphone calibration, filters, spectra of transient signals, and use of an artificial mastoid.

**CDis 8804. Evoked Potentials.** (3 cr. Prereq-8801)  
Research and methods used in measurement and application of evoked potentials. Early, middle, and late auditory evoked potentials and electroneurography.

**CDis 8820. Clinical Education in Audiology.** (1-8 cr [max 24 cr]; S-N only. Prereq-Grad com dis major)  
Clinical experience.

**CDis 8830. Seminar: Hearing.** (3 cr [max 12 cr])  
Advanced study/analysis of research in hearing science and audiology.

**CDis 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

**CDis 8994. Directed Research.** (1-12 cr [max 18 cr]. Prereq-#)  
Directed research.

# Communication Studies (Comm)

Department of Communication Studies  
College of Liberal Arts

**Comm 5110. Special Topics in Communication Theory.** (3 cr [max 6 cr])  
Advanced theoretical problems. See department office for current offering.

**Comm 5210. Contemporary Problems in U.S. Electronic Media.** (3 cr [max 3 cr]. Prereq-3211)  
Problems affecting U.S. commercial and educational electronic media. Audiences; race/gender issues; regulation.

**Comm 5220. Television Genres.** (3 cr [max 3 cr])  
Nature, historical development, and influence on society of specific genres of television programming: drama, situation comedy, mystery, soap opera. Program genre change over time and how society, government regulation, and economics of production influence that historical process.

**Comm 5233W. Electronic Media and National Development.** (3 cr)  
Use of electronic media to change social, political, economic, and cultural life. Use by developing nations to improve agricultural practices, hygienic standards, literacy, and awareness of civic responsibility.

**Comm 5261. Political Economy of Media Culture.** (3 cr. Prereq-3211 or #)  
Organizational practices of media communicators. Media content as link between communicators and audiences. How viewers use/process media content.

**Comm 5401. Advanced Theories of Communication.** (3 cr. Prereq-3401 or grad)  
Survey of major theoretical approaches to communication including, positivism, constructivism, and systems.

**Comm 5402. Advanced Interpersonal Communication.** (3 cr. Prereq-1102, 3402 or 3411 or 3431 or 3441 or 3451)  
Social scientific approaches to interpersonal communication; theory and research findings.

**Comm 5404. Language, Culture, and Identity.** (3 cr. Prereq-3401 or #)  
How language/communication transmit cultural knowledge, attitudes, and beliefs. Connections among language, thought, and culture. Social/ethnic perspectives on study of language/communication.

**Comm 5406. Communication and Gender.** (3 cr. Prereq-One women's studies course or #)  
How gender affects verbal communication. Development of analytical skills through readings, exercises, research that raise awareness of the power of language and the influence of gender prescriptions. Comparisons across languages where possible.

**Comm 5408. Social Cognition.** (3 cr)  
Role of cognitive processing in communication studies. Models include perception, attention, memory and their use in communication. Evaluation of social cognition theory and research.

**Comm 5411. Small Group Communication Research.** (3 cr; A-F only. Prereq-3411 or #)  
Survey of small group communication research; theory and practice. Group decision-making and leadership.

**Comm 5421. Quantitative Methods in Communication Research.** (3 cr; A-F only. Prereq-3401 or #)  
Social scientific methods used in studying human communication. Optional data processing laboratory for additional credit.

**Comm 5431. The Process of Persuasion.** (3 cr. Prereq-3431)  
Communication campaigns (e.g., advertising, political) illustrating persuasive processes and theories. Research paper required.

**Comm 5441. Communication in Human Organizations.** (3 cr. Prereq-9 cr social science, 3441 or #)  
Communication in organizational settings. Organizational structure and dynamics and their effect upon the communication process. Individual projects.

**Comm 5451W. Intercultural Communication Processes.** (3 cr)  
Theory and research on cultural differences in values, norms, behaviors, and perceptions that affect communication across cultures internationally and domestically.

**Comm 5461. Conversation Analysis.** (3 cr. Prereq-Ling 3001 or Ling 5001)  
Discourse processes in dyadic and multiparty conversation. Application of concepts through analysis of conversations.

**Comm 5462. Field Research in Spoken Language.** (3 cr. Prereq-5461, Ling 3001 or Ling 5001)  
Transcribing and analyzing verbal communication and movement related to it. Applying concepts to recorded conversations.

**Comm 5611. Survey of Rhetorical Theory.** (3 cr. Prereq-1101)  
Survey of rhetorical theory from ancient to contemporary period; application of theory to public discourse.

**Comm 5615W. Introduction to Rhetorical Criticism.** (3 cr. Prereq-1101, 3601 recommended)  
Analysis of public discourse using various theoretical perspectives.

**Comm 5617. History and Criticism of U.S. Public Discourse: 1630-1865.** (3 cr. Prereq-Jr)  
How discourse has been used to establish or maintain power. Speeches and public debates used to examine American public address from 17th century (e.g., Puritan sermons) to the Civil War.

**Comm 5618. History and Criticism of U.S. Public Discourse: 1865-1950.** (3 cr. Prereq-Jr)  
How discourse has been used to establish or maintain power. Speeches and public debates used to examine U.S. public address from the mid 19th century to 1950.

**Comm 5970. Directed Study.** (1-3 cr [max 6 cr]; S-N only. Prereq-Nine 3xxx-5xxx Comm or Spch cr, #, Δ, □)  
Guided individual reading or study.

**Comm 5994. Communication Research Practicum.** (1-3 cr [max 9 cr]; S-N only. Prereq-#)  
Students participate in research group.

**Comm 8110. Seminar: Advanced Speech Problems.** (3 cr [max 15 cr]. Prereq-Undergrad degree in spch-comm or equiv)  
Evaluation of research methods in speech-communication.

**Comm 8210. Seminar: Selected Topics in U.S. Electronic Media.** (3 cr [max 6 cr]. Prereq-5210 or #; offered when feasible)  
Literature survey; evaluating research on topics; conducting independent research project on a particular topic.

**Comm 8211. Critical Communication Studies: History, Theory, Method.** (3 cr)  
Qualitative research methods for studying media institutions, texts, audiences, and contexts.

**Comm 8231. Seminar: National and International Electronic Media Systems.** (3 cr. Prereq-4231 or #)  
Historical and contemporary aspects of national and international electronic media systems. Roles of national and international regulatory bodies. Approaches to programming and evidence of effectiveness.

**Comm 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**Comm 8402. Seminar: Interpersonal Communication.** (3 cr. Prereq-5402 or #)  
Evaluate and develop new perspectives for analyzing, diagnosing, and managing interpersonal communication problems.

**Comm 8403. Seminar: Emotion and Communication.** (3 cr)  
Major theories of emotion and the role of emotion in communication.

**Comm 8406. Seminar: Language and Gender Research.** (3 cr. Prereq-5406)  
Readings and research on current issues. Data collected to test hypotheses and apply theory.

**Comm 8411. Seminar: Small Group Communication Theory.** (3 cr)  
Research problems and methods.

**Comm 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**Comm 8451. Seminar: Intercultural and Diversity Research.** (3 cr. Prereq-#)  
Development of ideas/methods for research project, M.A. Plan B project, or Ph.D. dissertation.

**Comm 8452. Seminar: Methods of Intercultural/Diversity Facilitation.** (3 cr. Prereq-4451 or 5452 recommended)  
Theories of and techniques for managing effective intercultural communication and diversity. Intercultural training.

**Comm 8502. Seminar: Communication Theory Construction.** (3 cr. Prereq-5421 or #)  
Logic of communication theory development and modification from a social scientific perspective. Types of communication theories.

**Comm 8503. Historical and Descriptive Research in Speech-Communication.** (3 cr)  
Elements involved in conducting and analyzing historical and descriptive research; approaches to historical research, assessing primary and secondary sources; completing a major research project.

**Comm 8504. Seminar: Rhetorical Criticism.** (3 cr. Prereq-5615 or #)  
Rhetorical criticism theories and methods. Rhetoric as applied to literary studies and the growth of hermeneutics as vantage points for reassessing rhetorical methods.

**Comm 8606. Seminar: Rhetorical Analysis of Campaigns and Movements.** (3 cr. Prereq-5431, 5617 or 5618, 10 cr soc sci or #)  
Literature and methodology in historical and contemporary rhetorical campaigns and movements.

**Comm 8611. Seminar: Rhetoric.** (3 cr [max 6 cr]. Prereq-5611 or #)  
History/criticism of rhetorical theory. Research in rhetoric.

**Comm 8625. Seminar: Communication Ethics.** (3 cr; A-F only. Prereq-Ethics course or #)  
Independent research on communication ethics in interpersonal, group, organizational, intercultural, and media settings. Theories of ethics and methods of analysis.

**Comm 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Comm 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Comm 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

**Comm 8994. Directed Research.** (1-3 cr [max 6 cr]; S-N only)  
Supervised research project.

## Comparative Literature (CLit)

*Department of Cultural Studies and Comparative Literature*

*College of Liberal Arts*

**CLit 5331. Discourse of the Novel.** (3 cr. §CSCL 5331)  
Comparative study of the novel (eighteenth century to present): its relation to ordinary language practices, emergent reading publics, technologies of cultural dissemination, problems of subjectivity; its role in articulating international cultural relations.

**CLit 5555. Introduction to Semiotics.** (3 cr. §CSCL 5555)  
Problems of the nature of the sign; sign function; sign production; signifying systems as articulated in philosophy, linguistics, anthropology, psychoanalysis, and art theory. Applying semiotics to various signifying practices (e.g., literature, cinema, daily life).

**CLit 5751. Basic Concepts of Cinema.** (4 cr. §CSCL 5751, §CSDS 5751)  
Cinema as object of theoretical/historical analysis. Emphasizes concepts that have transformed scope/aim of film analysis since 1960s. Readings of filmic/theoretical texts.

**CLit 5910. Topics in Comparative Literature.** (3 cr [max 24 cr])  
Topics specified in *Class Schedule*.

**CLit 5992. Directed Reading in Comparative Literature.** (1-3 cr [max 9 cr]. Prereq-#)  
Guided individual reading and study.

**CLit 8001. Basic Seminar in Comparative Literature I.** (4 cr)  
Key texts, positions, and problematics in field of comparative critical theory. Special attention to historical precursors, influential contemporary debates, and disciplinary genealogies.

**CLit 8002. Basic Seminar in Comparative Literature II.** (4 cr)  
Key texts, positions, and problematics in field of comparative critical theory. Special attention to historical precursors, influential contemporary debates, and disciplinary genealogies.

**CLit 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**CLit 8362. Modernity and Its Others.** (4 cr)  
Dialectical interrogation of Western and non-Western theories of modernity. Reckoning with differences and variations in its history, providing an account of the normative category of modernity (designated as European), and alternative articulations around the globe.

**CLit 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**CLit 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**CLit 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

**CLit 8901. Pedagogy of Cultural Studies and Comparative Literature.** (3 cr. Prereq-Grad comp lit major)  
Prepares graduate majors for teaching. Issues of pedagogy. Preparing syllabi for specific courses that graduate instructors teach. Required for students planning to teach in Department of Cultural Studies and Comparative Literature.

**CLit 8910. Advanced Topics in Comparative Literature.** (4 cr [max 32 cr])  
Practical applications of specific methodologies and theories to a determined area. Topics vary by instructor and semester.

**CLit 8920. Advanced Topics in Comparative Literature.** (3 cr [max 15 cr])  
Practical applications of specific methodologies and theories to a determined area. Topics vary by instructor and semester.

**CLit 8992. Directed Reading in Comparative Literature.** (1-4 cr [max 12 cr]. Prereq-#)

**CLit 8994. Directed Research in Comparative Literature.** (1-4 cr [max 12 cr]. Prereq-#)

## Comparative Studies in Discourse and Society (CSDS)

*Department of Cultural Studies and Comparative Literature*

*College of Liberal Arts*

**CSDS 5301. Society, Ideology, and the Production of Art.** (3 cr. §CSCL 5301)  
Recent critical theories of relation of arts to social/ideological forces. Selected artifices from Western culture (e.g., Renaissance to 20th century; high, popular, mass culture). Music, visual art, literature.

**CSDS 5302. Aesthetics and the Valuation of Art.** (3 cr. §CSCL 5302)  
Society, ideology, aesthetic value in light of recent critical theories of visual art, music, literature. Mediations of place, social class, gender, ideology on aesthetic judgment in post-renaissance Western culture.

**CSDS 5751. Basic Concepts of Cinema.** (4 cr. §CSCL 5751, §CLit 5751)  
Cinema as object of theoretical/historical analysis. Emphasizes concepts that have transformed scope/aim of film analysis since 1960s. Readings of filmic/theoretical texts.

**CSDS 5910. Topics in Comparative Studies in Discourse and Society.** (3 cr [max 24 cr])  
Themes in comparative, sociohistorical analysis of discursive practices. Individually or team taught. Topics specified in *Class Schedule*.

**CSDS 5993. Directed Study.** (1-3 cr [max 9 cr]. Prereq-#)  
Guided individual reading and study.

**CSDS 8001. Basic Seminar in Comparative Studies in Discourse and Society I.** (4 cr)  
Key texts, positions, and problematics in field of comparative critical theory. Special attention to historical precursors, influential contemporary debates, and disciplinary genealogies.

**CSDS 8002. Basic Seminar in Comparative Studies in Discourse and Society II.** (4 cr)  
Key texts, positions, and problematics in field of comparative critical theory. Special attention to historical precursors, influential contemporary debates, and disciplinary genealogies.

**CSDS 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**CSDS 8404. International Hierarchy.** (4 cr)  
Asymmetric structures and processes of international relations; systemic conditions and implications of informal empire and structures of dependency and hegemony.

**CSDS 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**CSDS 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**CSDS 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

**CSDS 8901. Pedagogy of Cultural Studies and Comparative Literature.** (3 cr. Prereq-Grad CSDS major)  
Prepare graduate majors for teaching. Issues of pedagogy. Preparing syllabi for specific courses that graduate instructors teach. Required for students planning to teach in Department of Cultural Studies and Comparative Literature.

**CSDS 8910. Advanced Topics in Comparative Studies in Discourse and Society.** (4 cr [max 32 cr])  
Themes in comparative, sociohistorical analysis of discursive practices. Individually or team taught. Topics vary by instructor and semester.

**CSDS 8920. Advanced Topics in Comparative Studies in Discourse and Society.** (3 cr [max 15 cr])  
Practical applications of specific methodologies and theories to a determined area. Topics vary by instructor and semester.

**CSDS 8993. Directed Study in Comparative Studies in Discourse and Society.** (1-4 cr [max 12 cr]. Prereq-#)

**CSDS 8994. Directed Research in Comparative Studies in Discourse and Society.** (1-4 cr. Prereq-#)

## Computer Engineering (CmpE)

*Department of Electrical and Computer Engineering*  
*Institute of Technology*

**CmpE 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**CmpE 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

## Computer Science (CSci)

*Department of Computer Science*  
*Institute of Technology*

**CSci 5103. Operating Systems.** (3 cr. Prereq-4061 or #)  
Conceptual foundation of operating system designs and implementations. Relationships between operating system structures and machine architectures. UNIX implementation mechanisms as examples.

**CSci 5106. Programming Languages.** (3 cr. Prereq-4011 or #)  
Design and implementation of high-level languages. Course has two parts: (1) language design principles, concepts, constructs; (2) language paradigms, applications. Note: course does not teach how to program in specific languages.

**CSci 5107. Fundamentals of Computer Graphics I.** (3 cr. §4107. Prereq-[4041 or #], fluency in C/C++, mastery of basic concepts in linear algebra)  
Fundamental algorithms in computer graphics. Emphasizes programming projects in C/C++. Scan conversion, hidden surface removal, geometrical transformations, projection, illumination/shading, parametric cubic curves, texture mapping, anti-aliasing, ray tracing. Developing graphics software, graphics research.

**CSci 5108. Fundamentals of Computer Graphics II.** (3 cr. Prereq-5107 or #)  
Advanced topics in image synthesis, modeling, and rendering. Image processing, image warping, global illumination, non-photorealistic rendering, texture synthesis. Parametric cubic surfaces, subdivision surfaces, acceleration techniques, advanced texture mapping. Programming is in C/C++.

**CSci 5109. Visualization.** (3 cr. Prereq-1902, 4041 or equiv or #)  
Fundamental theory/practice in data visualization. Emphasizes programming applications. Volume visualization, vector field visualization, information visualization, multivariate visualization, visualization

of large datasets, visualization in immersive virtual environments, and perceptual issues in effective data representation. Projects are implemented in C++ using VTK or similar visualization API.

**CSci 5115. User Interface Design, Implementation and Evaluation.** (3 cr. Prereq–4041 or #)  
Theory, design, programming, and evaluation of interactive application interfaces. Human capabilities and limitations, interface design and engineering, prototyping and interface construction, interface evaluation, and topics such as data visualization and World Wide Web. Course is built around a group project.

**CSci 5116. GUI Toolkits and Their Implementation.** (3 cr. Prereq–5115 or 5107 or #)  
Structure and design of user interface toolkits and frameworks. Aspects of GUI toolkits (e.g., window system protocols, event processing, geometry management, resource management, data management, constraints). Course is built around implementation assignments and case studies of toolkits.

**CSci 5131. Advanced Internet Programming.** (3 cr. \$4131. Prereq–5106 or 5211 or #; [4081 or 5801], 5707 recommended)  
Issues in internet programming: Java programming, concurrent programming, workflow, distributed databases, security, collaborative computing, object-oriented architecture/design, network publishing, messaging architecture, distributed object computing, internets.

**CSci 5161. Introduction to Compilers.** (3 cr. Prereq–4011 or #)  
Theories and mechanisms of programming language processing tools. General compiler organization: lexical scanner, syntax parser, symbol table, internal program representation, code generator. Relationship between design and implementation. Run-time memory management mechanism.

**CSci 5204. Advanced Computer Architecture.** (3 cr. \$8203, SEE 8365, SEE 5364. Prereq–4203 or EE 4363)  
Instruction set architecture, processor microarchitecture, memory, I/O systems. Interactions between computer software and hardware. Methodologies of computer design.

**CSci 5211. Data Communications and Computer Networks.** (3 cr. \$4211. Prereq–[4061 or #], basic knowledge of [computer architecture, operating systems, probability])  
Fundamental concepts, principles, protocols, and applications of computer networks. Layered network architectures, data link protocols, local area networks, network layer/routing protocols, transport, congestion/flow control, emerging high-speed networks, network programming interfaces, networked applications. Case studies using Ethernet, Token Ring, FDDI, TCP/IP, ATM, Email, HTTP, and WWW.

**CSci 5283. Computer-Aided Design I.** (3 cr. Prereq–2021 or #)  
CAD for digital systems. Emphasizes VLSI. Hardware description languages, synthesis, simulation, test generation.

**CSci 5285. Computer-Aided Design of VLSI.** (3 cr. Prereq–2021 or #)  
CAD for digital systems. Emphasizes VLSI. Physical design: partitioning, placement/routing, electrical rule checks. Inherent complexity of algorithms. Analysis of best known algorithms.

**CSci 5302. Analysis of Numerical Algorithms.** (3 cr. Prereq–2031 or #)  
Additional topics in numerical analysis: interpolation, approximation, extrapolation, numerical integration/differentiation, numerical solutions of ordinary differential equations.

**CSci 5304. Computational Aspects of Matrix Theory.** (3 cr. Prereq–5302 or #)  
Perturbation theory for linear systems and eigenvalue problems. Direct and iterative solution of large linear systems. Decomposition methods. Computation of

eigenvalues and eigenvectors. Singular value decomposition. LAPACK and other software packages. Methods for sparse and large structured matrices.

**CSci 5321. Linear and Nonlinear Programming.** (4 cr. Prereq–2031, some programming experience)  
Standard form for linear programming (LP), simplex method and geometry of LP, revised simplex method, duality theory and sensitivity, approximation of data by LP, interior methods, affine scaling algorithms, unconstrained optimization.

**CSci 5403. Computational Complexity.** (3 cr. Prereq–4041 or #)  
Computational models, complexity measures in each model, and related complexity classes.

**CSci 5421. Advanced Algorithms and Data Structures.** (3 cr. Prereq–4041 or #)  
Fundamental paradigms of algorithm and data structure design. Divide-and-conquer, dynamic programming, greedy method, graph algorithms, amortization, priority queues and variants, search structures, disjoint-set structures. Theoretical underpinnings. Examples from various problem domains.

**CSci 5451. Introduction to Parallel Computing: Architectures, Algorithms and Programming.** (3 cr. Prereq–4041 or #)  
Parallel architectures design, embeddings, routing, examples of parallel computers, fundamental communication operations, performance metrics, parallel algorithms for sorting, matrix problems, graph problems, dynamic load balancing, types of parallelisms, parallel programming paradigms, message passing programming in MPI, data parallel programming in HPF, shared-address space programming in threads.

**CSci 5471. Modern Cryptography.** (3 cr. Prereq–[2011, 4041, [familiarity with number theory or finite fields]] or #)  
Introduction to cryptography. Theoretical foundations, practical applications. Threats, attacks, and countermeasures, including cryptosystems and cryptographic protocols. Secure systems/networks. History of cryptography, encryption (conventional, public key), digital signatures, hash functions, message authentication codes, identification, authentication, applications.

**CSci 5481. Computational Techniques for Genomics.** (3 cr. Prereq–4041 or #)  
Techniques to analyze biological data generated by genome sequencing, proteomics, cell-wide measurements of gene expression changes. Algorithms for single/multiple sequence alignments/assembly. Search algorithms for sequence databases, phylogenetic tree construction algorithms. Algorithms for gene/promoter and protein structure prediction. Data mining for micro array expression analysis. Reverse engineering of regulatory networks.

**CSci 5511. Artificial Intelligence I.** (3 cr. Prereq–2011 or #)  
Introduction to AI. Problem solving, search, inference techniques. Logic and theorem proving. Knowledge representation, rules, frames, semantic networks. Planning and scheduling. Lisp programming language.

**CSci 5512W. Artificial Intelligence II.** (3 cr. \$5519. Prereq–5511 or #)  
Advanced topics in AI for solving complex problems. Machine learning (symbolic/neural networks approaches), genetic algorithms, reasoning with uncertainty, utility theory and decision theoretic methods, natural language processing, perception robotics, introduction to Prolog programming language.

**CSci 5519. Artificial Intelligence II (non-WI).** (3 cr. \$5512. Prereq–5511 or #)  
See 5512W for description.

**CSci 5521. Pattern Recognition.** (3 cr. Prereq–5301, Stat 3021 or #)  
Problems of pattern recognition, feature selection, measurement techniques. Classification methods: statistical decision theory, nonstatistical techniques. Automatic feature selection and data clustering. Syntactic pattern recognition. Mathematical pattern recognition and artificial intelligence. Applications in information retrieval and WWW data mining.

**CSci 5551. Introduction to Intelligent Robotic Systems.** (3 cr. Prereq–5511 or #)  
Transformations, kinematics/inverse kinematics, dynamics, control. Sensing (robot vision, force control, tactile sensing), applications of sensor-based robot control, robot programming, mobile robotics, and microrobotics.

**CSci 5561. Computer Vision.** (3 cr. Prereq–5511 or #)  
Issues in perspective transformations, edge detection, image filtering, image segmentation, and feature tracking. Complex problems in shape recovery, stereo, active vision, autonomous navigation, shadows, and physics-based vision. Applications.

**CSci 5707. Principles of Database Systems.** (3 cr. \$4707, \$INet 4707. Prereq–4041 or #)  
Concepts, database architecture, alternative conceptual data models, foundations of data manipulation/analysis, logical data models, database designs, models of database security/integrity, current trends.

**CSci 5708. Architecture and Implementation of Database Management Systems.** (3 cr. Prereq–5707 or #)  
Techniques in commercial and research-oriented database systems. Catalogs. Physical storage techniques. Query processing and optimization. Transaction management. Mechanisms for concurrency control, disaster recovery, distribution, security, integrity, extended data types, triggers, and rules.

**CSci 5801. Software Engineering I.** (3 cr. \$4081W. Prereq–[1902, 2011] or #)  
Advanced introduction to software engineering. Software life cycle, development models, software requirements analysis, software design, coding, maintenance.

**CSci 5802. Software Engineering II.** (3 cr. Prereq–5801 or #)  
Introduction to software testing, software maturity models, cost specification models, bug estimation, software reliability models, software complexity, quality control, and experience report. Student groups specify, design, implement, and test partial software systems. Application of general software development methods and principles from 5801.

**CSci 5980. Special Topics in Computer Science.** (1-3 cr [max 9 cr]. Prereq–#)  
Lectures and informal discussions on current topics in computer science.

**CSci 5991. Independent Study.** (1-3 cr [max 9 cr]. Prereq–#; may be repeated for cr)  
Independent study arranged with CS faculty member.

**CSci 5994. Directed Research.** (1-3 cr [max 9 cr]. Prereq–#; may be repeated for cr)  
Directed research arranged with faculty member.

**CSci 5996. Curricular Practical Training.** (1 cr [max 3 cr]; S-N only. Prereq–[CSci or CompE] major, #)  
Industrial work assignment involving advanced computer technology. Reviewed by faculty member. Grade based on final report covering work assignment.

**CSci 8101. Advanced Operating Systems.** (3 cr. Prereq–5103 or #)  
Successful research systems and existing theory of systems design. Goal is not merely to catalog systems or learn mathematics, but to develop a sense of elegance of design that leads to successful systems.

**CSci 8102. Operating Systems Theory.** (3 cr. Prereq–8101 or #)  
Fundamental principles underlying design of distributed and multiprocessor operating systems. Foundations of distributed computing systems; shared multiprocessor systems.

**CSci 8115. Human-Computer Interaction and User Interface Technology.** (3 cr. Prereq-5115 or #)  
Current research issues in human-computer interaction, user interface toolkits and frameworks, and related areas. Research techniques, model-based development, gesture-based interfaces, constraint-based programming, event processing models, innovative systems, HCI in multimedia systems.

**CSci 8161. Advanced Compiler Techniques.** (3 cr. Prereq-4061 or #)  
Techniques for uniprocessors and parallel computers. Fundamental program analysis instruments such as data flow analysis and data dependence analysis. Variety of code generation and transformation techniques.

**CSci 8205. Parallel Computer Organization.** (3 cr. SEE 8367. Prereq-5204 or EE 5364 or #)  
Design/implementation of multiprocessor systems. Parallel machine organization, system design. Differences between parallel, uniprocessor machines. Programming models. Synchronization/communication. Topologies, message routing strategies. Performance optimization techniques. Compiler, system software issues.

**CSci 8211. Advanced Computer Networks and Their Applications.** (3 cr. Prereq-5211 or #)  
Current research issues in traffic and resource management, quality-of-service provisioning for integrated services networks (such as next-generation Internet and ATM networks) and multimedia networking.

**CSci 8283. Research Problems in Computer-Aided Design for Electronic Design.** (3 cr. Prereq-5201 or 5283 or equiv or #)  
Open research problems in contemporary CAD for electronic design, approaches to their solution.

**CSci 8314. Iterative Methods for Linear Systems.** (3 cr. Prereq-5304 or #)  
Large sparse systems. Sparse systems; methods like Jacobi, Gauss-Seidel, relaxation, and conjugate gradient; preconditioning; and parallel implementation.

**CSci 8323. Numerical Solutions of Linear Least Square Problems.** (3 cr. Prereq-5304 or #)  
Numerical methods for linear and nonlinear least square problems; designing efficient and accurate algorithms. Sensitivity of least squares problems, modification of decompositions, generalized least squares, special methods for structured problems, and nonlinear least squares.

**CSci 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**CSci 8353. Advanced Parallel Numerical Methods.** (3 cr. Prereq-5301, 5451 or #)  
Parallel methods for problems in numerical linear algebra. Review of vector and parallel architectures; programming environments; parallel methods for linear least squares; eigenvalue problems, singular value decomposition, structured matrices, and linear systems.

**CSci 8363. Numerical Linear Algebra in Data Exploration.** (3 cr. Prereq-5304 or #)  
Computational methods in linear algebra, matrix decompositions for linear equations, least squares, eigenvalue problems, singular value decomposition, conditioning, stability in method for machine learning, large data collections. Principal directions, unsupervised clustering, latent semantic indexing, linear least squares fit. Markov chain models on hyperlink structure.

**CSci 8404. Design and Analysis of Approximation Algorithms.** (3 cr. Prereq-5403 or 5421 or #)  
Because an exact solution is often unfeasible for computationally difficult problems in important applications, approximation algorithms are a significant area of study. Introduces techniques for design of approximation algorithms; theory for evaluating the algorithms' performance.

**CSci 8442. Computational Geometry and Applications.** (3 cr. Prereq-5421 or #)  
Designing efficient algorithms and data structures for geometric problems. Models of computation, convex hulls, geometric duality, multidimensional search, Voronoi diagrams and Delaunay triangulations, linear programming in fixed dimensions, lower bound techniques. Applications, advanced topics.

**CSci 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**CSci 8481. Parallel Algorithms for Numeric and Non-numeric Problems.** (3 cr. Prereq-4041 or #)  
Parallel algorithms for many important problems in computer science and related fields. Parallel algorithms for sorting, selection, graph problems, computational geometry, matrix problems, FFT, combinatorial search algorithms, dynamic programming, and data mining.

**CSci 8521. Neural Computing and Neural Networks.** (3 cr. Prereq-5511 or #)  
Introduction to artificial neural networks (ANNs). Network architectures and learning rules; design of ANNs.

**CSci 8551. Intelligent Agents.** (3 cr. Prereq-5511 or #)  
Theories of intelligent agents. Agent architectures; knowledge representation, communication, cooperation, and negotiation among multiple agents; planning and learning; issues in designing agents with a physical body; dealing with sensors and actuators; world modeling.

**CSci 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**CSci 8701. Overview of Database Research.** (3 cr. Prereq-5708 or #)  
Research papers from journals and conferences on current topics in databases, such as database research methodologies, relational implementation techniques, active databases, storage systems, benchmarking, distributed and parallel databases, new data models, prototype systems, data mining, and future directions.

**CSci 8703. Distributed and Parallel Databases.** (3 cr. Prereq-5708 or #)  
Distributed database management systems (DBMS) architecture, including client-server, distributed DB design, distributed query optimization and processing; distributed transaction management (concurrency control and recovery); federated/multibases (definition and issues); database machines (concepts, successes, and failures); parallel databases.

**CSci 8705. Scientific Databases and Applications.** (3 cr. Prereq-5708 or #)  
Application domains of geographical information systems, common data types, queries and analyses, data models, languages to query, query optimization, access methods, clustering methods and file structures, system architectures and design (e.g., parallelism, extensibility), and new trends (e.g., spatial graphs).

**CSci 8760. Plan B Project.** (3 cr; S-N only. Prereq-CSci MS student, #)  
Project arranged between student and faculty.

**CSci 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**CSci 8801. Advanced Software Engineering.** (3 cr. Prereq-5801 or #)  
Software reusability, internet/intranet programming, software reengineering, and software safety.

**CSci 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

**CSci 8970. Computer Science Colloquium.** (1 cr [max 3 cr]; S-N only)  
Recent developments in computer science and related disciplines. Students must attend 13 of the 15 lectures.

**CSci 8980. Special Advanced Topics in Computer Science.** (1-3 cr [max 9 cr]. Prereq-#)  
Lectures and informal discussions.

**CSci 8991. Independent Study.** (1-3 cr. Prereq-#)

**CSci 8994. Directed Research in Computer Science.** (1-3 cr [max 9 cr]. Prereq-#)

## Conservation Biology (CBio)

### College of Biological Sciences

**CBio 8001. Conservation Biology Seminar.** (1 cr [max 6 cr]; S-N only. Prereq-#)  
Topics vary.

**CBio 8004. Economic and Social Aspects of Conservation Biology.** (3 cr. Prereq-CBio student or #)  
Economic/social aspects of conservation biology. Ecological economics, human dimension of conservation biology, values of conserving species/ecosystems.

**CBio 8095. Contemporary Problems in Conservation Biology.** (1 cr; S-N only. Prereq-8004, FW 8452, #)  
Comprehensive review of conservation biology issue. Written exam.

**CBio 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**CBio 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**CBio 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**CBio 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**CBio 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

## Control Science and Dynamical Systems (CSDy)

### Institute of Technology

**CSDy 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**CSDy 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**CSDy 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

**CSDy 8899. Seminar in Control Science and Dynamical Systems.** (1-3 cr [max 9 cr]; S-N only. Prereq-CSDy or IT grad)  
Current research and advanced topics.

## Coptic (Copt)

### Department of Classical and Near Eastern Studies College of Liberal Arts

**Copt 5001. Elementary Coptic.** (3 cr)  
Introduction to Coptic grammar and vocabulary, chiefly in the Sahidic dialect.

**Copt 5002. Elementary Coptic.** (3 cr. Prereq-5001 or equiv)  
Reading a variety of Coptic literature, such as Gnostic, martyrological, or monastic texts.

## Cultural Studies and Comparative Literature (CSCL)

Department of Cultural Studies and Comparative Literature

College of Liberal Arts

### CSCL 5147. Teaching as Dialogue. (3 cr)

Teaching and the teacher are the subject. Entering into dialogue is the method. Issues with the politics of teaching, the means of entering into dialogue, questions of judgment, and the idea of self-teaching as the goal of teaching.

### CSCL 5154W. Theoretical Constructions of Space. (3 cr)

Inquiry into theories of space drawn from various disciplines including anthropology, architecture, geography, history, landscape design, philosophy, planning, and sociology. Focus on sociopolitical interests that are served and sustained; emphasis on opportunities and implications for personal identity.

### CSCL 5256. Suburbia. (3 cr)

Suburbia from origins in 18th-century England to the present. Historical changes and present challenges, especially in America. Ideology, mythology, planning, development, geography, transportation, the family. Specific sites and designs; representations in film, television, popular literature, and music.

### CSCL 5301. Society, Ideology, and the Production of Art. (3 cr)

Recent critical theories on the relation of the arts to social and ideological forces; selected artifices from Western culture (Renaissance to 20th century; high, popular, and mass culture). Music, visual art, literature.

**CSCL 5302. Aesthetics and the Valuation of Art.** (3 cr)  
Society, ideology, and aesthetic value considered in light of recent critical theories of visual art, music, and literature. Meditations of place, social class, gender and ideology on aesthetic judgment in post-Renaissance Western culture.

### CSCL 5331. The Discourse of the Novel. (3 cr)

Comparative study of the novel, 18th century to present. Its relations to ordinary language practices, emergent reading publics, technologies of cultural dissemination, problems of subjectivity, and its role in articulating international cultural relations.

### CSCL 5555. Introduction to Semiotics. (3 cr)

Problems of the nature of the sign; sign function; sign production; signifying systems as articulated in philosophy, linguistics, anthropology, psychoanalysis, and art theory. Application of semiotics to various signifying practices (literature, cinema, daily life).

### CSCL 5711. Sociocriticism. (3 cr)

Sustained consideration of the modern tradition of sociological reflection on literature. Early and late Birmingham School, Frankfurt School, Bakhtin circle, and the various French initiatives associated with both *Les Temps Modernes* and *Tel Quel*.

### CSCL 5751. Basic Concepts of Cinema. (4 cr)

Examination of the cinema as an object of theoretical and historical analysis. Emphasis on the concepts that have emerged to radically transform the scope and aim of film analysis since the 1960s. Readings of filmic and theoretical texts.

### CSCL 5835. Richard Wagner's "Der Ring des Nibelungen": Music, Myth, and Politics. (3 cr. Prereq-#)

Literary and musical analysis and historical context of the four works of Wagner's "Ring": *Das Rheingold*, *Die Walküre*, *Siegfried*, *Götterdämmerung*. Critical assessment of Wagner's achievement and influence.

### CSCL 5910. Topics in Cultural Studies and Comparative Literature. (3 cr [max 24 cr])

Topics specified in *Class Schedule*.

### CSCL 5993. Directed Study. (1-3 cr [max 9 cr]. Prereq-#, Δ, □)

Guided individual reading or study.

## Curriculum and Instruction (CI)

Department of Curriculum and Instruction

College of Education and Human Development

### CI 5008. Theory and Practice of Teaching Art in Elementary Schools. (1-2 cr; A-F only)

Art concepts, skills, processes appropriate for elementary school. Methods of art instruction. Children's production of/responses to art.

### CI 5045. Advanced Contemporary Crafts. (2 cr; A-F only)

In-depth experiences in craft techniques, including ceramics, fibers, jewelry, and metal design, with emphasis on design analysis, understanding of materials, and mastery of processes.

### CI 5049. Art Media Techniques. (1-4 cr; A-F only)

Lectures, demonstrations, studio labs and critique session on creative processes; handling specific media. Topic varies.

### CI 5050. Issues in Art Education. (1-4 cr [max 12 cr])

Issues/trends, current practices, recent research.

### CI 5052. Introduction to Art Therapy. (2 cr; A-F only)

History, current conceptions, and practices of art therapy.

### CI 5055. Postmodern Visual Culture and Global Education. (1-3 cr; A-F only. Prereq-Grad students)

Representations of knowledge. Postmodern conditions of education and relationships to the influences of visual culture. Introduction to issues concerning the value and importance of visual imagery; influence of computer networking, mass communication, and other image sources.

### CI 5065. Improving Art Programs in the Schools. (3 cr; A-F only. Prereq-Initial lic students majoring in art ed)

Issues of art instruction, including teaching methods and evaluation, philosophical frameworks of pedagogy, and institutional issues concerning art programs in primary and secondary schools; social and cultural structures of schooling, practical issues of teaching art.

### CI 5069. Curriculum Innovations in Art Education. (3 cr; A-F only)

Study and analysis of innovations; evaluation of materials for teaching units and projects.

### CI 5075. The Social and Historical Foundations of Art Education. (1-3 cr; A-F only. Prereq-Grad student)

Issues of culture in education; examination of various forms of art as representations of knowledge, belief, and cultural capital. Epistemology, the meaning of function, and the conceptual location of visual culture in education and general culture. Seminar discussions include problems of cross-cultural and multicultural art education.

### CI 5078. Application of Aesthetic Theory in Education. (2 cr; A-F only)

Contemporary theories of art; psychological and philosophical foundations. Open to teachers, supervisors, and administrators concerned with art in general education at all levels.

### CI 5096. Art Education: Practicum. (1-6 cr [max 6 cr]; A-F only)

Issues of art instruction, including teaching methods and evaluation, philosophical frameworks of pedagogy, and institutional issues concerning art programs in primary and secondary schools. Practicum requiring students to work in a public school setting.

### CI 5097. Student Teaching in Art Education. (8 cr; S-N only. Prereq-Licensure student in art ed)

Observation of, participation in, and supervisory experiences with various types and levels of art classes.

### CI 5111. Introduction to Elementary School Teaching. (3 cr; A-F only. Prereq-Foundations of ed major or elem ed initial lic)

Curriculum organization, instruction, management, assessment, professional decision making.

### CI 5113. Classroom Management in the Elementary School. (3 cr)

For teachers, administrators, and support staff working in elementary school programs. Focus on management of student behavior, instruction as it relates to student behavior, and teacher organizational tasks in the classroom.

### CI 5133. Curriculum Planning and Design. (3 cr; A-F only. Prereq-Grad student)

Application of the theoretical and practical bases of disciplinary and interdisciplinary curriculum design to the problem of designing, implementing and evaluating the quality of a course or program of study.

### CI 5136. History of the American Curriculum. (3 cr)

Survey of formation of public school subjects and curriculum theory in United States. Social, political, and economic implications of curriculum theory.

### CI 5137. Multicultural Gender-Fair Curriculum. (3 cr; A-F only. Prereq-Grad student)

Issues related to diversity in learning settings and the exploration of culture in educational contexts. Explores rationale for and process of considering a multicultural and gender-fair curriculum; cultural issues inherent in curricular change; language, culture, sexual preference, special needs students, and the conflicts between culture and curriculum.

### CI 5138. Multicultural and Moral Perspectives on Classroom Instruction. (3 cr. Prereq-MEd or PhD student)

Factors leading to effective communication in ethnically diverse classroom, preschool to adult. Communication techniques and classroom structures that have cultural and moral implications.

### CI 5139. Moral Education Programs. (3 cr.

Prereq-Social or moral development course)  
Review of history, traditions, and efficacy of moral education programs in the schools; current school and district programs. Includes site visits to schools that are implementing social skills programs.

### CI 5141. Reflective Teaching and Professional Ethics. (3-4 cr. Prereq-Teaching license and one yr teaching exper)

Students develop their professional identities as educators by considering their world views and values in relation to their professional role and responsibilities in the context of a diverse society. Encourages reflective practice and critical review of research.

### CI 5147. Language, Culture, and Education. (3 cr; A-F only. Prereq-MEd or grad student)

Applies current sociolinguistic and discourse theory/research to study of relationships between language and culture in educational settings; language curriculum and instruction; classroom language use; borders between school and home/community language use; and educational policies on literacy/second-language instruction.

### CI 5149. Issues of Diversity in Schools and Classrooms. (3-4 cr. Prereq-Grad student or Teacher Leadership program)

Examination of issues in schools and classrooms that affect people from diverse groups, using historical, communication, value, and intercultural frameworks.

### CI 5150. Curriculum Topics. (1-6 cr [max 12 cr])

Special topics, current trends in curriculum. Subject integration, curriculum contexts, development, implementation, evaluation.

### CI 5155. Contemporary Approaches to Curriculum: Instruction and Assessment. (3 cr; A-F only. Prereq-Grad student)

Current research/issues that cross disciplinary boundaries in curriculum development, instructional practices, and assessment methods. Interrelations among curriculum, instruction, and assessment within framework of constructivist learning theory. Individual classroom practices/theories.

- CI 5162. Peer Coaching for Teachers.** (1-2 cr; A-F only. Prereq—Teaching exper)  
Teachers coaching teachers; acquiring concepts, skills, and dispositions necessary for observing classroom instruction and providing constructive feedback.
- CI 5172. Teaching Students with Learning Difficulties.** (3 cr; A-F only. Prereq—Elem teaching exper or #)  
Theory and practice in teaching students with learning difficulties across the curriculum.
- CI 5177. Practical Research.** (3 cr; A-F only. Prereq—CI Med student, or CI or EdPA Teacher Leadership Med student)  
Preparation for identifying a research and development topic, reviewing the existing knowledge on the topic, planning and carrying out a project, further investigating the topic, and writing a report on the project.
- CI 5178. Project in Teacher Leadership.** (3-6 cr. Prereq—CI or EdPA teacher leadership Med student)  
Create, implement, evaluate, and present a leadership project designed to initiate positive change in educational environments. Review related literature, proposal development, project development, implementation/evaluation, critical reflection. Share learning outcomes.
- CI 5181. Clinical Experience in Elementary School Teaching.** (4-8 cr; S-N only. Prereq—Foundations of Education and Elem Ed init lic only)  
Students spend full days in the elementary classroom gradually assuming responsibility for teaching the class. Students prepare a portfolio based on criteria given. One seminar per week.
- CI 5183. Applying Instructional Methods in the Elementary Classroom.** (1-2 cr [max 8 cr]; S-N only. Prereq—Foundations of ed major or elem ed initial licensure only)  
Supervised experience in elementary classrooms.
- CI 5186. School-Related Projects.** (1-4 cr; A-F only. Prereq—Med student)  
Research or evaluation project related to teaching, curriculum, or other aspect of schooling. Approved and supervised by faculty adviser.
- CI 5187. Practicum: Improvement of Teaching in Elementary or PreKindergarten Schools.** (2-3 cr; S-N only. Prereq—Med student in elem or early childhood ed)  
Elementary school classroom teaching project designed to improve specific teaching skills. Approved and directed by adviser.
- CI 5190. Directed Individual Study in Curriculum and Instruction.** (1-6 cr [max 12 cr]. Prereq—Grad students only)  
Directs students to individual studies that focus on producing and evaluating curriculum materials; literature review of issues and problems; and assessing curriculum processes.
- CI 5251. Social and Philosophical Foundations of Early Childhood Education.** (3 cr; A-F only. Prereq—[Med student in ECE or ECSE] or #)  
Surveys imagery, history, philosophy, and psychology of early childhood education. Analyzing/interpreting trends in early education, including diversity, special needs, legislation, public policy, and educationally appropriate practice.
- CI 5252. Facilitating Social and Physical Learning in Early Childhood Education.** (3 cr. Prereq—Med student in early childhood ed or in early childhood special ed)  
Current theoretical/empirical literature and developmental knowledge as basis for planning, implementing, and evaluating social/physical growth/development of young children. For students obtaining ECE/ECSE licensure.
- CI 5253. Facilitating Cognitive and Creative Learning in Early Childhood Education.** (3 cr; A-F only. Prereq—Med student in early childhood ed or early childhood special ed)  
Overview of cognitive, creative, and language characteristics of children ages 0-8 years and of how teachers can plan curriculum to facilitate children's development in these areas.
- CI 5254. Kindergarten Methods.** (2 cr; A-F only. Prereq—Foundations of Education/Elementary Education or M.Ed./LP Elementary Education)  
Purpose of kindergarten, its place in elementary program. Curriculum appropriate for needs of age group, including children with special needs. Assessment procedures, role of classroom teacher.
- CI 5281. Student Teaching in Early Childhood Education.** (3-6 cr; S-N only. Prereq—Med student in early childhood ed or early childhood special ed)  
Application of theory/research relating to teaching preschool children. For individuals obtaining ECE licensure.
- CI 5330. Topics in Instructional Systems and Technology.** (1-3 cr [max 12 cr])  
Topics related to needs of in-service teachers. Topics, location, credits, and duration are flexible.
- CI 5331. Introduction to Instructional Systems and Technology.** (3 cr)  
Orientation to the field to examination of various issues affecting the use of technology. Advanced students identify research topics for investigation in future courses and identify key literature in the field in preparation for masters and doctoral examinations.
- CI 5336. Planning for Multimedia Design and Development.** (3 cr)  
Theory, research, practice in instructional design. Generic components of instructional design process. Applying principles to design/development of computer-based instructional materials.
- CI 5337. Planning for K-12 Technology Design and Integration.** (3 cr; A-F only)  
Designing/planning for technology integration in K-12 contexts. Focuses on school, district, state, and national levels. School visits, guest speakers, school-focused technology planning project.
- CI 5342. School Technology Planning.** (1 cr; A-F only)  
How to establish plans for use of technology that support K-12 instruction and student learning. Facilitating ongoing comprehensive planning for technology integration. Identifying priorities for technology planning.
- CI 5343. School Technology Funding.** (1 cr; A-F only. Prereq—[Mac or PC] with 128 MB RAM, Windows NT or 2000 or XP or Mac OS 9 or OS 10], Pentium 2 or faster, Internet connectivity, up-to-date Netscape, Internet Explorer, virus protection software)  
Developing a multi-year funding strategy for establishing K-12 technology integration in accordance with a technology vision/plan.
- CI 5344. Facilitating Technology Integration in Classrooms I.** (1 cr; A-F only)  
Intersection of student learning theories and research base on effective technology practices. Video cases of technology-supported teaching, peer teaching exercise.
- CI 5345. Facilitating Technology Integration in Classrooms II.** (1 cr; A-F only. Prereq—[5344 or #], [Mac or PC] with 128 MB RAM, [Windows NT or 2000 or XP or Mac OS 9 or OS 10], Pentium 2 or faster, Internet connectivity, up-to-date Netscape, Internet Explorer, virus protection software)  
Technology-supported teaching/learning at one's educational site. Preparing a vision statement for technology's role in student learning. How to assume an advocacy role in establishing technology use for instruction/learning.
- CI 5346. Staff Technology Development and Support.** (1 cr. Prereq—[Mac or PC] with at least 256 MB of RAM, [Windows NT or 2000 or XP or Mac OS 9 or 10], Pentium 2 or faster, internet connection, up-to-date version of [Netscape, Internet Explorer], virus protection software, #)  
How to lead organization in designing, implementing, evaluating, improving, and sharing approaches to staff development. Technology-related staff development. Facilitating development through use of technology.
- CI 5351. Technology Tools for Educators.** (3 cr; A-F only. Prereq—Basic knowledge of Macintosh operating system and a word processing program)  
Develop skills in using selected technology applications to support teaching and learning. Internet applications, presentation software, multimedia authoring tools, desktop publishing software, Web page creation. May also include a field-site project.
- CI 5361. Teaching Via the Internet.** (3 cr)  
Examination of the capabilities of the Internet for professional development and instructional use. Use of specific client/server software for accessing the Internet; instructional issues and opportunities; implications for K-12 student involvement and classroom management; and Web page development by teachers and their students. Previous experience with computers desirable.
- CI 5362. Introduction to Educational Multimedia.** (3 cr. Prereq—Familiarity with basic computer operations)  
Issues influencing design/development of educational multimedia for CD-ROM/Internet delivery. Hardware/software for CD-ROM, Web-based delivery. Design, development, project management.
- CI 5363. Introduction to Computer-Based Instructional Design.** (3 cr; A-F only)  
Learn to design and develop computer-based instructional materials using a state of the art authoring language. Introduction to principles of courseware design; multimedia components in instruction; development of computer courseware using the authoring language; tutorial design.
- CI 5364. Computer-Based Instruction: Games and Simulation.** (3 cr; A-F only. Prereq—5363)  
Principles and procedures of computer simulation and game design. Types of computer simulation, the components common to simulation design, and the theory underlying educational simulation design.
- CI 5367. Interactive Multimedia Instruction.** (3 cr; A-F only. Prereq—Knowledge of principles and procedures of CBI design and one multimedia authoring system)  
Principles of effective computer-based design; tools in multimedia development; contemporary issues and skills used in the design, development, and implementation of interactive multimedia instruction. Use multimedia development tools, create a multimedia portfolio, and investigate the issues surrounding their effective use.
- CI 5391. Technology in the Postsecondary Development Curriculum.** (3 cr)  
Examines ways in which use of technology is transforming learning environments, teaching practices, and the curriculum in developmental education for postsecondary students. Course taught online.
- CI 5401. Literature for the Elementary School.** (3 cr; A-F only. Prereq—Children's lit course or #)  
Evaluative survey of books for children; research related to children's reading interests; selection of literature for themed instruction.
- CI 5402. Introduction to Special Collections.** (2-4 cr; A-F only. Prereq—Children's lit course)  
Special collections of children's literature as research material. Study of manuscripts, original art, and letters. Materials from the Kerlan Collection in Walter Library will be available.
- CI 5403. Creative Writing For and By Children.** (2-4 cr; S-N only. Prereq—Children's lit course or #)  
Creative aspects of writing and illustrating children's literature and children's own writing. Features authors and illustrators of children's books.
- CI 5410. Special Topics in the Teaching of Literacy.** (1-3 cr [max 12 cr])  
Topics related specifically to the needs of in-service teachers. Topics, location, credits, and duration will be highly flexible.
- CI 5411. Teaching Reading in the Elementary School.** (3 cr; A-F only)  
Aids the inservice elementary classroom teacher in the development of knowledge of theory and practice in the teaching of reading.

**CI 5412. Reading Difficulties: Instruction and Assessment.** (3 cr; A-F only. Prereq–5411 or 5451)  
Causes, diagnosis and assessment, prevention and correction; intervention practices useful to the classroom teacher and special teacher of reading.

**CI 5413. Teaching Students with Reading Difficulties.** (3 cr; A-F only. Prereq–5412)  
Assessment and tutoring of individual children who have difficulty reading in school.

**CI 5415. Literacy Development in the Primary Grades.** (3 cr; A-F only. Prereq–Elem teaching exper or #)  
Integration of skill and aesthetic activities in graded and non-graded primary classroom settings. Use national and state language arts standards and statewide assessment protocols to examine elementary literacy curricula.

**CI 5416. Literacy Development in the Intermediate Grades.** (3 cr; A-F only. Prereq–Elem teaching exper or #)  
Theory and practice of integrated teaching of reading, literature, writing, and language.

**CI 5418. Whole Language Teaching and Learning in the Elementary School.** (3 cr; A-F only. Prereq–MEd or grad student, minimum one yr teaching exper)  
Theory, research, and politics of whole language teaching. Applications for developing an elementary school whole language curriculum.

**CI 5422. Teaching Writing in the Elementary School.** (3 cr; A-F only. Prereq–Init lic or MEd or grad student)  
Theory of and research on the writing process. Applications to developing an elementary school writing curriculum.

**CI 5424. Reading, Language Arts, and Literature: Primary.** (3 cr; A-F only. Prereq–Elem ed init lic only)  
Curricular and methodological issues of reading, language arts, and children’s literature. Major topics include emergent literacy, reading process, strategy instruction for word recognition and comprehension, methods of word recognition, authentic assessment strategies, and teaching diverse students.

**CI 5431. Introduction to Instructional Leadership in K-12 Reading.** (3 cr; A-F only. Prereq–Minnesota license valid for classroom teaching in pre-kindergarten, [adult basic education or grades kindergarten through 6 or 1 through 6 or 5 through 8 or 9 through 12 or kindergarten through 12])  
K-12 curriculum in reading, major theories/research that motivate curriculum. Major instructional principles, alignments needed, resources available.

**CI 5432. Instructional Leadership in Reading in Kindergarten and the Elementary Grades.** (3 cr; A-F only. Prereq–5431)  
Research-based reading instruction for elementary grades. How to help other teachers improve practice. Characteristics of effective schools within context of improving students’ reading achievement.

**CI 5433. Instructional Leadership in Reading for the Middle and Secondary Grades.** (3 cr; A-F only. Prereq–5432)  
Curriculum/instruction for middle/secondary school students.

**CI 5434. Instructional Leadership in Preventing Reading Difficulties.** (3 cr; A-F only. Prereq–5433)  
Research-based reading interventions for struggling readers. How to help other teachers improve their practice. Theory/research behind preventing reading difficulties. Principles/techniques for assessing reading difficulties and students’ progress.

**CI 5435. Professional Development and Evolving Practice in K-12 Reading.** (1 cr [max 3 cr]; A-F only. Prereq–5432 or 5433 or 5434)  
Developing e-portfolio to assess competence in standards for teaching K-12 reading. Evolving teaching practices. Applications of current technologies.

**CI 5441. Teaching Literature in the Secondary School.** (2-3 cr; A-F only. Prereq–Fall, English init lic only, 2 cr; other sections, 3 cr)

Current theories of teaching literature; critical approaches to analyzing literature; theory and research on response to literature; adolescent literature and reading interests; methods for devising response activities and units; incorporating multicultural literature; relating media and literature; linking writing of literature to understanding literature; designing literature curriculum; evaluating and assessing students’ growth in literary response.

**CI 5442. Literature for Adolescents.** (3 cr; A-F only)  
Characteristics of literature written for adolescents; rationale for using adolescent literature; adolescents’ reading interests and attitudes; analysis of quality and appeal; individualized reading programs; methods of promoting reading; multicultural literature; developing teaching activities.

**CI 5451. Teaching Reading in Content Areas.** (3 cr; A-F only. Prereq–Fall, English init lic only)  
Methods of accommodating to students’ abilities and facilitating reading in regular content classes.

**CI 5461. Teaching Composition in the Secondary School and College.** (3 cr; A-F only. Prereq–Spring, English init lic only)  
Current theories of composition instruction, methods for teaching various composing processes within social contexts, uses of informal writing, linking reading and writing, describing and evaluating features of student writing, using and modeling conference strategies, using computer-mediated software, teaching writing of fiction and non-fiction, grammar and writing, editing instruction, writing assessment, uses of portfolios.

**CI 5462. Evaluating and Assessing Writing.** (3 cr; A-F only. Prereq–5461)  
Methods of evaluating writing; identifying rhetorical and linguistic features of and explaining difficulties in writing; strategies for giving descriptive feedback to informal and formal writing; training for peer conferences; strategies for portfolio writing evaluation and assessment; methods for conducting large-scale writing assessments; issues of validity and reliability with writing assessments with particular application to the Minnesota Graduation Standards basic skills writing test.

**CI 5472. Teaching Film, Television, and Media Studies.** (3 cr; A-F only)  
Methods of teaching film, video, and media studies at the secondary and college level; methods for eliciting critical responses; analysis of film/video techniques; analysis of cultural representations and genre characteristics; connecting and comparing film/video and literature; studying documentary and television news; developing media studies units.

**CI 5481. Developments in Teaching English and Speech.** (2 cr; A-F only. Prereq–English init lic)  
Current theories of English/speech curriculum. Teaching oral language. Organizing curriculum. Linking components of English/speech curriculum. Reflecting on pre-student-teaching experience.

**CI 5482. Reading, Language Arts, and Literature: Intermediate.** (3 cr; A-F only. Prereq–Elem ed init licensure only)  
Aids the preservice teacher in understanding theory and practice in the teaching of reading to students in the upper elementary grades.

**CI 5496. Directed Experiences in Teaching English.** (8 cr; S-N only. Prereq–MEd/init lic students in English ed only)  
Student teaching/clinical experience for English post-baccalaureate students only.

**CI 5500. Special Topics: Outdoor Science Education.** (1-8 cr [max 12 cr]. Prereq–Elem tchg exper)  
Classroom and fieldwork activities aimed at increasing the knowledge and interest of students in teaching outdoor in all seasons. Topics include snow and ice ecology, the timber wolf and white-tailed deer, pond ecology, Twin Cities’ geology, trees and plants of Minnesota, and stargazing.

**CI 5501. Teaching Science and Health in the Elementary School.** (2 cr; A-F only. Prereq–Elem ed init licensure only)  
Methods and materials for teaching science and health at the elementary school level.

**CI 5504. Elementary School Science: Materials and Resources.** (3 cr. Prereq–Elem tchg exper or #)  
Examination of the teacher’s role in inquiry teaching; the current science curriculum; and resources for teaching science in the elementary school.

**CI 5531. Teaching Middle School Science.** (4 cr; A-F only. Prereq–Init lic student in science ed)  
Methods of planning/teaching science to middle school students.

**CI 5532. Teaching Secondary School Science.** (4 cr; A-F only. Prereq–Admission to init lic program in science)  
Methods of planning and teaching science for secondary school students.

**CI 5533. Current Developments in Science Teaching.** (3 cr; A-F only. Prereq–[MEd, init lic, grad student] or #)  
Using curriculum standards to design science courses.

**CI 5534. Studies in Science Education.** (3 cr; A-F only. Prereq–M.Ed., init lic, or #)  
Improvement of science teaching through the application of research findings.

**CI 5535. Foundations of Science Education.** (3 cr; A-F only. Prereq–[M.Ed., grad student] or #)  
Analysis of present science teaching practices in light of historical and philosophical foundations of science education.

**CI 5536. Advanced Methods of Teaching and Assessment in Science.** (3 cr. Prereq–[MEd or grad] student or #)  
Development/teaching of extended science activities: structured controversies, field-based activities, service learning projects, computer-based investigations. Development of authentic assessments, students’ portfolios based on national/state guidelines.

**CI 5540. Special Topics: Science Education.** (1-8 cr [max 12 cr])  
Detailed examination and practice of the teaching of one area of science (e.g. geology, health, physical science) or one method of instruction (e.g. laboratories, demonstrations, Internet, simulations).

**CI 5596. Clinical Experience in Middle School Science.** (4 cr; A-F only. Prereq–Init lic in science ed)  
Supervised clinical experience in middle school science teaching.

**CI 5597. Clinical Experience in Secondary School Science Teaching.** (4-8 cr; S-N only. Prereq–Init lic or #)  
Supervised clinical experience in secondary school science teaching.

**CI 5619. Teaching Second Languages and Cultures in Elementary Schools.** (3 cr)  
Methods and materials for ESL and foreign languages; development of oral and written communication in a second language; alternatives in second-language program format; global awareness and cross-cultural experience; assessment of children’s language; children’s literature, games, and songs; planning and development of units and lessons.

**CI 5631. Second Language Curriculum Development and Assessment.** (3 cr; A-F only. Prereq–SLC init lic only)  
Developing skills for selecting, organizing, providing, and assessing effective second language learning opportunities through study, practice, and reflection.

**CI 5632. Communication and Comprehension in Second Language Classrooms.** (3 cr; A-F only. Prereq–SLC init lic only)  
Comprehension and communication processes in a second language focus on listening, speaking, reading and writing; techniques for initial to advanced literacy instruction; fundamental principles of effective second language instruction; the relationship of culture to proficiency in the four modalities; traditional and alternative approaches to assessing language proficiency; use of technology to enhance instruction.

**CI 5634. Content-Based Instruction in Second Language Settings.** (3 cr; A-F only. Prereq–SLC init lic only)

Content-based language instruction: principles, models and methods; learning strategy instruction; developing content-based language curriculum; traditional and alternative approaches to assessing cognitive-academic language proficiency; use of technology to enhance content-based instruction.

**CI 5635. Culture and Diversity in Second Language Classrooms.** (3 cr. Prereq–init lic program only)

Developing skills for teaching a diverse student population in both foreign language and English as a second language instructional settings through study, practice, and reflection.

**CI 5642. The Assessment of Learners with Limited English Proficiency.** (3 cr; A-F only)

Explores policies, procedures, and instruments in use in assessing the English language proficiency and academic readiness of limited English proficient students in American public schools; academic competence, bilingualism and special needs populations; alternative assessment; preparation of students for mainstream classrooms.

**CI 5644. Working with Linguistically and Culturally Diverse Students in the Mainstream Classroom.** (1 cr)

Benefits and challenges of working with linguistically and culturally diverse students; instructional practices and strategies; issues related to language learning, cultural considerations, and integration of culturally and linguistically diverse learners in the classroom.

**CI 5646. Understanding and Teaching English Grammar.** (3 cr. Prereq–Ling 5001 or #)

English syntax from pedagogical perspective. Grammatical structures that challenge ESL learners. Analyzing learner errors. Issues/activities related to teaching grammar in ESL contexts.

**CI 5651. Foundations of Second Languages and Cultures Education.** (3 cr; A-F only)

Historical overview of second language teaching and learning in the U.S. Exploration of second language instructional settings across multiple contexts: elementary and secondary options for foreign language, bilingual education, immersion language programs, and English as a second language programs. Theoretical frameworks for language instruction are tied to practice.

**CI 5652. Integrating Culture in the Second Language Classroom.** (3 cr)

Exploration of culture in second language contexts. Rationale for and process of implementing cultural awareness, culture learning, and the integration of language and culture instruction as integral to effective second language development.

**CI 5656. Reading and Writing in a Second Language.** (3 cr; A-F only)

Reading comprehension and composing processes in a second language; relationship between first and second language comprehension and composing processes; relationship between reading and writing; relationship of culture to reading comprehension and writing; politics of literacy; assessment of second language reading comprehension and writing proficiency; using technology to enhance literacy instruction.

**CI 5657. Speaking and Listening in a Second Language.** (3 cr; A-F only)

Theories and methods in teaching language as communication in oral and aural modes; planning student interaction; classroom organization for oral language learning and acquisition; using technology to enhance interaction; assessment of listening comprehension and oral communication.

**CI 5658. Second Language Testing and Assessment.** (3 cr; A-F only)

Aligning second language classroom instruction and assessment; fundamental concepts in language assessment; traditional and alternative approaches to assessing proficiency in speaking, listening, reading, writing; creation of formative and summative assessments; critique of common assessment instruments.

**CI 5660. Special Topics in the Teaching of Second Languages and Cultures.** (1-3 cr [max 12 cr])

Topics related specifically to the needs of the in-service teacher. Topics, location, credits, and duration are flexible.

**CI 5662. Issues in Second Language Curriculum Design.** (3 cr; A-F only)

Historical overview of curriculum development in second language education; contexts that influence curriculum development; models for curriculum development in second language settings; politics of curricular reform; national and state standards and implications for curriculum development; effects of technology on second language curriculum.

**CI 5671. Content-Based Second Language Curriculum, Instruction, and Assessment.** (3 cr. Prereq–#)

Instruction/curriculum models for immersion, bilingual, and ESL teachers. Balancing content and language goals. Standards, assessment. Using technology to support content-based curriculum and assessment.

**CI 5672. Language-Focused Instructional Practices and Strategies.** (3 cr. Prereq–#)

Keeping a language development focus while teaching content in second language. Materials development, proactive/reactive instructional techniques, choice of form. Linguistic complexity and developmental stage of student.

**CI 5693. Directed Study in Second Languages and Cultures.** (1-4 cr. Prereq–#)

Individual or group work on curricular, instructional, or assessment problems.

**CI 5696. Practicum: Teaching World Languages and Cultures in Elementary Schools.** (2 cr. Prereq–5619, adviser approval; credits cannot be counted on a graduate degree program for endorsement candidates)

Teaching and learning experiences in Second Languages and Cultures at the elementary-school level. Requires students to work in a public school setting.

**CI 5697. Practicum: ESL in the Elementary School.** (2 cr. Prereq–5619, adviser approval)

Teaching and learning experiences in an English as a Second Language setting at the elementary school level. Requires students to work in a public school setting.

**CI 5698. Student Teaching in Second Languages and Cultures.** (2 cr. Prereq–Adviser approval; credits cannot be counted on a graduate degree program)

Student teaching in Second Languages and Cultures at the secondary level for teachers already licensed in another field. Requires students to work in a public school setting.

**CI 5699. Clinical Experiences in Second Languages.** (6-8 cr; A-F only. Prereq–SLC init lic program only)

Teaching and learning experiences in elementary and secondary second language instructional settings. Includes a seminar held concurrently to support the student teaching experience.

**CI 5701. Teaching Social Studies in the Elementary School.** (2 cr; A-F only. Prereq–5111 or equiv, elem ed init lic only)

Content and organization of elementary social studies programs; programs of understanding, improving the learning situation, and effective use of materials.

**CI 5731. Social Studies for the In-Service Elementary/Middle School Teacher.** (3 cr; A-F only. Prereq–Elem/middle school teaching exper or #)

Content and organization of elementary and middle school social studies programs. Understanding and improving the teaching-learning situation through the analysis of current trends and issues in the field. Integration with other subject areas where appropriate.

**CI 5741. Introduction to Social Studies Education.** (3 cr; A-F only. Prereq–Social studies init lic student)

Broad issues and themes related to social studies education, including societal context, rationale, and scope and sequence. Analysis and evaluation of selected teaching strategies, methods, and resources.

**CI 5742. Advanced Methods of Teaching the Social Studies.** (3 cr; A-F only. Prereq–Secondary social studies init lic student)

Focus on developing a repertoire of instructional methods that support authentic pedagogy and assessment. Enhancing reading comprehension and writing skills in the social studies.

**CI 5743. The Social Sciences and the Social Studies.** (3 cr; A-F only. Prereq–Secondary social studies init lic student)

Development of instructional strategies and contexts for exploring the social sciences as disciplines at the secondary level; central concepts and generalizations; tools of inquiry; competing structures and theories; and the relative impact of multicultural and gender-fair perspectives on the nature of history and the social sciences.

**CI 5744. Seminar: Reflecting on Professional Development in Social Studies Education.** (1 cr; A-F only. Prereq–Secondary social studies init lic student)

Emphasis on reflecting on the teaching experience, developing a professional identity, and refining teaching skills.

**CI 5747. Global and Environmental Education: Content and Practice.** (3 cr; A-F only)

Prepares educators for leadership responsibilities in the area of global environmental education. Focus on the knowledge and process skills necessary to carry out a leadership role in the curriculum.

**CI 5761. Social Studies Education for the Inservice Middle/Secondary Teacher.** (3 cr)

Trends and issues in social studies education. Current developments and controversies in social studies pedagogy, curriculum, and assessment.

**CI 5762. Developing Civic Discourse in the Social Studies.** (3 cr; A-F only. Prereq–MEd or grad student)

Philosophies, strategies, and research on developing civic discourse in the secondary social studies classroom: selecting issues, developing a democratic classroom climate, relating to social and cultural contexts. Applicable to all of the social sciences.

**CI 5765. Teaching About Newspapers in the Classroom.** (3 cr)

Use of daily newspaper in the classroom. Instructional strategies, curriculum development techniques, and teaching materials useful in teaching about newspaper in elementary/secondary classrooms.

**CI 5782. Clinical Experiences in Teaching Social Studies.** (1-8 cr [max 16 cr]; S-N only. Prereq–Social studies postbac student)

Principles of learning pertinent to the modern program of mathematics in elementary grades. Objectives, content, philosophy, instructional materials, and methods of instruction and evaluation.

**CI 8075. Seminar: Art Education.** (2 cr; A-F only. Prereq–Educ grad student or #)

Reports, evaluation of problems, and review of recent literature.

**CI 8079. Research in Art Education.** (3 cr; A-F only. Prereq–Educ grad student or #)

Current research agenda. Helps students identify research questions and choose appropriate methodologies.

**CI 8095. Problems: Art Education.** (1-12 cr [max 12 cr]. Prereq–Grad art educ major or #)

Independent research under faculty guidance; may include advanced studio practice and educational issues requiring a research methodology.

**CI 8111. Representations of Knowledge in Curriculum and Culture.** (1-3 cr [max 3 cr]. Prereq–CI grad student or #)

Overview of research and theory on sociology of knowledge and education. Conceptions of knowledge in curriculum; connections between cultural conditions and curriculum design and implementation; influence of national political agendas, population, the mass media, and textbooks on curriculum in diverse educational settings.

**CI 8115. Curriculum and Achievement Outcomes in a Diverse Society.** (3 cr; A-F only. Prereq-Doctoral student)

Analysis of American public school experiences for students of African-American, Hispanic, Asian, and American Indian background; social, political, regional, and educational variables that influence student outcomes; perspectives concerning ethnic student achievement; factors influencing school achievement, and prospects for change.

**CI 8121. Curriculum Change: Perspectives, Processes, and Participants.** (3 cr. Prereq-CI grad student or #) Examination of curriculum within educational organizations; educational organization as mediator and transmitter of societal/cultural perspectives; implications of organizational context for curriculum change, change processes, and change participants.

**CI 8127. Curriculum Theory and Research: Alternative Paradigms and Research Methods.** (3 cr. Prereq-CI grad student or #) Traditions of inquiry, exemplary studies, and associated research methods; survey and assessment of topics and methods as applied to curriculum questions; and relationships between theory and research.

**CI 8131. Curriculum and Instruction Core: Critical Examination of Curriculum in Context.** (3 cr; A-F only. Prereq-CI PhD student)

Central concepts, ideas, and debates in professional field of curriculum. Critical discussion about curriculum in general education to lay a foundation for student research and innovation in a particular school subject or related field.

**CI 8132. Curriculum and Instruction Core: Teaching Theory and Research.** (3 cr; A-F only. Prereq-CI PhD student)

Overview of research on teaching: historical perspective, modern research and findings, and implications for practice and future research.

**CI 8133. Research Methods in Curriculum and Instruction.** (3 cr; A-F only. Prereq-CI PhD student) Survey of educational research methods and comparison of underlying assumptions and procedures.

**CI 8148. Conducting Qualitative Studies in Educational Contexts.** (3 cr. Prereq-CI MA or PhD student or #) Introduction to use of qualitative research methods. Ethnography, sociolinguistics, symbolic interactionism. Emphasizes observation.

**CI 8149. Qualitative Research: Coding, Analysis, Interpretation, and Writing.** (3 cr; A-F only. Prereq-[8133, 8148, grad student, completion of a qualitative research study] or #) How to code/analyze field notes. Individual/group interviews, multimedia using NUDIST NVivo software. Students interpret analyzed material and complete an article length document that includes a review of related research/methodology.

**CI 8150. Topics in Research in Curriculum and Instruction.** (1-6 cr [max 12 cr]. Prereq-[MA or EdD or PhD] student or #) Special topics, current research trends in curriculum/instruction. Research review, subject integration, curriculum contexts, development, implementation, data collection, analysis, evaluation.

**CI 8161. Planning a Research Experience I.** (2 cr. Prereq-8133, CI PhD student or #) Designing research questions, initiating literature reviews, and selecting a research methodology.

**CI 8162. Planning a Research Experience II.** (2 cr. Prereq-8133, CI PhD student or #) Development of research methodology, data collection devices, and processes for successful research.

**CI 8181. Seminar in Teaching in Colleges of Education.** (3 cr. Prereq-CI PhD student or #) Goals, instructional strategies, evaluation procedures, and professional considerations.

**CI 8195. Problems: Improvement of Instruction.** (1-6 cr [max 6 cr]. Prereq-#) Independent research in curriculum and instruction.

**CI 8196. Practicum in Teaching in Colleges of Education.** (1 cr. Prereq-8181) Supervised teaching in an education course at the University of Minnesota or other college or university.

**CI 8197. Problems: Curriculum Studies.** (1-4 cr [max 8 cr]; A-F only. Prereq-MA student) Directs students to completing Plan B paper for M.A. degree.

**CI 8198. Problems: Teacher Education.** (1-6 cr [max 12 cr]. Prereq-#) Independent research.

**CI 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser approval, DGS approval)

**CI 8361. Advanced Courseware and Design: Issues.** (3 cr; A-F only) Examination and critique of existing research. Students identify a research topic, write a literature review, plan a study, and present a research proposal.

**CI 8391. Instructional Systems Seminar.** (1-3 cr [max 6 cr]. Prereq-CI grad student or #) Topics related to needs of the in-service teacher; topics, location, credits, and duration are highly flexible.

**CI 8395. Problems: Instructional Systems.** (1-6 cr [max 12 cr]. Prereq-#) Independent research.

**CI 8400. Special Topics in Children's and Young Adult Literature.** (1-6 cr [max 6 cr]. Prereq-Grad course in children's or young adult lit) Overview of research and issues. Study of original manuscripts and artwork for children's books; research in child and young adult response to literature. Topics vary by offering.

**CI 8410. Special Topics in Reading Research and Instruction.** (1-6 cr [max 6 cr]. Prereq-#) Research at all levels; topics vary by offering and may include research designs, trends, and specific studies.

**CI 8412. Research in Reading.** (3 cr. Prereq-#) Significant literacy research; critical analysis of methodology and findings, appraising research methods, population limitations, and educational implications.

**CI 8421. Research in Composition.** (3 cr. Prereq-#) Theories and methods. Research designs: experimental, case study, descriptive, qualitative, ethnographic. Methods for: writing in social contexts, teaching and evaluating writing, and rhetorical, linguistic, and discourse analysis of written texts. Validity and reliability in coding and rating; portfolio and large-scale writing assessments.

**CI 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser approval, DGS approval)

**CI 8470. Special Topics on Literacy.** (1-6 cr [max 6 cr]. Prereq-CI PhD student or #) Current theories and research on literacy and literacy development; alternative methods of conducting literacy research; implications for literacy instruction.

**CI 8492. Readings in English Education and Reading.** (1-2 cr [max 10 cr]. Prereq-#)

**CI 8495. Problems: Teaching English and Reading.** (1-6 cr [max 6 cr]; A-F only. Prereq-#) Individual research.

**CI 8511. Seminar: Research in Science Education.** (1 cr [max 6 cr]. Prereq-CI grad student or #) Students and faculty present research projects for comment and critique. Special topics may also be considered.

**CI 8570. Advanced Topics in Science Education.** (1-4 cr [max 6 cr]; A-F only. Prereq-CI grad student or #) Examination and critique of current research topics, methods, and issues.

**CI 8594. Conducting Research in Science Education.** (3 cr. Prereq-Sci educ research course) Application of research methodology to a specific science education issue.

**CI 8595. Problems: Science Education.** (1-6 cr [max 12 cr]. Prereq-CI grad student or #) Independent research.

**CI 8631. Research Seminar I: Second Languages and Cultures Education.** (3 cr; A-F only. Prereq-8133) Students explore a research topic through readings, seminar discussions, conducting an actual study, and peer critique of work.

**CI 8632. Research Seminar II: Second Languages and Cultures Education.** (3 cr; A-F only. Prereq-8631) Students complete data analyses and prepare written report on an original study as well as offer peer critique of work.

**CI 8650. Seminar: Special Topics in Second Languages and Cultures Research.** (1-3 cr [max 6 cr]. Prereq-CI grad student or #) Research topics vary.

**CI 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Doctoral student who has not passed prelim oral)

**CI 8691. Readings in Second Languages and Cultures Education.** (1-3 cr [max 3 cr]. Prereq-#) Independent reading.

**CI 8695. Problems: Second Languages and Cultures Education.** (1-6 cr [max 12 cr]. Prereq-#) Independent research.

**CI 8742. Seminar: Research in Social Studies Education.** (2 cr; A-F only. Prereq-CI grad student or #) Critical review and analysis of seminal research studies; criteria for appraising research findings; educational implications.

**CI 8795. Problems: Social Studies Education.** (1-6 cr [max 12 cr]. Prereq-CI grad student or #) Independent research.

**CI 8796. Research Internship in Social Studies Education.** (1-6 cr [max 6 cr]; A-F only. Prereq-CI grad student) Internship with social studies education faculty member; experience in collecting and analyzing data; drafting and presenting reports; writing for publication.

**CI 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA)

## Dance (Dnce)

*Department of Theatre Arts and Dance  
College of Liberal Arts*

**Dnce 5010. Modern Dance Technique 7.** (2 cr [max 4 cr]. Prereq-Δ; audit registration not permitted) Continuation of technical development. Performance range/style. Students study with various guest artists.

**Dnce 5020. Modern Dance Technique 8.** (2 cr [max 4 cr]. Prereq-5010 or Δ; audit registration not permitted) Continuation 5010. Performance range/style. Students study with various guest artists.

**Dnce 5110. Ballet Technique 7.** (2 cr [max 4 cr]. Prereq-Δ; audit registration not permitted) Continuation of ballet technique. Musicality, performance, stylistic differences. Practical work conducted within context of choreographic/aesthetic development of ballet.

**Dnce 5120. Ballet Technique 8.** (2 cr [max 4 cr]. Prereq-5110 or Δ; audit registration not permitted) Continuation of 5110. Musicality, performance, stylistic differences. Practical work conducted within context of choreographic/aesthetic development of ballet.

**Dnce 5210. Jazz Technique 7.** (1 cr [max 2 cr]. Prereq-Δ; audit registration not permitted)  
Continuation of jazz technique. Syncopation, performance projection. Specific styles: swing, bebop, lyrical, funk, latin.

**Dnce 5220. Jazz Technique 8.** (1 cr [max 2 cr]. Prereq-5210 or Δ; audit registration not permitted)  
Continuation of 5210. Syncopation, performance projection. Specific styles: swing, bebop, lyrical, funk, latin.

**Dnce 5500. Topics in Dance.** (1-3 cr [max 10 cr])  
Topics specified in *Class Schedule*.

**Dnce 5601. Dance Composition 5.** (1 cr. Prereq-4601, 4602, Δ)  
Final part of six-semester sequence in dance composition. Exploration of movement through independently scheduled rehearsals. Choreographic concepts. Tools in dance creation, development/refinement of movement, structure of group choreography.

**Dnce 5700. Performance.** (1 cr [max 4 cr]. Prereq-1technique course, Δ)  
Technique, improvisation, choreography, music, design, and technical production as they relate to dance performance.

**Dnce 5858. Teaching Dance.** (4 cr. Prereq-1020, Δ or #)  
Methods, principles, and techniques of teaching dance.

**Dnce 5970. Directed Studies.** (1-4 cr [max 10 cr]. Prereq-#, Δ, □)  
Guided individual study.

## Dentistry (Dent)

### School of Dentistry

**Dent 5101. Oral and Maxillofacial Radiology.** (3 cr; A-F only)  
General principles of radiology, radiation physics, dosimetry, biology, radiation protection, regulations and recent concepts of imaging.

**Dent 5102. Patient Management and Radiographic Interpretation.** (2 cr; A-F only. Prereq-Oral Rad I)  
Dental record keeping. Documentation/analysis of medical/clinical findings. Patient's rights, informed consent. Radiographic interpretation of deviations from normal.

**Dent 5103. Oral Radiology Preclinical Lab I.** (0 cr; S-N only)  
This course consists of preclinical demonstration-participation phases in radiographic technique using mounted human skulls.

**Dent 5104. Oral Radiology Preclinical Lab II.** (1 cr [max 2 cr]; S-N only)  
This course consists of preclinical demonstration-participation phases of radiographic technique using mounted human skulls.

**Dent 5121. Physical Evaluation I.** (3 cr; A-F only)  
General concepts of diagnosis and patient evaluation for use during examination of patients in various adult clinical programs in the School of Dentistry.

**Dent 5201. Pain and Anxiety Control.** (2 cr; A-F only)  
Didactic/clinical aspects of pain/anxiety control as pertains to dentistry. Emphasizes use of local anesthetics, conscious sedation (nitrous oxide inhalation). Acute/chronic pain mechanisms, neuropathic pain, issues pertaining to narcotic/other drug abuse.

**Dent 5301. Introduction to Oral Biology.** (2 cr; S-N only)  
Introduce the scientific foundation of dentistry. Oral microbiology, biochemistry, tissues, diseases, and pain will be related to clinical practice through lectures and discussions of current literature.

**Dent 5302. Topics in Dental Biochemistry.** (2 cr; A-F only. Prereq-None)  
Biological, chemical, and biochemical phenomenon occurring in the oral cavity and the interrelationships between these phenomenon. Biological and chemical basis of dental caries and how saliva, dental plaque, and plaque fluid interact and impact on the caries process. Metabolic handling and anticaries mechanisms of fluoride.

**Dent 5303. Microbiology for Dental Students.** (6 cr; A-F only. Prereq-(Dental) biochemistry/histology)  
General microbiology, bacterial pathogenesis, virology with specific emphasis on oral microbial ecology, dental caries and periodontal diseases. Evaluation of current literature will be done by student essays. Discussions are based on assigned literature and focus on methodology.

**Dent 5315. Oral Histology and Embryology and Medical Genetics.** (3 cr; A-F only)  
Embryologic development and histologic structure of tissues in the head, face, and mouth with emphasis on clinical correlations, principles of medical genetics, complex traits of the orofacial region, and genetic contributions to oral diseases.

**Dent 5321. Introduction to Dental Biomaterials.** (2 cr; A-F only)  
This introductory course includes ten laboratory sessions and ten lectures. In the laboratory class, students practice handling materials used in restorative dentistry and prosthodontics. Accompanying lectures provide a scientific foundation for selection and use of dentistry materials.

**Dent 5322. Applied Dental Biomaterials.** (2 cr; A-F only. Prereq-Satisfactory completion of Dent 5321)  
Lectures on applications of dental materials, including areas of restorative dentistry, prosthodontics, orthodontics, and endodontics. Instruction in the scientific basis for selection and utilization of materials. Areas of current controversy, including replacement of traditional materials with new materials. Literature review seminars cover the evaluation principles for information sources on dental materials.

**Dent 5401. Dental Care Delivery, Epidemiology, and Prevention.** (3 cr; A-F only)  
Dental public health. Epidemiology, biostatistics, professional ethics, financing of dental care, health economics, health policy. Students participate in site visits and search, manage, and evaluate dental information from various resources.

**Dent 5402. Dental Care Delivery, Epidemiology, and Prevention.** (2 cr; A-F only)  
Aspects/principles of prevention. Risk assessment, screening, dietary analysis. Models of health education, health promotion. How dental profession influences public. Student groups research/present materials about oral health topic.

**Dent 5411. Professional Problem Solving.** (0 cr; A-F only)  
Critical thinking in ethical/professional problems in dentistry. How to organize, analyze, and reflect on issues, rights, responsibilities, codes of behavior/ethics, and consequences.

**Dent 5412. Professional Problem Solving.** (1 cr; A-F only)  
Critical thinking in ethical/professional problems in dentistry. How to organize, analyze, and reflect on issues, rights, responsibilities, codes of behavior/ethics, and consequences.

**Dent 5441. Periodontology II, Patient Management II.** (3 cr; A-F only)  
Introduction to management of dental patients. Process/development of comprehensive treatment plans. Students are exposed to treatment planning in private-practice setting.

**Dent 5501. Pediatric Dentistry Pre-Clinic.** (2 cr; A-F only)  
Physical, emotional, dental, and language development; diagnosis, prevention, and management of oral diseases in children.

**Dent 5601. Introduction to Clinical Preventive Dentistry.** (2 cr; S-N only)  
Application of principles of prevention through case-based small group learning format and clinical experiences. Clinical observation of preventive protocols/techniques. Students prepare/deliver presentation on preventive topic.

**Dent 5611. Periodontology I Lecture.** (1 cr; A-F only)  
Periodontal anatomy, physiology/etiology of periodontal diseases. Clinical, histopathological, and pathogenesis of gingivitis and periodontitis. Role of genetics, tobacco use, and systemic disorders.

**Dent 5612. Periodontology Technique.** (2 cr; A-F only)  
Presurgical procedures in periodontics. Development of clinical skills to examine, diagnose, prevent, and treat periodontal patients.

**Dent 5613. Periodontology Technique II.** (1 cr; S-N only. Prereq-5612)  
Extension of Dent 5612. Closely supervised, students treat at least three periodontal patients during the summer semester. Students develop clinical skills to examine, diagnose, prevent, and treat periodontal patients before assuming responsibility for their comprehensive care.

**Dent 5701. Introduction to Endodontics Lecture and Laboratory.** (4 cr; A-F only)  
Study of morphology, physiology, and pathology of the human dental pulp and periradicular tissues.

**Dent 5801. Operative Dentistry I.** (2 cr; A-F only. Prereq-Dental anatomy, biomaterials)  
Restoration of small caries lesions, cervical abrasion lesions, and attrition defects. Practical aspects of caries risk assessment, lesion identification, and comprehensive caries management. Emphasizes indications for surgical intervention, principles of restoration design, and rationale for various design features.

**Dent 5802. Operative Dentistry I Laboratory.** (3 cr; A-F only. Prereq-Dental anatomy, biomaterials)  
Restoration of small caries lesions, cervical abrasion lesions, and attrition defects in clinical simulation setting. Emphasizes designing/executing retentive/resistant restorations, conserving tooth structure, and operating in clinically relevant orientations. Self-evaluation techniques, discriminatory skills.

**Dent 5803. Operative Dentistry II.** (2 cr; A-F only. Prereq-5801)  
Diagnosis, treatment planning, and treatment of moderate to severe phase of dental caries. Use of dental amalgam, cast gold, composite resin, and cast porcelain. Aesthetic modification to teeth.

**Dent 5804. Operative Dentistry II Laboratory.** (3 cr; A-F only. Prereq-5802)  
Exercises in treatment of moderate to severe phase of dental caries utilizing dental amalgam, cast gold, composite resin, and cast porcelain. Aesthetic modifications to teeth.

**Dent 5805. Operative Dentistry III.** (3 cr; A-F only. Prereq-5801, 5802, 5803, 5804)  
Integration/application of skills/knowledge in diagnosis, treatment planning, and treatment. Clinical setting.

**Dent 5901. Oral Anatomy I.** (4 cr [max 4 cr]; A-F only)  
Tooth morphology, nomenclature, classification, charting, calcification, and eruption sequences; mouth growth and development.

**Dent 5902. Preclinical Prosthodontics Technique Lecture I.** (2 cr; A-F only. Prereq-4848)  
Oral anatomy, fixed prosthodontic lab techniques, fundamentals of tooth preparation.

**Dent 5903. Preclinical Prosthodontics Technique Lab I.** (3 cr; A-F only. Prereq-4848, 4949)  
Demo of clinical and lab procedures.

**Dent 5904. Preclinical Prosthodontic Technique Lecture and Laboratory II.** (4 cr; A-F only. Prereq-5901, 5902, 5903)  
Lab techniques, fundamentals of tooth preparation.

**Dent 5905. Preclinical Prosthodontic Technique Lecture III.** (3 cr; A-F only. Prereq—4848, 4949, 4950, 4951) Second-year preclinical courses to include fixed, removable, and occlusion topics.

**Dent 5906. Preclinical Prosthodontics Technique Lab III.** (6 cr; A-F only. Prereq—4848, 4949, 4950, 4951, 4952) Fixed, removable, and occlusion topics.

**Dent 5907. Preclinical Prosthodontics Technique Lecture IV.** (3 cr; A-F only. Prereq—4848, 4949, 4950, 4951, 4952, 4953) Fixed, removable, and occlusion topics.

**Dent 5908. Preclinical Prosthodontic Technique Lab IV.** (6 cr; A-F only. Prereq—4848, 4949, 4950, 4951, 4952, 4953, 4954) Fixed, removable, and occlusion topics.

**Dent 5909. Preclinical Prosthodontics Technique Lecture V.** (2 cr; A-F only. Prereq—4848, 4949, 4950, 4951, 4952, 4953, 4954, 4955) Fixed, removable, and occlusion topics.

**Dent 5910. Preclinical Prosthodontics Technique Laboratory V.** (2 cr; A-F only. Prereq—4848, 4949, 4950, 4951, 4952, 4953, 4954, 4955, 4956) Fixed, removable, and occlusion topics.

**Dent 8031. Topics and Problems in Dental Education.** (1-3 cr) Independent study in student learning, instructional development, curriculum planning, student testing and evaluation, and academic administration, where these areas and their interfaces are applied directly to professional dental education. Provides opportunity for applying and extending concepts learned in Dent 7033.

**Dent 8090. Evidence-based Clinical Pediatric Dentistry.** (2 cr; A-F only) Selected pediatric dentistry topics. In-depth literature review, seminar discussion.

**Dent 8091. Interdisciplinary Care of the Cleft Palate Patient.** (1 cr; S-N only) Comprehensive surgical, dental, and speech and hearing evaluation and management of patients with cleft lip and palate.

**Dent 8100. Topics in Advanced Periodontology: Literature Review.** (2 cr) State-of-the-art information on a variety of topics concerning risk factors and therapeutic modalities for periodontal disease.

**Dent 8101. Dental Implantology: A Multidisciplinary Approach.** (2 cr) Dental implant therapy from perspective of several dental disciplines.

**Dent 8120. Advanced Principles and Techniques of TMJ and Orofacial Pain Disorders.** (3 cr; A-F only. Prereq—Participation in TMJ and orofacial pain advanced education program) Interdisciplinary study of theory, principles, epidemiology, and mechanisms associated with TMJ and craniofacial pain disorders and a basis for scientific understanding of diagnostic and management strategies for them.

**Dent 8121. Current Literature in TMJ and Craniofacial Pain.** (1 cr; A-F only) Review of current literature and of how it relates to past literature, theories on pain, and philosophies of management.

**Dent 8123. Advanced Topics in Orofacial Pain.** (3 cr; A-F only. Prereq—Grad student in dentistry or other health sciences grad student or #) Review of cutting edge research and clinical findings regarding etiology/treatment of acute/chronic orofacial pain conditions and related disorders.

**Dent 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**Dent 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

## Dermatology (Derm)

*Department of Dermatology  
Medical School*

**Derm 8225. Clinical Dermatology.** (7 cr)

**Derm 8226. Clinical Seminar.** (1 cr)

**Derm 8227. Histology of the Skin.** (1 cr)

**Derm 8230. Functional Biology of the Skin.** (1 cr)

**Derm 8232. Seminar: Dermatologic Histopathology and Mycology.** (1 cr)

## Design Institute (DesI)

*College of Architecture and Landscape  
Architecture*

**DesI 5100. Design Institute Directed Study.** (1-3 cr [max 6 cr]; A-F only) Guided independent study in design.

## Design, Housing, and Apparel (DHA)

*Department of Design, Housing, and Apparel  
College of Human Ecology*

**DHA 5111. History of Decorative Arts.** (4 cr; A-F only. Prereq—General art history survey course or #) In depth study of textiles, ceramics, metal, and glass from selected historical periods. Focus on the Goldstein Gallery collections.

**DHA 5170. Special Topics in Design, Housing, and Apparel.** (1-4 cr [max 8 cr]; A-F only. Prereq—Depends on topic, check with dept) In-depth investigation of a single specific topic, announced in advance.

**DHA 5193. Directed Study in Design, Housing, and Apparel.** (1-4 cr; A-F only. Prereq—#) Independent study in design, housing, and apparel under tutorial guidance.

**DHA 5196. Field Study: National/International.** (1-10 cr [max 10 cr]; A-F only. Prereq—#) Faculty-directed field study in a national or international setting.

**DHA 5216. Textile and Apparel Consumer.** (3 cr; A-F only. Prereq—[1201, 2213] or #, [jr or sr or grad student]) Consumer actions concerning textile/clothing products for home and other physical interiors. Personal use as part of daily living in different social, economic, and cultural settings, nationally and internationally.

**DHA 5381. Digital Illustration.** (3 cr; A-F only. Prereq—4334, [DHA major or grad student]) Integration of design with computer applications. Use of raster-/vector-based programs for illustration.

**DHA 5382. Digital Sound and Video.** (3 cr; A-F only. Prereq—[4334, [DHA major or grad student]] or #) Design solutions involving time-based media. Emphasizes sound/video. Electronic publishing via Internet.

**DHA 5383. Animation Design.** (3 cr; A-F only. Prereq—[4334, [DHA major or grad student]] or #) Animation in time-based electronic design. Introduction to three-dimensional modeling.

**DHA 5385. Internet-Based Media.** (3 cr; A-F only. Prereq—[4334, [DHA major or grad student]] or #) Designing interactive presentations (using various operating systems) for Internet/Web. Electronic publishing. Development of internet-based communication.

**DHA 5388. Design Planning, Analysis, and Evaluation.** (3 cr; A-F only. Prereq—[4354, DHA major] or grad or #) Preliminary research, including theoretical, applied, and legal aspects. Planning/developmental models. Design prototyping, testing, and analysis.

**DHA 5399W. Theory of Electronic Design.** (3 cr; A-F only. Prereq—[DHA major, sr] or grad student or #; offered alternate yrs) Theories, methodologies, histories of electronic design, its impact on visual communications. Digital artifacts, processes, paradigms.

**DHA 5463. Housing Policy.** (3 cr; A-F only. Prereq—2401, 2463 or #) Explore the institutional and environmental settings that make up housing policy in the United States. Examine competing ideas about solving the nation's housing problems through public intervention in the market. Federal and local public sector responses to housing problems will be evaluated.

**DHA 5467W. Housing and the Social Environment.** (4 cr; A-F only. Prereq—2401 or #) Housing choices in context of social environment. Emphasizes special needs of elderly, disabled, minorities, large families, female-headed households, and low-income households. Students conduct a post-occupancy evaluation of housing.

**DHA 5471. Housing Studies Certificate Seminar.** (2 cr; A-F only. Prereq—Admitted to housing studies certificate prog) Integrative seminar and "capstone" to Certificate program. Students prepare an individual career plan that focuses on application of housing studies to community/workplace.

**DHA 5481. Housing for the Elderly and Special Populations.** (3 cr; A-F only. Prereq—2401 or #) Introduction to the changing housing needs of individuals and families across the life span. Particular emphasis will be on housing needs of children, older adults, and persons with disabilities.

**DHA 5484. Rural Housing Issues.** (3 cr; A-F only. Prereq—2401, 2463 or #) Housing issues in nonmetropolitan areas. The housing concerns of specific rural populations (e.g., low income, elderly persons, American Indians, migrant workers) are identified and comparisons with urban housing issues are made.

**DHA 8101. Philosophical Foundations of Design, Housing, and Apparel.** (4 cr; A-F only) The nature of thought underlying and within professional areas of the field.

**DHA 8103. Methodological Orientations: Qualitative Research.** (3 cr; A-F only) Assessment of field research methods relevant to research regarding material culture. Relationship of selected research problem (and its theoretical framework) to practical problems of fieldwork. Rationale and plan for appropriate field methods of data collection.

**DHA 8111. Analysis of Design Literature.** (3 cr; A-F only) Classic and contemporary literature; visualization, creativity, and design methods literature.

**DHA 8112. Design Theory and Criticism.** (3 cr; A-F only) Students establish a framework for criticism by examining various theories used in design disciplines, study existing designed environments to explain the designer's purpose, identify problem-solving processes, and describe interaction between humans and design. Field investigations.

**DHA 8113. Education and Evaluation in Design Studios.** (3 cr; A-F only) Educational processes and methods used in design studio courses. Learning styles, team projects, criticism, evaluation, and curriculum development.

**DHA 8114. Design Studio.** (4 cr; A-F only. Prereq—#) Advanced problem analysis, design solution.



**DHA 8164. Innovation Theory and Analysis.** (3 cr; A-F only)  
Theories and factors that influence adoption and diffusion of designed products. Methodologies used in analysis of diffusion process.

**DHA 8170. Topics in Design, Housing, and Apparel.** (1-3 cr [max 6 cr]; A-F only. Prereq—Varies with topic)  
In-depth investigation of a topic announced in advance.

**DHA 8180. Professional Seminar in Design, Housing, and Apparel.** (1-2 cr [max 4 cr]; A-F only)  
Professional development issues and trends.

**DHA 8181. Ethics and Research.** (1 cr; S-N only. Prereq—Grad student)  
Overview of ethical concerns/questions in conducting/disseminating research. Mentoring relationships, use of human subjects, data handling, plagiarism, authorship, publishing, research funding, social responsibility of researchers, code of conduct.

**DHA 8192. Readings in Design, Housing, and Apparel.** (1-3 cr [max 8 cr]; A-F only. Prereq—#)  
Independent study and review of books and periodicals under tutorial guidance.

**DHA 8193. Directed Study in Design, Housing, and Apparel.** (1-3 cr [max 8 cr]; A-F only. Prereq—#)

**DHA 8222. Plan B Master's Project.** (3 cr; S-N only. Prereq—DHA master's student, #)  
Plan B master's project.

**DHA 8262. Writings on Dress: Historical Perspectives.** (3 cr; A-F only)  
Dress as a significant factor in human interaction prior to 1940. Early social science and philosophical writing, beginning with Montaigne in 1537. These perspectives appraised for relevance to current research and theory.

**DHA 8263. Writings on Dress: Contemporary Themes.** (3 cr; A-F only. Prereq—8101 or #)  
Current conceptualizations and thematic areas in literature of textiles and apparel.

**DHA 8265. Dress: Race, Class, and Gender.** (3 cr; A-F only. Prereq—4212 or #)  
Dressing the body as a sociocultural and personal expression of an individual's identity. Gender, race, and class differences in apparel explored to understand the global market, international and niche retailing, as related to clothing practices.

**DHA 8266. Aesthetic Concepts Related to Apparel Design.** (3 cr; A-F only. Prereq—Grad DHA major or #)  
Aesthetics of dress; application of a framework for visual analysis and evaluation.

**DHA 8267. Dress and Culture.** (3 cr; A-F only. Prereq—4212 or #)  
Cultural factors of identity expressed through dress. Focuses on issues of cultural diversity through analysis of dress and textiles within a specific world region.

**DHA 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**DHA 8361. Color, Design, and Human Perception.** (3 cr; A-F only. Prereq—Basic color theory course or #)  
Perceptual and psychological aspects of color and design. Human factors of color variables and design strategies that can enhance human experience of, and interaction with, color.

**DHA 8362. The Nature of Representation in Visual Communication.** (3 cr; A-F only. Prereq—Grad DHA major or #)  
Relationship of images to the design communication process. Aspects of representation and pictorial information modes. Human interaction with images and their role in increasing understanding, enhancing learning, and positively affecting human experience.

**DHA 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**DHA 8463. Housing: Race and Class.** (3 cr; A-F only)  
Roles of difference (race, gender, class) in shaping distribution of housing, particularly in cities. Role of housing in patterns of social differentiation.

**DHA 8467. Theoretical Perspectives in Housing Studies.** (3 cr; A-F only. Prereq—5467 or #)  
Investigation/evaluation of theories applied to study of housing. Levels of analysis. Links between theory, research questions, and methodological approaches.

**DHA 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**DHA 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**DHA 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

**DHA 8990. MFA Creative Thesis.** (6 cr [max 12 cr]; A-F only. Prereq—Completed coursework requirements for MFA in DHA w/multimedia emphasis, #)  
MFA project.

## Development Studies and Social Change (DSSC)

### College of Liberal Arts

**DSSC 8111. Approaches to Knowledge and Truth: Ways of Knowing in Development Studies and Social Change.** (3 cr; S-N only. Prereq—Grad DSSC minor or #)  
Approaches practiced by physical, biological, and social scientists and humanities scholars. "Ways of knowing" in different cultures or in different groups within cultures. Team taught by faculty from biological and social sciences and the humanities.

**DSSC 8211. Doctoral Research Workshop in Development Studies and Social Change.** (1 cr; S-N only. Prereq—Grad DSSC minor or #)  
Identification of potential funding sources for field research and the writing of grant proposals. Preparing for and conducting field research. Taken during the year before undertaking field research, typically the third year of graduate study.

**DSSC 8212. Doctoral Research Workshop in Development Studies and Social Change.** (1 cr; S-N only. Prereq—Grad DSSC minor or #)  
Identification of potential funding sources for field research and the writing of grant proposals. Preparing for and conducting field research. Taken during the year before undertaking field research, typically the third year of graduate study.

**DSSC 8310. Topics in Development Studies and Social Change.** (2-3 cr [max 9 cr]. Prereq—Grad DSSC minor or #)  
Offered in conjunction with MacArthur Program on Peace and International Cooperation workshop series.

## Dutch (Dtch)

### Department of German, Scandinavian, and Dutch College of Liberal Arts

**Dtch 5490. Topics in Dutch Literature.** (3 cr [max 9 cr])  
Topic may focus on a specific author, group of authors, genre, period, or subject matter. Topics specified in *Class Schedule*.

**Dtch 5741. Medieval and Early Modern Dutch.** (3 cr)  
Introduction to the linguistic aspects of medieval and early modern Dutch. Reading and analysis of representative literary texts from the Dutch Middle Ages to 1700.

**Dtch 5993. Directed Studies.** (1-4 cr [max 12 cr]. Prereq—#, Δ, □)  
Guided individual reading or study.

## East Asian Studies (EAS)

### Institute of International Studies College of Liberal Arts

**EAS 5940. Topics in Asian History.** (1-4 cr [max 16 cr]. Prereq—Grad or #)  
Selected topics such as cultural, economic, intellectual, political, and social history.

**EAS 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**EAS 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

## Ecology, Evolution and Behavior (EEB)

### Department of Ecology, Evolution, and Behavior College of Biological Sciences

**EEB 5008. Forest Response to Quaternary Climate Change.** (2 cr; A-F only. Prereq—Biol 3407, EEB 4631 or Geo 4631; ¶EEB 5009)

Forest responses to past climate change at the population, community, and ecosystem level. Response to natural and human disturbance, range shifts and invasions. Limitations to the speed of response to rapid climate change.

**EEB 5009. Quaternary Vegetation History and Climate.** (2 cr. Prereq—4631 or Geo 4631 or #)  
Reconstructing and dating changes in vegetation and climate from Quaternary pollen stratigraphy of major world biomes; evidence from other indicators of past environments; comparison with climate models.

**EEB 5011. Pollen Morphology.** (2 cr. Prereq—Biol 3007, PBio 4321 or #)  
Morphology and nomenclature of pollen grains and pteridophyte spores, survey of pollen and spores of major plant families, lab techniques.

**EEB 5013. Quaternary Plant Macrofossils.** (2 cr. Prereq—PBio 4321 or 4511 or #)  
Morphology of seeds, fruits, and other macroscopic remains likely to occur in Quaternary deposits, survey of fossils of major plant families, lab techniques.

**EEB 5033. Population and Quantitative Genetics.** (4 cr. Prereq—[Biol 4003 or GCD 3022], intro statistics) or #)  
Genetic basis of variation in populations and of evolutionary change. Allelic frequency dynamics: emphasizes natural selection, additive genetic variance, and heritability. Current topics related to consequences of artificial selection and of inbreeding.

**EEB 5051. Analysis of Populations.** (3 cr. Prereq—Intro biology, intro statistics or #)  
Factors involved in the regulation, growth, and general dynamics of populations. Data needed to describe populations, population growth, population models, and regulatory mechanisms.

**EEB 5053. Ecology: Theory and Concepts.** (4 cr. Prereq—Biol 3407 or #)  
Classical and modern mathematical theories of population growth, interspecific interactions, ecosystem dynamics and functioning, with emphasis on underlying assumptions and on effects of added biological reality on robustness of predictions, stability, interspecific interactions, ecosystem structure and functioning.

**EEB 5122W. Plant Interactions with Animals and Microbes.** (4 cr; A-F only. Prereq—Biol 2012 or 3002, 3407 or 3409)  
Ecological and environmental implications of mutualistic and antagonistic interactions between plants, animals and microbes at organismal, population, and community levels.

**EEB 5221. Molecular and Genomic Evolution.** (3 cr; A-F only. Prereq—[[Biol 4003 or GCD 3022], grad student] or #)

Molecular basis of evolutionary change. Current studies of selection and neutral evolutionary processes at molecular level. Evolution from gene to genome level: protein structure and function, multigene families, organelle genomes, genome organization. Lectures, discussions of current literature, and workshops where students practice analyses.

**EEB 5321. Evolution of Social Behavior.** (3 cr; A-F only. Prereq—Biol 3411 or #)

Introduction to theories and concepts relating to behavior evolution, mating systems, and cooperative behavior in animals.

**EEB 5323. Neural and Endocrine Mechanisms Underlying Vertebrate Behavior.** (2 cr; A-F only. Prereq—Biol 3411 or Biol 3101 or NSc 3101 or Phsl 3101 or #)

Selected aspects of the physiological basis of vertebrate behavior with emphasis on neural and endocrine integration and the effects of evolutionary pressures on it. Hormones and sex behavior, sensory perception, neuroethology of communication.

**EEB 5327. Behavioral Ecology.** (3 cr. Prereq—Biol 3411 or #)

Evolutionary principles applied to aggressive competition, mate choice, cooperation, and parental investment. Optimization models used to examine foraging strategies, predator/prey interactions, and territoriality. Evolution of sex, sexual selection, dispersal. Evolutionary game theory.

**EEB 5361. Visions of Nature: The Natural World and Political Thought.** (4 cr. Prereq—Advanced studies in history, philosophy, or biology)

Theories about the organization of nature, human nature, and their significance for the development of ethics, religion, political and economic philosophy, civics, and environmentalism in Western and other civilizations. Graduate credit requires paper on conceptual topic on human ecology.

**EEB 5371. Principles of Systematics.** (3 cr. Prereq—#)

Theoretical and practical procedures of biological systematics. Phylogeny reconstruction, including computer-assisted analyses, morphological and molecular approaches, species concepts and speciation, comparative methods, classification, historical biogeography, nomenclature, and use and value of museums.

**EEB 5961. Decision Analysis and Modeling in**

**Conservation Biology.** (3 cr; A-F only. Prereq—Grad student or #)  
Decision analysis/modeling in conservation biology. Techniques, concepts, software.

**EEB 8010. Seminar in Paleoeology.** (1 cr [max 4 cr]; S-N only. Prereq—#)

Reading and discussion of recent literature on Quaternary paleoecology.

**EEB 8020. Community Ecology Seminar.** (1 cr [max 5 cr]; S-N only. Prereq—#)

Research topics in selected areas.

**EEB 8050. Population Biology Seminar.** (1 cr [max 5 cr]; S-N only. Prereq—#)

Research topics in selected areas.

**EEB 8051. Empirical Ecology.** (4 cr. Prereq—Stat or biometry course or #)

Overview of analytical methods in interpreting data collected from observational and experimental studies in ecology and related fields of evolution, behavior, and conservation biology. Univariate, bivariate, and multivariate methods, including computationally intensive methods, ordination, and hypothesis testing.

**EEB 8060. Evolutionary Genetics Seminar.** (1 cr [max 5 cr]; S-N only. Prereq—#)

Research topics in selected areas.

**EEB 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**EEB 8360. Behavioral Biology Seminar.** (1 cr [max 5 cr]; S-N only. Prereq—#)

Research topics in selected areas.

**EEB 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**EEB 8641. Spatial Ecology.** (3 cr. Prereq—[5051, 2 sem calculus] or [3 sem calculus, [course in statistics or probability], #])

Introduction to spatial ecology. Role of space in population dynamics and interspecific interaction. Single species/multispecies models. Deterministic/stochastic theory. Modeling, effects of implicit/explicit space on competition, pattern formation, stability, diversity, and invasion. Reading/discussion of recent literature.

**EEB 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**EEB 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**EEB 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

**EEB 8980. Seminar on Current Topics.** (1-3 cr [max 6 cr]; S-N only. Prereq—[1st yr or 3rd sem] grad student, #)

Current research in ecology, evolution, and behavior.

**EEB 8990. Graduate Seminar.** (1 cr [max 5 cr]; S-N only. Prereq—#)

Research topics in selected areas.

**EEB 8991. Independent Study: Ecology, Evolution, and Behavior.** (1-10 cr [max 10 cr]; S-N only. Prereq—#)  
Individual research on a specialized topic.

**EEB 8994. Directed Research.** (1-5 cr [max 10 cr]; S-N only. Prereq—#)

## Economics (Econ)

### Department of Economics

#### College of Liberal Arts

**Econ 5109H. Game Theory for Engineers.** (4 cr; A-F only. \$8101, \$8102, \$8103, \$8104, \$8117, \$8118, \$8119.

Prereq—[[Math 2283, Math 2373, Math 2374, Math 3283] or Math 4606], M./PhD student in [engineer or comp sci or info tech or operations mgmt]] or #; not for econ [undergrads or PhD students])

Introduction to game theory and its applications. Utility theory, noncooperative/cooperative games, bargaining theory. Games in normal/extensive form, Nash equilibria/refinements.

**Econ 5151. Elements of Economic Analysis: Firm and Household.** (2 cr. Prereq—3101, 3102, or equiv; Math 1271 or equiv; Math 2243 or equiv, grad or #)

Decision-making by households and firms under conditions of perfect competition, monopoly, and monopolistic competition.

**Econ 5152. Elements of Economic Analysis: Income and Employment.** (2 cr. Prereq—3101, 3102 or equiv; Math 1271 or equiv; Math 2243 or equiv; grad or #)

Determinants of national income, employment, and price level; aggregate consumption, investment, and asset holding.

**Econ 5312. Growth, Technology, and Development.** (3 cr. Prereq—3101, 3102 or equiv or #)

Economics of research and development; technical change and productivity growth; impact of technology on institutions; science and technology policy.

**Econ 5890. Economics of the Health-Care System.** (3 cr; A-F only. Prereq—[3101, 3102] or #)

Economic analysis of U.S. health-care sector. Emphasizes problems of pricing, production, distribution. Health-care services as one factor contributing to nation's health.

**Econ 8001. Microeconomic Analysis.** (2 cr. Prereq—5151 or equiv, Math 2243, Math 2263 or equiv or #)

Theories of consumer demand, producer supply, and market equilibrium; general equilibrium and welfare. Sample topics: externalities, economics of information and uncertainty, and game theory. This seven-week course meets with 4161.

**Econ 8002. Microeconomic Analysis.** (2 cr. Prereq—8001)

Theories of consumer demand, producer supply, and market equilibrium; general equilibrium and welfare. Sample topics: externalities, economics of information and uncertainty, and game theory. This seven-week course meets with 4162.

**Econ 8003. Microeconomic Analysis.** (2 cr. Prereq—8002)

Theories of consumer demand, producer supply, and market equilibrium; general equilibrium and welfare. Sample topics: externalities, economics of information and uncertainty, and game theory. This seven-week course meets with 4163.

**Econ 8004. Microeconomic Analysis.** (2 cr. Prereq—8003)

Theories of consumer demand, producer supply, and market equilibrium; general equilibrium and welfare. Sample topics: externalities, economics of information and uncertainty, and game theory. This seven-week course meets with 4164.

**Econ 8101. Microeconomic Theory.** (2 cr. Prereq—5151 or equiv, Math 2243 or equiv, ¶Math 5615 or ¶Math 8601, grad econ major or #)

Decision problems faced by the household and firm; theories of choice under conditions of certainty and uncertainty. Partial equilibrium analysis of competition and monopoly. General equilibrium analysis. Welfare economics: economic efficiency of alternative market structures, social welfare functions. Dynamics: stability of markets, capital theory. Seven-week course.

**Econ 8102. Microeconomic Theory.** (2 cr. Prereq—8101, ¶Math 5615 or ¶Math 8601, grad econ major or #)

Decision problems faced by the household and firm; theories of choice under conditions of certainty and uncertainty. Partial equilibrium analysis of competition and monopoly. General equilibrium analysis. Welfare economics: economic efficiency of alternative market structures, social welfare functions. Dynamics: stability of markets, capital theory. Seven-week course.

**Econ 8103. Microeconomic Theory.** (2 cr. Prereq—8102, ¶Math 5616 or ¶Math 8602 or comparable abstract math course, grad econ major or #)

Decision problems faced by the household and firm; theories of choice under conditions of certainty and uncertainty. Partial equilibrium analysis of competition and monopoly. General equilibrium analysis. Welfare economics: economic efficiency of alternative market structures, social welfare functions. Dynamics: stability of markets, capital theory. Seven-week course.

**Econ 8104. Microeconomic Theory.** (2 cr. Prereq—8103, ¶Math 5616 or ¶Math 8602 or comparable abstract math course, grad econ major or #)

Decision problems faced by the household and firm; theories of choice under conditions of certainty and uncertainty. Partial equilibrium analysis of competition and monopoly. General equilibrium analysis. Welfare economics: economic efficiency of alternative market structures, social welfare functions. Dynamics: stability of markets, capital theory. Seven-week course.

**Econ 8105. Macroeconomic Theory.** (2 cr. Prereq—5152 or equiv, Math 2243, Math 2263 or equiv or #)

Dynamic general equilibrium models: solving for paths of interest rates, consumption, investment, prices. Models with uncertainty, search, matching, indivisibilities, private information. Implications for measurement and data reporting. Overlapping generations and dynasty models. Variational and recursive methods. This seven-week course meets with 4165.

**Econ 8106. Macroeconomic Theory.** (2 cr. Prereq-8105) Dynamic general equilibrium models: solving for paths of interest rates, consumption, investment, prices. Models with uncertainty, search, matching, indivisibilities, private information. Implications for measurement and data reporting. Overlapping generations and dynasty models. Variational and recursive methods. This seven-week course meets with 4166.

**Econ 8107. Macroeconomic Theory.** (2 cr. Prereq-8106) Dynamic general equilibrium models: solving for paths of interest rates, consumption, investment, prices. Models with uncertainty, search, matching, indivisibilities, private information. Implications for measurement and data reporting. Overlapping generations and dynasty models. Variational and recursive methods. This seven-week course meets with 4167.

**Econ 8108. Macroeconomic Theory.** (2 cr. Prereq-8107) Dynamic general equilibrium models: solving for paths of interest rates, consumption, investment, prices. Models with uncertainty, search, matching, indivisibilities, private information. Implications for measurement and data reporting. Overlapping generations and dynasty models. Variational and recursive methods. This seven-week course meets with 4168.

**Econ 8111. Introduction to Mathematical Economics.** (2 cr. Prereq-Math 2243 or equiv, ¶Econ 8101, ¶Math 5615 or equiv or #; Math 4242 recommended) Use of mathematical models in economic theory.

**Econ 8112. Introduction to Mathematical Economics.** (2 cr. Prereq-8111, ¶8102, ¶Math 5615 or comparable abstract math course) Use of mathematical models in economic theory. Standard techniques.

**Econ 8113. Introduction to Mathematical Economics.** (2 cr. Prereq-8112, Math 5616 or comparable abstract math course, ¶8103) Use of mathematical models in economic theory. May include special topics.

**Econ 8117. Noncooperative Game Theory.** (2 cr. Prereq-Math 5616 or equiv or #) Solution concepts for noncooperative games in normal form, including Nash and perfect equilibrium and stable sets of equilibria. Extensive form games of perfect and incomplete information, sequential equilibrium, and consequences of stability for extensive form. Applications including bargaining and auctions. Seven-week course.

**Econ 8118. Noncooperative Game Theory.** (2 cr. Prereq-8117) Solution concepts for noncooperative games in normal form, including Nash and perfect equilibrium and stable sets of equilibria. Extensive form games of perfect and incomplete information, sequential equilibrium, and consequences of stability for extensive form. Applications including bargaining and auctions. Seven-week course.

**Econ 8119. Cooperative Game Theory.** (2 cr. Prereq-8104, Math 5616 or equiv or #) Basics of cooperative game theory, emphasizing concepts used in economics. Games with and without transferable utility; the core, the value, and other solution concepts. Recent results, including potentials, reduced games, consistency, and noncooperative implementation of cooperative solution concepts. Seven-week course.

**Econ 8124. History of Economic Thought.** (2 cr. Prereq-8104, 8108 or #) Selected topics, emphasizing development of theoretical topics. Seven-week course.

**Econ 8125. History of Economic Thought.** (2 cr. Prereq-8124 or #) Selected topics, emphasizing development of theoretical topics. Seven-week course.

**Econ 8181. Advanced Topics in Microeconomics.** (2 cr [max 4 cr]. Prereq-8104 or #; offered when feasible) Faculty and student presentations based on recent literature. Seven-week course.

**Econ 8182. Advanced Topics in Microeconomics.** (2 cr [max 4 cr]. Prereq-8104 or #; offered when feasible) Faculty and student presentations based on recent literature. Seven-week course.

**Econ 8185. Advanced Topics in Macroeconomics.** (2 cr [max 4 cr]. Prereq-8108 or #; offered when feasible) Faculty and student presentations based on recent literature. Seven-week course.

**Econ 8186. Advanced Topics in Macroeconomics.** (2 cr [max 4 cr]. Prereq-8108 or #) Faculty and student presentations based on recent literature. Seven-week course.

**Econ 8191. Workshop in Mathematical Economics.** (1-3 cr [max 10 cr]. Prereq-8104 or #)

**Econ 8192. Workshop in Mathematical Economics.** (1-3 cr [max 10 cr]. Prereq-8104 or #)

**Econ 8201. Econometric Analysis.** (2 cr. Prereq-[3101 or equiv], [Math 1272 or equiv], Stat 5102) or #) Basic linear regression model, its variants. Panel data, censored/truncated regression, discrete choice models. Time series, simultaneous equation models.

**Econ 8202. Econometric Analysis.** (2 cr. Prereq-8201) Basic linear regression model, its variants. Panel data, censored/truncated regression, discrete choice models. Time series, simultaneous equation models.

**Econ 8203. Econometric Analysis.** (2 cr. Prereq-8202) Basic linear regression model, its variants. Panel data, censored/truncated regression, discrete choice models. Time series, simultaneous equation models.

**Econ 8204. Econometric Analysis.** (2 cr. Prereq-8203) Basic linear regression model, its variants. Panel data, censored/truncated regression, discrete choice models. Time series, simultaneous equation models.

**Econ 8205. Applied Econometrics.** (2 cr. Prereq-Math 4242 or equiv, ¶Econ 8101, ¶Econ 8105, ¶Stat 5101 or #) Application in research, including classical and Bayesian approaches; formulation, comparison, and use of models and hypotheses; inference and prediction in structural models; simulation methods. Seven-week course.

**Econ 8206. Applied Econometrics.** (2 cr. Prereq-8205, ¶8102, ¶8106, ¶Stat 5101 or #) Application in research, including classical and Bayesian approaches; formulation, comparison, and use of models and hypotheses; inference and prediction in structural models; simulation methods. Seven-week course.

**Econ 8207. Applied Econometrics.** (2 cr. Prereq-8206, ¶8103, ¶8107, ¶Stat 5102 or #) Application in research, including classical and Bayesian approaches; formulation, comparison, and use of models and hypotheses; inference and prediction in structural models; simulation methods. Seven-week course.

**Econ 8208. Applied Econometrics.** (2 cr. Prereq-8207, ¶8104, ¶8108, ¶Stat 5102 or #) Application in research, including classical and Bayesian approaches; formulation, comparison, and use of models and hypotheses; inference and prediction in structural models; simulation methods. Seven-week course.

**Econ 8211. Econometrics.** (2 cr. Prereq-5151, 5152, Math 4242 or equiv, Stat 5102 or #) Linear regression; general linear hypotheses; Gauss Markov Theorem, generalized least squares and their applications. Decision-theoretic choice among estimators. Simultaneous equations models; identification and estimation. Asymptotic distribution theory. Applications, including multivariate time series models and/or limited dependent variables models. Seven-week course.

**Econ 8212. Econometrics.** (2 cr. Prereq-8211) Linear regression; general linear hypotheses; Gauss Markov Theorem, generalized least squares and their applications. Decision-theoretic choice among estimators. Simultaneous equations models; identification and estimation. Asymptotic distribution

theory. Applications, including multivariate time series models and/or limited dependent variables models. Seven-week course.

**Econ 8213. Econometrics.** (2 cr. Prereq-8212) Linear regression; general linear hypotheses; Gauss Markov Theorem, generalized least squares and their applications. Decision-theoretic choice among estimators. Simultaneous equations models; identification and estimation. Asymptotic distribution theory. Applications, including multivariate time series models and/or limited dependent variables models. Seven-week course.

**Econ 8281. Advanced Topics in Econometrics.** (2 cr [max 4 cr]. Prereq-8213 or #; offered when feasible) Faculty and student presentations based on recent literature. This is a 7-week course.

**Econ 8282. Advanced Topics in Econometrics.** (2 cr [max 4 cr]. Prereq-8213 or #) Faculty and student presentations based on recent literature. Seven-week course.

**Econ 8291. Workshop in Econometrics.** (1-3 cr [max 10 cr]. Prereq-8213 or #)

**Econ 8292. Workshop in Econometrics.** (1-3 cr [max 10 cr]. Prereq-8213 or #)

**Econ 8311. Economic Growth and Development.** (2 cr. Prereq-8104, 8106 or #) Methods of analyzing dynamical systems; applying methods to new models of growth and development; deriving and evaluating models' quantitative implications in light of growth and development in a number of countries. Seven-week course.

**Econ 8312. Economic Growth and Development.** (2 cr. Prereq-8311 or #) Methods of analyzing dynamical systems; applying methods to new models of growth and development; deriving and evaluating models' quantitative implications in light of growth and development in a number of countries. Seven-week course.

**Econ 8313. Economic Growth and Development.** (2 cr. Prereq-8312 or #) Methods of analyzing dynamical systems; applying methods to new models of growth and development; deriving and evaluating models' quantitative implications in light of growth and development in a number of countries. Seven-week course.

**Econ 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**Econ 8381. Advanced Topics in Economic Development.** (2 cr [max 4 cr]. Prereq-8312 or #; offered when feasible) Faculty and student presentations based on recent literature. Seven-week course.

**Econ 8382. Advanced Topics in Economic Development.** (2 cr [max 4 cr]. Prereq-8312 or #) Faculty and student presentations based on recent literature. Seven-week course.

**Econ 8391. Workshop in Economic Growth and Development.** (1-3 cr [max 10 cr]. Prereq-#)

**Econ 8392. Workshop in Economic Growth and Development.** (1-3 cr [max 10 cr]. Prereq-#)

**Econ 8401. International Trade and Payments Theory.** (2 cr. Prereq-8103, 8105 or #) Impact of trade on factor rentals. Stolper-Samuelson, Rybczynski, and factor price equalization theorems. Heckscher-Ohlin theorem. Derivation of offer curves and general international equilibrium. Transfer problem. Seven-week course.

**Econ 8402. International Trade and Payments Theory.** (2 cr. Prereq-8401 or #) Tariffs, quotas, and other barriers to trade; gains from trade; trading blocs; increasing returns; growth. This is a seven-week course.

**Econ 8403. International Trade and Payments Theory.** (2 cr. Prereq-8402 or #) International business cycles; exchange rates; capital movements; international liquidity. This is a 7-week course.

**Econ 8404. International Trade and Payments Theory.** (2 cr. Prereq-[8402, 8403] or #)  
Theoretical models of international trade. Trade data, empirical work on trade. Seven-week course.

**Econ 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**Econ 8481. Advanced Topics in International Trade.** (2 cr [max 4 cr]. Prereq-8403 or #; offered when feasible)  
Faculty and student presentations based on recent literature. Seven-week course.

**Econ 8482. Advanced Topics in International Trade.** (2 cr [max 4 cr]. Prereq-8403 or #; offered when feasible)  
Faculty and student presentations based on recent literature. Seven-week course.

**Econ 8491. Workshop in Trade and Development.** (1-3 cr [max 10 cr]. Prereq-#)

**Econ 8492. Workshop in Trade and Development.** (1-3 cr [max 10 cr]. Prereq-#)

**Econ 8501. Wages and Employment.** (2 cr. Prereq-8102, 8106 or #)  
Economic analysis of labor markets and their operation under conditions of both individual and collective bargaining. Implications of labor market operations for resource allocation, wage and price stability, income and employment growth. Wage structures and wage levels. Wage and employment theories and practices. Economic impacts of unions. Seven-week course.

**Econ 8502. Wages and Employment.** (2 cr. Prereq-8501 or #)  
Economic analysis of labor markets and their operation under conditions of both individual and collective bargaining. Implications of labor market operations for resource allocation, wage and price stability, income and employment growth. Wage structures and wage levels. Wage and employment theories and practices. Economic impacts of unions. Seven-week course.

**Econ 8503. Wages and Employment.** (2 cr. Prereq-8502 or #)  
Economic analysis of labor markets and their operation under conditions of individual/collective bargaining. Implications of labor market operations for resource allocation, wage/price stability, income/employment growth. Wage structures and wage levels. Wage/employment theories/practices. Economic impacts of unions. Seven-week course.

**Econ 8581. Advanced Topics in Labor Economics.** (2 cr [max 4 cr]. Prereq-8502 or #; offered when feasible)  
Faculty and student presentations based on recent literature. Seven-week course.

**Econ 8582. Advanced Topics in Labor Economics.** (2 cr [max 4 cr]. Prereq-8502 or #; offered when feasible)  
Faculty and student presentations based on recent literature. Seven-week course.

**Econ 8601. Industrial Organization and Government Regulation.** (2 cr. Prereq-8102 or #)  
Behavior of businesses and industries: productivity, firm size distributions, exit-entry dynamics, etc. Theories of the firm, industry structure and performance, invention and innovation, and technology adoption. Positive and normative theories of regulation. Seven-week course.

**Econ 8602. Industrial Organization and Government Regulation.** (2 cr. Prereq-8601 or #)  
Behavior of businesses and industries: productivity, firm size distributions, exit-entry dynamics, etc. Theories of the firm, industry structure and performance, invention and innovation, and technology adoption. Positive and normative theories of regulation. Seven-week course.

**Econ 8603. Industrial Organization and Government Regulation.** (2 cr. Prereq-8602 or #)  
Behavior of businesses and industries: productivity, firm size distributions, exit-entry dynamics, etc. Theories of the firm, industry structure and performance, invention and innovation, and technology adoption. Positive and normative theories of regulation. Seven-week course.

**Econ 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Econ 8681. Advanced Topics in Industrial Organization.** (2 cr [max 4 cr]. Prereq-8603 or #; offered when feasible)  
Faculty and student presentations based on recent literature. Seven-week course.

**Econ 8682. Advanced Topics in Industrial Organization.** (2 cr [max 4 cr]. Prereq-8603 or #; offered when feasible)  
Faculty and student presentations based on recent literature. Seven-week course.

**Econ 8691. Workshop in Applied Microeconomics.** (1-3 cr [max 10 cr]. Prereq-#)

**Econ 8692. Workshop in Applied Microeconomics.** (1-3 cr [max 10 cr]. Prereq-#)

**Econ 8701. Monetary Economics.** (2 cr. Prereq-8103, 8106 or #)  
Economic role of principal financial institutions. Determinants of value of money. Principal problems of monetary policy. Seven-week course.

**Econ 8702. Monetary Economics.** (2 cr. Prereq-8701 or #)  
Economic role of principal financial institutions. Determinants of value of money. Principal problems of monetary policy. Seven-week course.

**Econ 8703. Monetary Economics.** (2 cr. Prereq-8702 or #)  
Economic role of principal financial institutions. Determinants of value of money. Principal problems of monetary policy. Seven-week course.

**Econ 8704. Financial Economics.** (2 cr. Prereq-8103, 8106 or #)  
Role of financial institutions in efficient allocation of risk; multiperiod and continuous-time securities markets; theory of firm under uncertainty; financial intermediation; derivation of empirical asset-pricing relationships; tests concerning alternative market structures. Seven-week course.

**Econ 8705. Financial Economics.** (2 cr. Prereq-8704 or #)  
Role of financial institutions in efficient allocation of risk; multiperiod and continuous-time securities markets; theory of firm under uncertainty; financial intermediation; derivation of empirical asset-pricing relationships; tests concerning alternative market structures. Seven-week course.

**Econ 8706. Financial Economics.** (2 cr. Prereq-8705 or #)  
Role of financial institutions in efficient allocation of risk; multiperiod and continuous-time securities markets; theory of firm under uncertainty; financial intermediation; derivation of empirical asset-pricing relationships; tests concerning alternative market structures. Seven-week course.

**Econ 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Econ 8781. Advanced Topics in Monetary Economics.** (2 cr [max 4 cr]. Prereq-8702 or #; offered when feasible)  
Faculty and student presentations based on recent literature. Seven-week course.

**Econ 8782. Advanced Topics in Monetary Economics.** (2 cr [max 4 cr]. Prereq-8702 or #; offered when feasible)  
Faculty and student presentations based on recent literature. Seven-week course.

**Econ 8791. Workshop in Macroeconomics.** (1-3 cr [max 10 cr]. Prereq-#)

**Econ 8792. Workshop in Macroeconomics.** (1-3 cr [max 10 cr]. Prereq-#)

**Econ 8801. Public Economics.** (2 cr. Prereq-8103, 8106 or #)  
Theories of public choice and role of government in economy. Economic effects of taxes, public debt, and public expenditure. Current problems in economics of public sector, including political economy. Seven-week course.

**Econ 8802. Public Economics.** (2 cr. Prereq-8801 or #)  
Theories of public choice and role of government in economy. Economic effects of taxes, public debt, and public expenditure. Current problems in economics of public sector, including political economy. Seven-week course.

**Econ 8803. Public Economics.** (2 cr. Prereq-8802 or #)  
Theories of public choice and role of government in economy. Economic effects of taxes, public debt, and public expenditure. Current problems in economics of public sector, including political economy. Seven-week course.

**Econ 8881. Advanced Topics in Public Economics.** (2 cr [max 4 cr]. Prereq-8803 or #; offered when feasible)  
Faculty and student presentations based on recent literature. Seven-week course.

**Econ 8882. Advanced Topics in Public Economics.** (2 cr [max 4 cr]. Prereq-8803 or #; offered when feasible)  
Faculty and student presentations based on recent literature. Seven-week course.

**Econ 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

**Econ 8891. Workshop in Public Economics and Policy.** (1-3 cr [max 10 cr]. Prereq-#)

**Econ 8892. Workshop in Public Economics and Policy.** (1-3 cr [max 10 cr]. Prereq-#)

**Econ 8990. Individual Graduate Research.** (1-7 cr. Prereq-#)

## Education (Educ)

### College of Education and Human Development

**Educ 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**Educ 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**Educ 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Educ 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Educ 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

## Education and Human Development (EdHD)

### College of Education and Human Development

**EdHD 5001. Learning, Cognition, and Assessment in the Schools.** (3 cr; A-F only. Prereq-MEd/init lic student or CLA music ed or preteaching major or #; psych course recommended)

Principles of learning, cognition, cognitive development, classroom management, motivation, instruction, assessment. Approaches include behaviorism, cognitive and social constructivism, human information processing theory. Topics include intelligence, knowledge acquisition, reasoning skills, scholastic achievement, standardized testing, reliability, validity, student evaluation, performance assessment, portfolios, demonstrations. Applications to instruction and organization of curricular materials.

**EdHD 5003. Developmental and Individual Differences in Educational Contexts.** (3 cr; A-F only. Prereq-MEd/init lic or CLA music ed or preteaching major or #)  
Overview of developmental and individual differences of children and adolescents in educational contexts; emphasis on a dynamic systems perspective; developmental transitions in childhood and

adolescence; interactions between the student, environment, and task; and accommodations and adaptations for students in special education.

**EdHD 5005. School and Society.** (2 cr; A-F only. \$EdPA 5090. Prereq—MEd/init lic student or CLA music ed major or preteaching major or #)

Readings in history, philosophy, social sciences, and law revealing diverse educational values in a pluralistic society. Multiple expectations of schools. Civil liberties, rights, community. Varying cultural backgrounds of students, family circumstances, exceptional needs.

**EdHD 5007. Technology for Teaching and Learning.** (1.5 cr; A-F only. \$5007 (qtr version), \$CI 5300. Prereq—[MEd/init lic or CLA music ed major or preteaching major or #], basic computer skills)

Diverse educational technology in K-12 classrooms. Effective use of technology. Computer technologies used to stimulate personal productivity/communication and to enhance teaching/learning processes.

**EdHD 5009. Human Relations: Applied Skills for School and Society.** (1 cr; A-F only. Prereq—MEd/init lic or CLA music ed or preteaching or #)

Issues of prejudice/discrimination in terms of history, power, social perception. Knowledge/skills acquisition in cooperative learning, multicultural education, group dynamics, social influence, leadership, judgment/decision making, prejudice reduction, conflict resolution, teaching in diverse educational settings.

## Educational Policy and Administration (EdPA)

*Department of Educational Policy and Administration*

*College of Education and Human Development*

**EdPA 5001. Formal Organizations in Education.** (3 cr)  
Classical/current theories of organizations.  
Applications to education and related fields.

**EdPA 5021. Historical Foundations of Modern Education.** (3 cr)

Analysis and interpretation of important elements in modern education derived from pre-classical sources: Greeks, Romans, Middle Ages, Renaissance, Reformation, Enlightenment, and Industrial Revolution.

**EdPA 5023. History of Western Educational Thought.** (3 cr)

Great educational classics of Western civilization: Plato, Aristotle, Quintilian, Montaigne, Milton, Locke, Rousseau, and others.

**EdPA 5024. History of Ideas in American Education.** (3 cr)

Readings in American cultural development related to education, including: Franklin, Jefferson, Mann, B.T. Washington, W.E.B. DuBois, Dewey. Special reference to the emerging system of public education in changing contexts, agrarian to urban-industrial, moderate pluralism to intense diversity.

**EdPA 5028. Education Imagery in Europe and America.** (3 cr)

Images and ideas of education expressed in the visual arts of Western civilization (antiquity to 20th century) in relation to concurrent educational thought and practice; symbolism, myth, propaganda, didacticism, genre, caricature.

**EdPA 5032. Comparative Philosophies of Education.** (3 cr)

Exploration of the principal philosophies in educational thought today, e.g., realism, idealism, pragmatism, and postmodernism. Practice in philosophical critique.

**EdPA 5036. Ethics, Morality, and Values in Education.** (3 cr)

Application to key issues of professional practice. Moral education, virtues, principles.

**EdPA 5041. Sociology of Education.** (3 cr)

Structures and processes within educational institutions; linkages between educational organizations and their social contexts, particularly related to educational change.

**EdPA 5044. Introduction to the Economics of Education.** (3 cr)

Costs and economic benefits of education, with a focus on K-12; educational markets, prices, and production relationships; investment and cost-benefit analysis.

**EdPA 5048. Cross-Cultural Perspectives on Leadership.** (2 cr)

Introduction to cultural variables of leadership that influence functioning of cross-cultural groups. Lectures, case studies, discussion, problem-solving, simulations. Intensive workshop.

**EdPA 5052. Ethnic Groups and Communities: Families, Children, and Youth.** (3 cr)

Roles of young people in widely varied North American communities. Comparative aspects of youth commitment to society, economic value of youth, youth-adult conflict, youth roles in family. Well-defined analyses of contextual roles. Complexity of policy for appropriate educational/community development.

**EdPA 5056. Case Studies for Policy Research.** (3 cr; A-F only)

Qualitative case study research methods and their applications to educational policy and practice. Emphasis on designing studies that employ open-ended interviewing as primary data collection technique.

**EdPA 5061. Ethnographic Research Methods.** (3 cr)

Practice in aspects of field methodology below the level of full field study; detailed reading; analysis of studies in anthropology and education for methodological content.

**EdPA 5064. Divergent Perspectives in Educational Policy and Practice.** (3 cr)

Examines fundamental and current issues in the field of education. Participants learn how to approach an issue from multiple perspectives, develop skills to identify and analyze its component parts, and examine personal belief systems to place a given issue within a personal context.

**EdPA 5080. Special Topics: Educational Policy and Administration.** (1-3 cr [max 24 cr])

Topical issues in educational policy/administration.

**EdPA 5087. Seminar: Educational Policy and Administration.** (1-3 cr [max 24 cr])

Shared responsibility of students/instructor in presentation of topics.

**EdPA 5095. Problems: Educational Policy and Administration.** (1-3 cr [max 24 cr])

Course or independent study on specific topic within department program emphasis.

**EdPA 5096. Internship: Educational Policy and Administration.** (1-9 cr [max 24 cr])

Internship in elementary, secondary, general, or postsecondary administration, or other approved field related setting.

**EdPA 5101. International Education and Development.** (3 cr)

Introduction to comparative and international development education, contemporary theories regarding the role of education in the economic, political, and sociocultural development of nations; examination of central topics and critical issues in the field.

**EdPA 5102. Knowledge Formats and Applications: International Development Education Contexts.** (3 cr)  
Analyzes the interrelationships of "knowledge capital" (noetic symbolic resources) and culture through

intrinsic, cross-, and multicultural perspectives.

Distinguishes knowledge from information and data, focusing on national and international developments occurring along basic and applied knowledge paths.

**EdPA 5103. Comparative Education.** (3 cr)

Examination of systems and philosophies of education globally with emphasis upon African, Asian, European, and North American nations. Foundations of comparative study with selected case studies.

**EdPA 5104. Strategies for International Development of Education Systems.** (3 cr; A-F only. Prereq—Grad student)

Strategies for improving quality/efficiency of schooling in developing countries. Introduction to current research on what policy/programmatic interventions have proven most successful in increasing access, raising quality, and improving efficiency of education in developing countries.

**EdPA 5121. Educational Reform in International Context.** (3 cr)

Critical policy analysis of educational innovation and reform in selected countries. Use theoretical perspectives and a variety of policy analysis approaches to examine actual educational reforms and their implementation.

**EdPA 5124. Critical Issues in International Education and Educational Exchange.** (3 cr)

Analysis of comprehensive policy-oriented frameworks for international education; practices of U.S. and other universities; conceptual development of international education and its practical application to programs, to employment choices, and to pedagogy.

**EdPA 5128. Anthropology of Learning.** (3 cr)

Cross-cultural perspectives in examining educational patterns; the implicit and explicit cultural assumptions underlying them. Methods and approaches to cross-cultural studies in education.

**EdPA 5132. Intercultural Education and Training: Theory and Application.** (3 cr)

Examination of intercultural education; formal and nonformal education programs intended to teach about cultural diversity, promote intercultural communication and interaction skills, and teach students from diverse background more effectively.

**EdPA 5301. Contexts of Learning: Historical, Contemporary, and Projected.** (3 cr; A-F only)

Contextual understanding of education as a social institution. Education is studied as one institution among the several that constitute its dynamic context.

**EdPA 5302. Educational Policy: Context, Inquiry, and Issues.** (3 cr)

Review of social science concepts/research in considering educational policies/issues, process of inquiry that affect policy development, implementation, evaluation. Focus on pre-K-12. Role of educational leaders, administrators.

**EdPA 5303. Managing the Learning Organization.** (3 cr; A-F only)

Examines schools, colleges, and other human service organizations centered on learning. Focuses on perspectives and skills needed to manage organizations effectively.

**EdPA 5304. Educational Leadership for Equity, Opportunity, and Outcome.** (3 cr)

Implications of multiple contexts in which leadership occurs. Role of followers. Complexities of collaborative structures and of shared governance.

**EdPA 5305. Leadership and Vision in School Technology.** (1 cr. Prereq—[Mac or PC] with at least 256

MB of RAM, [Windows NT 2000 or XP or Mac OS 9 or 10], Pentium 2 or faster, internet connection, up-to-date version of Netscape, Internet Explorer, virus protection software, #)

How to create a shared vision for comprehensive integration of technology into educational environments. Ways to foster environment/culture conducive to realizing that vision.

**EdPA 5306. Staff Technology Development and Support.**

(1 cr. Prereq—[Mac or PC] with at least 256 MB of RAM, [Windows NT 2000 or XP or Mac OS 9 or 10], Pentium 2 or faster, internet connection, up-to-date version of Netscape, Internet Explorer, virus protection software, #)

How to lead an organization in designing, implementing, evaluating, improving, and sharing approaches to staff development. Technology-related development. Facilitating staff development through use of technology.

**EdPA 5307. School Management and Technology.**

(1 cr. Prereq—[Mac or PC] with at least 256 MB of RAM, [Windows NT 2000 or XP or Mac OS 9 or 10], Pentium 2 or faster, internet connection, up-to-date version of Netscape, Internet Explorer, virus protection software, #)

Various organizational/management issues impacted by information technology. Focuses on hardware, software, and database technologies designed to facilitate management/operations of school organizations.

**EdPA 5308. Emerging Issues and School Technology.**

(1 cr. Prereq—[Mac or PC] with at least 256 MB of RAM, [Windows NT 2000 or XP or Mac OS 9 or 10], Pentium 2 or faster, internet connection, up-to-date version of Netscape, Internet Explorer, virus protection software, #)

Needs of schools/administrators to remain on forefront of information technologies. Focuses on anticipated technological trends years/decades ahead.

**EdPA 5309. Electronic Communication Tools and Environments for Schools.**

(1 cr. Prereq—[Mac or PC] with at least 256 MB of RAM, [Windows NT 2000 or XP or Mac OS 9 or 10], Pentium 2 or faster, internet connection, up-to-date version of Netscape, Internet Explorer, virus protection software, #)

Various electronic communication channels, information environments to facilitate educational organizations' operations/communication. Focuses on networked environments, integration with handheld computers, and outreach to internal/external stakeholders.

**EdPA 5310. Data-Driven Decision-Making I.**

(1 cr. Prereq—[Mac or PC] with at least 256 MB of RAM, [Windows NT 2000 or XP or Mac OS 9 or 10], Pentium 2 or faster, internet connection, up-to-date version of Netscape, Internet Explorer, virus protection software, #)

Data-driven decision-making needs of schools/administrators. Focuses on data collection/analysis needs of educational organizations and on use of appropriate software/databases to collect, manage, analyze, and report school information.

**EdPA 5311. Data-Driven Decision-Making II.**

(1 cr. Prereq—[Mac or PC] with at least 256 MB of RAM, [Windows NT 2000 or XP or Mac OS 9 or 10], Pentium 2 or faster, internet connection, up-to-date version of Netscape, Internet Explorer, virus protection software, #)

Continuation of 5310. Data-driven decision-making needs of schools/administrators. Hands-on training in students' own organizations in using technology to analyze data to make educational decisions.

**EdPA 5312. School Technology Policy Issues.**

(1 cr. Prereq—[Mac or PC] with at least 256 MB of RAM, [Windows NT 2000 or XP or Mac OS 9 or 10], Pentium 2 or faster, internet connection, up-to-date version of Netscape, Internet Explorer, virus protection software, #)

Various state/national policy issues related to educational technology. Focuses on "digital divide" in schools/communities, federal educational technology policy initiatives, and state/federal educational technology legislation.

**EdPA 5313. Legal and Ethical Issues in School Technology.**

(1 cr. Prereq—[Mac or PC] with at least 256 MB of RAM, [Windows NT 2000 or XP or Mac OS 9 or 10], Pentium 2 or faster, internet connection, up-to-date version of Netscape, Internet Explorer, virus protection software, #)

Social, legal, and ethical issues related to school technology. How to model responsible decision-making related to these issues.

**EdPA 5314. School Technology Safety and Security.**

(1 cr. Prereq—[Mac or PC] with at least 256 MB of RAM, [Windows NT 2000 or XP or Mac OS 9 or 10], Pentium 2 or faster, internet connection, up-to-date version of Netscape, Internet Explorer, virus protection software, #)

School safety/security issues impacted by information technology. Network/data security. Physical safety of students, employees, and facilities. Computer recycling/disposal. Appropriate ergonomic environments for students/employees.

**EdPA 5315. School Technology Leadership Multimedia Project.**

(1 cr. Prereq—[Mac or PC] with at least 256 MB of RAM, [Windows NT 2000 or XP or Mac OS 9 or 10], Pentium 2 or faster, internet connection, up-to-date version of Netscape, Internet Explorer, virus protection software, #)

Students focus on individualized school technology leadership topic of choice, deliver a multimedia presentation of project results. Regular consultation with faculty, peer mentors, and outside mentors.

**EdPA 5321. The Principalsip.**

(3 cr) Role of the principal: qualifications, duties, and problems.

**EdPA 5322. School Superintendency.**

(3 cr) Role/responsibility of superintendent in school district. Emphasizes real life experiences, leadership potential as CEO. Purposes, power, politics, practices of position. Interplay of internal school forces, external community forces analyzed in multiple contexts. Manifestations of leadership in public, high-profile appointment.

**EdPA 5323. Women in Leadership.**

(3 cr. Prereq—Technology access) Women in leadership, in context of larger systems and their own lives. Supporting equity/equality across areas of difference.

**EdPA 5324. Financial Management for Elementary-Secondary Education.**

(3 cr) Provides an overview of state-local school finance systems, budgeting, governmental fund accounting, and interpretation of financial information. For graduate students pursuing licensure as elementary-secondary principals and superintendents.

**EdPA 5328. Introduction to Educational Planning.**

(3 cr) Principles, tools, comparative practices, and emerging issues in K-12 and higher education settings; decision making models; strategic and project planning; barriers to effectiveness; and change management processes.

**EdPA 5332. Leadership Development Seminar.**

(3 cr) Assessment and development of skills required of the educator in planning, decision making, and human relations. Introduction to contemporary issues in educational administration.

**EdPA 5336. Laboratory in Decision Making.**

(3 cr) Contributions of recent research and theory to effective administration. Analysis of administrative behavior in realistic settings; relations of administration to human behavior.

**EdPA 5341. The American Middle School.**

(3 cr) Focus on the uniqueness of the early adolescent and appropriate learning situations. For educators working with middle-level students.

**EdPA 5344. Legal Aspects of Elementary and Secondary Education.**

(3 cr) Overview of legal foundations of elementary/secondary education. Statutory themes, relevant case law, emergent policy issues. Implications for educational organizations and for administrative practice.

**EdPA 5346. Politics of Education.**

(3 cr; A-F only. Prereq—Postbac, MED, or grad student) Political dimensions of policy formulation/implementation in education. Use of power/influence in shaping educational policies and in resolving conflicts over educational issues. Analysis of consequences/cross-impacts.

**EdPA 5348. Public School Personnel Programs.**

(3 cr) Management concepts, functions, and practices of the personnel subsystem in education; selection, assignment, evaluation, and development of school personnel; collective bargaining and the grievance process.

**EdPA 5352. Projective Leadership for Strategic Learning Communities.**

(3 cr) Explores many trends and changes facing society, culture, and education from a strategic learning community perspective; helps students "futzurize the present."

**EdPA 5356. Disability Policy and Services.**

(3 cr) Policy, research, and current practices related to education, health, and social services that support children, youth, and adults with special needs, and that support their families. Federal, state, and local perspectives.

**EdPA 5361. Project in Teacher Leadership.**

(3 cr; S-N only. Prereq—MED student in Teacher Leadership Program) Create, implement, evaluate, and present a leadership project designed to initiate positive change in educational environments. Review of related literature, proposal development, project development, implementation and evaluation, critical reflection, sharing learning outcomes.

**EdPA 5364. Context and Practice of Educational Leadership.**

(3 cr; A-F only) Current research/practice on educational leadership. Focuses on creating school cultures conducive to continuous improvement/change. Strategies for personal/organizational leadership in PK-12 settings.

**EdPA 5368. Special Services Policy and Administration.**

(3 cr) Legislative, procedural, executive, and judicial actions that affect services, families, and children with special needs at all levels of government: federal, state, and local. For administrators, supervisors, and other professionals responsible for managing general, special, and alternative education programs.

**EdPA 5372. Youth in Modern Society.**

(3 cr) Youth in advanced societies and as a social entity; functions and roles in industrial society, family, education, politics and government, economy and work, welfare and religion; organizations, social movements, and subcultures; empirical research and cross-cultural perspectives.

**EdPA 5374. Leadership for Staff Development.**

(4 cr. Prereq—Postbaccalaureate, at least 3 yrs teaching experience) Designing, implementing, evaluating staff development in PK-12 settings. Research-based standards for effective staff development. Need for embedded time for collaborative learning, evaluating staff/student outcomes.

**EdPA 5376. Organizational Approaches to Youth Development.**

(3 cr) Defining youth development within framework of formal and informal organizations; organizational systems responsible for youth development in the community; policy issues surrounding these systems.

**EdPA 5378. Experiential Learning: Theory and Practice.**

(3 cr) Theory/practice of learning by doing. Educator's personal engagement in process. Technical, motivational, and evaluative aspects.

**EdPA 5381. The Search for Children and Youth Policy in the U.S.**

(3 cr) Review of contemporary policy issues affecting children and youth in the U.S. and South Africa; identify national standards, norms and principles of youth development; conflicting expectations facing policy-makers; and search for the critical content of youth policy.

**EdPA 5384. Collaboration in Heterogeneous Classrooms and Schools.**

(3 cr; A-F only) Policy, research, practice base for addressing range of student abilities/backgrounds in diverse schools. Collaborative approaches to curricular, instructional, social support.

**EdPA 5396. Field Experience in PK-12 Educational Administration.** (3 cr [max 6 cr]; S-N only. Prereq-#) Field experience or internship arranged for students seeking licensure as PK-12 principal/superintendent. Content/credit depend on licensure requirements specified in individual field experience agreement.

**EdPA 5501. Principles and Methods of Evaluation.** (3 cr)

Introduction to program evaluation. Planning an evaluation study, collecting and analyzing information, reporting results; evaluation strategies; overview of the field of program evaluation.

**EdPA 5521. Cost and Economic Analysis in Educational Evaluation.** (3 cr; S-N only)

Use and application of cost-effectiveness, cost-benefit, cost-utility, and cost-feasibility in evaluation of educational problems and programs.

**EdPA 5524. Evaluation Colloquium.** (1 cr [max 24 cr]; S-N only. Prereq-5501 or EPsy 5243)

Informal seminar of faculty and advanced students. Issues/problems of program evaluation.

**EdPA 5701. U.S. Higher Education.** (3 cr)

U.S. higher/postsecondary education in historical/contemporary perspective. Emphasizes structure, history, and purposes of system as a whole.

**EdPA 5704. Student and Faculty Issues in Higher Education.** (3 cr)

College student development, curricular/extracurricular activities, faculty work/development, student-faculty interaction.

**EdPA 5721. Racial and Ethnic Diversity in Higher Education.** (3 cr)

Review of research. Theoretical frameworks, methodological perspectives, and research strategies used to study students, staff, and faculty; historical perspectives.

**EdPA 5724. Leadership and Administration of Student Affairs.** (3 cr)

Scope, administration, coordination, and evaluation of programs in college and university student affairs.

**EdPA 5727. Developmental Education Programs and Postsecondary Students.** (3 cr. Prereq-Bachelor's degree)

Focuses on populations served by developmental education programs in the United States and abroad. Defines developmental education. Historical perspective for need for developmental education, student development theories that guide practice in developmental education. Identifying student needs. Model programs, best practices for student retention. Current issues/trends in field.

**EdPA 5728. Two-Year Postsecondary Institutions.** (3 cr)

Present status, development, functions, organization, curriculum, and trends in postsecondary, but nonbaccalaureate, institutions.

**EdPA 5732. The Law and Postsecondary Institutions.** (3 cr)

Analysis of court opinions and federal regulations affecting postsecondary educational institutions.

**EdPA 5734. Institutional Research in Postsecondary Education.** (3 cr; A-F only. Prereq-[5701, (EPsy 5231 or EPsy 8261), grad student] or #)

Scope, role, administration, research strategies, and evaluation of institutional research in postsecondary institutions. Overview of research methodologies, disciplinary foundations of institutional research. Use of institutional, state, and national databases in addressing full range of institutional missions/functions.

**EdPA 8002. Critical Issues in Contemporary Education.** (3 cr. Prereq-EdD or PhD student)

Meanings of difference from sociological, psychological, historical and philosophical perspectives as related to current and emerging critical issues in education. Participants help design, facilitate, and present the course.

**EdPA 8011. Doctoral Research Seminar I.** (1 cr; S-N only. Prereq-EdPA doctoral student)

Introduction/planning for individual program development, preliminary examinations, and dissertation prospectus. Modes of inquiry used in current research in education, databases relating to education, recent writings on literature synthesis, key contributions to education literature.

**EdPA 8012. Doctoral Research Seminar II.** (1 cr; S-N only. Prereq-EdPA doctoral student)

Introduction to quantitative/qualitative research approaches/methods. Nature of research, role of researcher, philosophical perspectives on research, ethical issues in conducting research.

**EdPA 8013. Doctoral Research Seminar III.** (1 cr; S-N only. Prereq-EdPA doctoral student)

Introduction to most important quantitative/qualitative approaches employed in educational policy research.

**EdPA 8014. Doctoral Research Seminar IV.** (1 cr; S-N only. Prereq-EdPA doctoral student)

Preparation of thesis prospectus.

**EdPA 8087. Seminar: Educational Policy and Administration.** (1-3 cr [max 24 cr])

Seminar on issues of educational policy and administration.

**EdPA 8095. Problems: Educational Policy and Administration.** (1-3 cr [max 24 cr])

Independent study on issues of educational policy/administration. Arranged with instructor.

**EdPA 8096. Internship: Educational Policy and Administration.** (1-9 cr [max 24 cr])

Internship on issues of educational policy/administration. Arranged with instructor.

**EdPA 8104. General Systems Thinking for the Analysis of Education.** (3 cr)

Critical aspects of historical and contemporary systems philosophy, thinking, and analysis. Development of concepts and skills applicable to coping with evolutionary and chaotic environments. Modeling and simulation of learning systems in rapidly changing national and international contexts.

**EdPA 8121. Doctoral Seminar: Comparative and International Development Education.** (1-6 cr; S-N only. Prereq-EdPA PhD candidate)

Focuses on needs of students while writing the dissertation; general guidance in how to construct the thesis.

**EdPA 8124. Classic Readings in Anthropology and Education.** (3 cr; A-F only)

Major contributions to theory or working paradigms.

**EdPA 8301. Contexts of Learning.** (3 cr)

Study of long-term contextual understanding of education as a social institution. Development of perspective-driven explanation.

**EdPA 8302. Educational Policy Perspectives.** (3 cr)

Public policy issues in education. Historical, international, political, research perspectives. Current policy strategies for reforming U.S. public schools.

**EdPA 8303. Modeling the Learning Organization.** (3 cr)

Computer software, perspectives on learning organization used to study global education, human service organizations.

**EdPA 8304. Leadership and Ethics.** (3 cr)

Review of major leadership theories, their application to problems of practice in educational organizations. Studies of leadership behavior illustrate major emerging issues in educational management.

**EdPA 8321. Data Analysis for Educational Management.** (3 cr)

Managers of educational organizations are faced with problems that require analysis of a wide range of information. Outlines a frame for data analysis and introduces a set of computer-based tools suited to the practice of educational administration.

**EdPA 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**EdPA 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**EdPA 8502. Program Evaluation Theory and Models: Qualitative and Quantitative Alternatives.** (3 cr. Prereq-5501 or EPsy 5243)

Concepts, approaches, models, and theoretical frameworks for program evaluation that have developed since the 1960s.

**EdPA 8595. Evaluation Problems.** (1-6 cr [max 24 cr]. Prereq-[5501 or EPsy 5243], #)

Independent study of an issue in theory or practice of program evaluation.

**EdPA 8596. Evaluation Internship.** (1-9 cr [max 24 cr]. Prereq-[5501 or EPsy 5243], #)

Hands-on experience in conducting a program evaluation in a real-world setting under supervision of an evaluation professional.

**EdPA 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**EdPA 8702. Administration and Leadership in Higher Education.** (3 cr. Prereq-5001, 5701)

Leadership, governance, and administration in higher education through theoretical perspectives and practical analysis. Planning, change, decision making, organizational culture, budgets, conflict.

**EdPA 8703. Public Policy in Higher Education.** (3 cr; A-F only. Prereq-5001, 5701)

Theories, analytic methods, and critical issues in postsecondary education policy at national/state levels. Equality of educational opportunity, affirmative action, system governance/coordination, research funding, student financial aid, public accountability.

**EdPA 8721. Instruction and Learning in Higher Education.** (3 cr)

Theory/practice of teaching strategies. Implications of student differences (learning style, ethnicity, gender, age) for teaching. Evaluation and professional development of teaching. Context/nature of faculty work, ethical issues, teaching portfolio development.

**EdPA 8724. Strategic Planning in Higher Education.** (3 cr. Prereq-5701)

Strategic planning principles, their application to higher education, pitfalls encountered by planners in higher education. Selected tools of strategic planning/management, strategic planning case studies.

**EdPA 8728. Economics of Higher Education.** (3 cr)

Institutional responses to changing external economic factors; economic effects resulting from higher education's output in teaching, research, and service; research on institutional and governmental policies.

**EdPA 8732. Financing Higher Education.** (3 cr. Prereq-5701)

Theories and critical issues in financing postsecondary education. Budgeting, cost-effectiveness, state/federal funding policies, tuition policies, student financial aid, financing educational opportunity.

**EdPA 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**EdPA 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

## Educational Psychology (EPsy)

*Department of Educational Psychology*

*College of Education and Human Development*

**EPsy 5100. Colloquium Series: Research and Issues in Psychological Foundations of Education.** (1 cr [max 3 cr]. Prereq-Grad student in psychological foundations of education or #)

Presentation/critique of faculty/student research.

**EPsy 5101. Intelligence and Creativity.** (3 cr; A-F only)  
Contemporary theories of intelligence and intellectual development and contemporary theories of creativity and their implications for educational practices and psychological research.

**EPsy 5112. Knowing, Learning, and Thinking.** (4 cr; A-F only)  
Principles of human information processing, memory, and thought; mental operations in comprehension and problem solving; developing expertise and automaticity; emphasis on applied settings.

**EPsy 5113. Psychology of Instruction and Technology.** (3 cr)  
Introduction to adult learning and instructional design. Application of core foundational knowledge to development of effective learning environments for adults. Topics include philosophy, learning theories, instructional models, development and experience, individual differences, evaluation, assessment, and technology.

**EPsy 5114. Psychology of Student Learning.** (3 cr; A-F only)  
Principles of educational psychology: how learning occurs, why it fails, and implications for instruction. Topics include models of learning, development, creativity, problem-solving, intelligence, character education, motivation, diversity, special populations.

**EPsy 5115. Psychology of Adult Learning and Instruction.** (3 cr)  
Survey of adult learning/instruction. Emphasizes instructional design, learning theories, experience, individual differences, evaluation, tests/measurement, technology. Implications for curricular/instructional design in higher education, continuing education, professional/business related training.

**EPsy 5117. Problem Solving and Decision Making.** (3 cr; A-F only)  
Strategies, rules, methods, and other cognitive components involved in problem solving and decision making, implications for educational practices, and applied domains.

**EPsy 5125. Psychology of Building Character, Values, and Behavior.** (3 cr; A-F only)  
New approaches to motivation, building prosocial values and behavior; how to alter values and behavior of anti-social individuals; strengths and weaknesses of traditional approaches to character education; instilling prosocial values as a way to alter negative behaviors.

**EPsy 5135. Human Relations Workshop.** (4 cr)  
Experiential course addressing issues of prejudice and discrimination in terms of history, power, and social perception. Includes knowledge and skills acquisition in cooperative learning, multicultural education, group dynamics, social influence, effective leadership, judgment and decision-making, prejudice reduction, conflict resolution.

**EPsy 5151. Cooperative Learning.** (3 cr)  
Participants learn how to use cooperative learning in their setting. Topics include theory and research, teacher's role, essential components that make cooperation work, teaching social skills, assessment procedures, and collegial teaching teams.

**EPsy 5152. Psychology of Conflict Resolution.** (3 cr)  
Overview of the field of conflict resolution. Major theories, research, major figures in the field, factors influencing quality of conflict resolution are covered. The nature of conflict, the history of field, and intrapersonal, interpersonal, intergroup conflict, negotiation, mediation are discussed.

**EPsy 5154. Organization Development and Change.** (3 cr)  
Overview of organizational development and change. Normative models of effective organizations, entry and contracting skills, diagnosis procedures and intervention procedures (data feedback, skills training, continuous improvement, mediation).

**EPsy 5155. Group Dynamics and Social Influence.** (3 cr)  
Overview of the field of group dynamics with emphasis on social influence. Major theories, research, and figures in the field are covered. Group goals, communication, leadership, decision making, problem solving, conflicts, power, uniqueness theory, deindividuation, and minority influence will be covered.

**EPsy 5156. Social and Personality Influences on Education.** (4 cr; A-F only)  
Survey of social psychology and personality applied to education. Application of major theories and research to classroom and school practices and educational issues are emphasized. Class sessions include lectures, discussions, simulations, experiential exercises. Intrapersonal, interpersonal, and group dynamics are discussed.

**EPsy 5157. Social Psychology of Education.** (3 cr; A-F only)  
Overview of social psychology and its application to education. Participants study the major theories, research, and major figures in field. Class sessions include lectures, discussions, simulations, role-plays, and experiential exercises.

**EPsy 5158. Power and Influence in Educational Settings.** (3 cr. Prereq-3xxx course in social sciences or #)  
How people can influence others and avoid manipulation. Factors that shape the extent to which influence is successful. Indirect/direct influence processes, minority influence, motivation, behavior management, conformity, followership, group dynamics, behavior management.

**EPsy 5191. Education of the Gifted and Talented.** (3 cr; A-F only)  
Theories of giftedness, talent development, instructional strategies, diversity and technological issues, implications for educational practices and psychological inquiry, and international considerations.

**EPsy 5200. Special Topics: Psychological Foundations.** (1-4 cr [max 30 cr])  
Focus on special topics in psychological and methodological concepts relevant to advanced educational theory, research, and practice not covered in other courses.

**EPsy 5216. Introduction to Research in Educational Psychology.** (3 cr; A-F only. Prereq-5261 or other intro statistics course)  
Introduction to educational research, leading students through the basic steps involved in designing and conducting a research study. Topics include reviewing literature, formulating research problem, using different approaches to gather data, managing and analyzing data, and reporting results.

**EPsy 5221. Principles of Educational and Psychological Measurement.** (4 cr. Prereq-5261 or equiv)  
Concepts, principles, and methods in educational/psychological measurement. Reliability, validity, item analysis, scores, score reports (e.g., grades). Modern measurement theories, including item response theory and generalizability theory. Emphasizes construction, interpretation, use, and evaluation of assessments regarding achievement, aptitude, interests, attitudes, personality, and exceptionality.

**EPsy 5222. Measurement and Analysis: K-12 Education Accountability.** (4 cr. Prereq-5231 or [5221, 5261] or [Psy 3305, Psy 5862] or #)  
Methods of educational accountability. Meaning of student/school accountability. Measurement of educational inputs, processes, and results. Data analysis, data use for school improvement.

**EPsy 5231. Introductory Statistics and Measurement in Education.** (4 cr. \$5261, \$5263)  
Students develop an understanding of basic statistics and measurement concepts and tools and apply them to the collection, analysis, and interpretation of data.

**EPsy 5243. Principles and Methods of Evaluation.** (3 cr)  
Introductory course in program evaluation; planning an evaluation study, collecting and analyzing information, reporting results; overview of the field of program evaluation.

**EPsy 5244. Survey Design, Sampling, and Implementation.** (3 cr. Prereq-[5221 or 5231 or 5261 or equiv], [CEHD grad student or MEd student])  
Survey methods, including mail, phone, and Web-based/email surveys. Principles of measurement, constructing questions/forms, pilot testing, sampling, data analysis, and reporting. Students develop a survey proposal and a draft survey, pilot the survey, and develop sampling/data analysis plans.

**EPsy 5246. Evaluation Colloquium: Psychological Foundations.** (1 cr [max 8 cr]; S-N only. Prereq-5243/EdPA 5501)  
Informal seminar of faculty and advanced students interested in the issues and problems of program evaluation.

**EPsy 5247. Qualitative Methods in Educational Psychology.** (3 cr. Prereq-Grad student)  
Introduction to qualitative methods of inquiry. Contrasting different research traditions (e.g., case study, phenomenology, ethnography, social interactionism, critical theory). Practice with field notes, observations, and interviewing. Use of NVIVO to track/code data.

**EPsy 5261. Introductory Statistical Methods.** (3 cr. \$5231, \$5263)  
Application of statistical concepts/procedures. Graphs, numerical summaries. Normal distribution, correlation/regression analyses, probability, statistical inferences for one or two samples. Hypothesis tests, Chi-square tests. Conceptual understanding/application of statistics.

**EPsy 5262. Intermediate Statistical Methods.** (3 cr. Prereq-5261 or equiv)  
Application of statistical concepts/procedures. Analysis of variance, covariance, multiple regression. Experimental design: completely randomized, block, split plot/repeated measures.

**EPsy 5271. Becoming a Teacher of Statistics.** (3 cr. Prereq-5261 or equiv)  
Current methods of teaching first courses in statistics. Innovative teaching methods, materials, and technological tools. Types of first courses, reform recommendations, goals for student learning, recommended content, teaching methods, technology, student assessment.

**EPsy 5281. Introduction to Computer Operations and Data Analysis in Education and Related Fields.** (3 cr; S-N only)  
Introductory computer literacy course to familiarize students with personal computers and computing resources at the University. Applications include electronic communications, spreadsheets, graphical presentation, and data analysis.

**EPsy 5300. Special Topics in Educational Psychology.** (1-9 cr [max 9 cr])  
Current issues in educational psychology or related areas not normally available through regular curriculum offerings.

**EPsy 5400. Special Topics in Counseling Psychology.** (1-4 cr [max 8 cr])  
Theory, research, and practice in counseling and student personnel psychology. Topics vary.

**EPsy 5401. Counseling Procedures.** (3 cr. Prereq-Upper div student)  
Emphasis on the counseling relationship and principles of interviewing. Case studies, role playing, and demonstration. For individuals whose professional work includes counseling and interviewing.

**EPsy 5412. Introduction to Developmental Counseling and Guidance.** (3 cr. Prereq-#)  
Contemporary models of counselors as advocates for all students. Emphasizes prevention and systems intervention with counselors involved in the

developmental guidance curriculum, school change, staff and community collaboration, individual student planning, and learning success with diverse populations.

**EPsy 5415. Child and Adolescent Development and Counseling.** (3 cr; A-F only. Prereq—Grad student or MEd student or K-12 [counseling endorsement or licensure] student)

Development, issues, and needs of children, kindergarten through high school ages. Counseling/developmental theory/strategies, family/social environment. Cultural diversity, legal/ethical issues in counseling children/adolescents.

**EPsy 5421. Leadership and Administration of Student Affairs.** (3 cr; A-F only)

Theoretical approaches, administrative structure, and evaluation methods used in college/university student affairs.

**EPsy 5422. Principles of Group Work: Theory and Procedures.** (3 cr. Prereq—Advanced undergrad or grad student in the helping professions)

Principles and practices of group work for educators and the helping professions. Discussion of various types of groups (e.g., counseling support, task, psychoeducational). Applications to various settings and populations (e.g., schools and community agencies).

**EPsy 5432. Foundations of Individual/Organizational Career Development.** (3 cr; A-F only)

Introduction to individual and organizational career development theory and practice. Examines critical issues in work patterns, work values, and workplaces in a changing global society, with implications for career planning, development, and transitions, emphasizing personal and organizational change. For nonmajors: serves students in adult ed, HRD, IR, college student advising, and other related fields.

**EPsy 5433. Counseling Women Over the Life Span.** (3 cr. Prereq—Counseling or career development course)

Counseling skills and interventions to facilitate career development of girls and women of different life stages and backgrounds (school girls to older women); developmental issues from a systematic integrative life planning framework; facts, myths, and trends regarding women's changing roles.

**EPsy 5434. Counseling Adults in Transition.** (3 cr.

Prereq—Advanced undergrad or grad student in the helping professions)

Psychological, physical, and social dimensions of adult transitions (e.g., family and personal relationships, career). Adult development theories, stress and coping, and helping skills and strategies as they relate to adult transition.

**EPsy 5451. The College Student.** (3 cr)

The psychology and sociology of college students, including research concerning diversity of populations, vocational development of students, student society, culture, mental health, underachievement, dropouts, values and attitudes, and relevant research methods.

**EPsy 5461. Cross-Cultural Counseling.** (3 cr; A-F only)

Effect of cross-cultural/cross-national psychological differences in human traits/characteristics. Framework for development/implementation of counseling interventions.

**EPsy 5601. Survey of Special Education.** (2 cr)

Introduction to programs and services provided to people with disabilities in school and community settings. Emphasis on the needs of families, to the roles and responsibilities of teachers, and to related service providers.

**EPsy 5602. Computer Technology in Special Education.** (2 cr; A-F only)

Develop skills, understand processes, and identify resources needed to utilize technology to benefit persons with disabilities. Emphasis on learning theory, principles of effective instruction, instructional and assistive technology integration.

**EPsy 5603. Childhood Language Development: Classroom Implications.** (3 cr)

Recent trends and findings in the study of language acquisition and communication; classroom implications, including education of exceptional children and implications of diversity on instruction.

**EPsy 5604. Transition From School to Work and Community Living for Persons With Special Needs.** (2 cr)

Design of training programs to promote independent living. Vocational and community adjustment for persons with disabilities and who are at-risk. Curriculum materials, methods, and organizational strategies for adolescents and adults, families, and community service providers.

**EPsy 5609. Family-Centered Services.** (2 cr; A-F only)

Methods for collaborating with families in the education of children with disabilities. Focus on family-centered approach to design of educational plans and procedures. Specific emphasis on multicultural perspectives of family life and expectations for children.

**EPsy 5612. Understanding of Academic Disabilities.** (3 cr; A-F only)

Introduction to issues related to the education of students with academic disabilities (learning disabilities, mild mental intellectual disabilities, and emotional/behavioral disabilities) including history, definition, assessment, classification, legislation, and intervention approaches.

**EPsy 5613. Foundations of Special Education I.** (3 cr; A-F only. Prereq—Child development course, 5601 or equiv)

Emphasis on the organization of educational programs and services for people with disabilities and their families. First course for students seeking to become licensed teachers in special education.

**EPsy 5614. Foundations of Special Education II.** (3 cr; A-F only. Prereq—5613)

Emphasis on assessment, planning, and implementing educational programs for people with disabilities. Second course for students seeking to become licensed teachers in special education.

**EPsy 5615. Advanced Academic Interventions.** (3 cr; A-F only. Prereq—5612)

Develop knowledge and skills in designing, implementing, and evaluating Individual Educational Plans (IEPs) for students eligible for special education service in learning disabilities, emotional/behavioral disorders, and mild mental intellectual disabilities.

**EPsy 5616. Behavior Analysis and Classroom Management.** (3 cr)

Introduction to assumptions, principles, and procedures of behavioral approach to analyzing behavior and programs for classroom management. Emphasis on specifying problems, conducting observations, intervening, and evaluating behavioral change.

**EPsy 5621. Functional/Basic Academic Interventions in Mental Retardation.** (3 cr; A-F only. Prereq—5613, 5614)

Methods and materials course emphasizing functional approaches to promoting academic learning in students with mild to moderate mental retardation and moderate to severe mental retardation.

**EPsy 5622. Programs and Curricula for Learners With Severe Disabilities.** (3 cr. Prereq—5616)

Emphasis on developing programs and curricula for students with moderate, severe, and profound developmental delays, as well as severe multihandicapping conditions. Special consideration given to preparing children and youth for integrated community environments.

**EPsy 5624. Biomedical and Physical Aspects of Developmental Disabilities.** (2 cr; A-F only)

Anatomy, physiology, and kinesiology. Central/peripheral nervous system. Prenatal, perinatal, and postnatal development. Physically disabling conditions. Management/education procedures.

**EPsy 5625. Education of Infants, Toddlers, and Preschool Children With Disabilities: Introduction.** (2 cr; A-F only)

Overview of the issues, problems, and practical applications in designing early intervention services for young children with disabilities and their families.

**EPsy 5626. Seminar: Developmental Disabilities and Instructional Management.** (3 cr. Prereq—[5621, 5622] or #)

Data-based strategies for school and nonschool instruction of learners with developmental disabilities including assessment, design, implementation, and evaluation of curriculum and instruction: curriculum content, concept and task analysis, classroom arrangements, natural and instructional cues, corrections, and consequences.

**EPsy 5635. Education of Students With Physical and Health Disabilities.** (3 cr; A-F only. Prereq—5601 or #)

Introduction to students with physical and health disabilities and their characteristics; the educational implications of physical disabilities; assessment procedures and appropriate educational interventions for learners with physical and health disabilities.

**EPsy 5636. Education of Multihandicapped Learners With Sensory Impairments.** (2 cr. Prereq—5613, 5614)

Characteristics of learners with visual and auditory impairments; design of instructional programs to remediate or circumvent disabilities, including use of prosthetic devices; related areas of performance affected by sensory impairments.

**EPsy 5641. Foundations of Education for Individuals Who Are Deaf/Hard of Hearing.** (3 cr)

Historical and current issues related to education of individuals who are deaf or hard of hearing. Implications of causes of hearing loss, social and cultural relationships, philosophies of education, characteristics and legislative guidelines and their applicability to education of individuals who are deaf or hard of hearing.

**EPsy 5642. Early Childhood Intervention for Infants, Toddlers, and Preschoolers Who Are Deaf/Hard of Hearing.** (3 cr. Prereq—Preservice teacher in deaf education licensing program or #)

Early identification/assessment. Family-centered, interdisciplinary servicing. Program development for infants, toddlers, preschoolers who are deaf/hard of hearing. Presentations, discussions, activities.

**EPsy 5644. Language Development and Programming for Deaf/Hard of Hearing Children.** (3 cr)

Comparative study of the development of functional language in communicatively disabled and nondisabled individuals. Philosophies, programs, and practices focusing on the development of language with deaf and hard of hearing individuals. Models of assessment and instruction for use in educational settings.

**EPsy 5646. Reading and Writing Practices With Deaf/Hard of Hearing Children.** (3 cr. Prereq—5644 or general educ methods in tchg reading and writing skills, or #)

Gain knowledge and skills to assess, plan, and implement instruction for children and youth with hearing loss. Emphasis is placed on research, theoretical, and programmatic issues in developing reading and writing skills, curricular adaptations, and effective instructional approaches.

**EPsy 5647. Aural and Speech Programming for Persons Who Are Deaf/Hard of Hearing.** (3 cr)

Study of the speech and hearing mechanisms, causes of hearing loss, and rehabilitation. Emphasis on instructional practices, aural rehabilitation in the educational setting, adaptive technology, and adaptations to optimize functional skills with individuals who are deaf or hard of hearing.

**EPsy 5648. Communication Systems for Children With Disabilities.** (2 cr)

Applied study of assessment, selection, and application of alternative communication strategies for infants, children, and youth with disabilities. Emphasis on children with hearing loss and additional disabilities.

**EPsy 5649. Models of Instructional Programming With Deaf and Hard of Hearing Students.** (3 cr. Prereq-[5641, 5644] or #)  
Design/development of portfolios for various models of educational service delivery systems for individuals with hearing loss. Emphasizes consultation skills, curriculum management/modifications, material/technology applications, and support service adaptations.

**EPsy 5656. Social and Interpersonal Characteristics of Students With Disabilities.** (3 cr; A-F only)  
Emphasis on children and youth of school age and on the ways in which their emotional, social, and behavioral disorders affect their functioning in school and on ways in which their behaviors disturb others.

**EPsy 5657. Interventions for Social and Emotional Disabilities.** (3 cr; A-F only. Prereq-5616, 5656)  
Developing comprehensive behavioral programs for students with social and emotional disabilities. Instructing students with social and emotional disabilities.

**EPsy 5671. Literary Braille.** (3 cr; A-F only)  
Mastery of literary braille code including all contractions and short-form words used in Grade 2 English Braille: American Usage. Use of specialized braille writing equipment including, braille writer, slate and stylus, and computer programs with six-key input.

**EPsy 5672. Advanced Braille Codes.** (2 cr; A-F only. Prereq-5671 or #)  
Mastery of the Nemeth code for braille mathematics transcription including elementary math computation, algebra, geometry, trigonometry, and symbolic logic notation. Introduction to foreign languages, computer notation, music, and raised line drawing techniques.

**EPsy 5673. Reading and Writing for Children With Visual Disabilities.** (2 cr; A-F only. Prereq-5671, CI 5414 or equiv, or #)  
Principles of preparation, selection, and use of instructional materials and adaptive technology for children with visual disabilities, including use of braille, large print, auditory tapes, and computer files to access and electronically convert information between these different media.

**EPsy 5674. Techniques of Orientation, Mobility, and Independence for Students With Visual Disabilities.** (3 cr; A-F only. Prereq-5675 or #)  
Introduction to basic techniques to gain skills in pre-cane techniques, orientation to learning environments, and adaptations for activities of daily living and independence. Introduction to mobility maps, consideration of cane, guide dog, and telescopic aids to mobility.

**EPsy 5675. Structure and Function of the Eye: Educational Implications.** (3 cr; A-F only)  
Anatomy and physiology of the eye and its relation to visual perception. Educational considerations for students with low vision studied in relation to ophthalmological and optometric evaluations and functional vision assessment.

**EPsy 5676. Case Management for Children With Visual Disabilities.** (3 cr; A-F only. Prereq-5671, 5673, 5675)  
Advanced course evaluating and managing cognitive, psychosocial, physical, and academic needs of students. Consideration of parent, teacher, and student in counseling and educational program management.

**EPsy 5681. Education of Infants, Toddlers, and Preschool Children With Disabilities: Methods and Materials.** (3 cr; A-F only. Prereq-5625)  
Overview of the methods and materials available to maximize the developmental and educational outcomes for young children, birth to age 5, with disabilities and their families in home, community, and school based-settings.

**EPsy 5701. Practicum: Field Experience in Special Education.** (1-6 cr [max 12 cr]; A-F only. Prereq-[5614, [FOE or SpEd grad or licensure student]] or #)  
Observations and supervised support of teaching practice in schools or agencies serving children with disabilities in integrated programs.

**EPsy 5720. Special Topics: Special Education.** (1-4 cr [max 12 cr]. Prereq-#)  
Lab and fieldwork approach, often assuming a product orientation, e.g., generation of action plan, creating set of observation field notes, collecting data in some form. Provides opportunities for educational personnel to study specific problems and possibilities related to special education.

**EPsy 5740. Special Topics: Interventions and Practices in Educational and Human Service Programs.** (1-4 cr [max 8 cr]. Prereq-#)  
Concepts, issues, and practices related to the community inclusion of children, youth, and adults with developmental disabilities through weekly seminar and extensive supervised experience working with individuals within the community.

**EPsy 5751. Student Teaching: Deaf/Hard of Hearing.** (1-6 cr [max 10 cr]. Prereq-#)  
Students participate in educational programming for infants, children, and youth who are deaf or hard of hearing, as well as in onsite, directed experiences under the supervision of master teachers of deaf and hard of hearing students.

**EPsy 5752. Student Teaching: Learning Disabilities.** (1-6 cr [max 10 cr]; S-N only. Prereq-#)  
Supervised experience in teaching or related work in schools or other agencies serving children and adolescents with learning disabilities.

**EPsy 5753. Student Teaching: Early Childhood Special Education.** (1-6 cr [max 8 cr]; S-N only. Prereq-#; completion of all course requirements for license in ECSE)  
Supervised experience in teaching or related work in schools, agencies, or home settings with infants, toddlers, and preschoolers with disabilities and their families.

**EPsy 5754. Student Teaching: Social and Emotional Disabilities.** (1-6 cr [max 8 cr]; A-F only. Prereq-Completion of all licensure courses for social and emotional disorders; #)  
Teach students with social and emotional disorders at public schools and other appropriate sites. Attend a weekly seminar on student teaching competencies.

**EPsy 5755. Student Teaching: Developmental Disabilities, Mild/Moderate.** (1-6 cr [max 6 cr]; A-F only. Prereq-Completion of all licensure coursework, #)  
Supervised student teaching, or special practicum project, in schools or other agencies serving students at elementary/secondary levels who have mild to moderate developmental disabilities.

**EPsy 5756. Student Teaching: Developmental Disabilities, Moderate/Severe.** (1-6 cr [max 6 cr]; A-F only. Prereq-Completion of all licensure coursework, #)  
Supervised student teaching, or special practicum projects, in schools or other agencies serving students at elementary/secondary levels who have moderate to severe developmental disabilities.

**EPsy 5757. Student Teaching: Physical and Health Related Disabilities.** (1-6 cr [max 8 cr]; A-F only. Prereq-#)  
Supervised student teaching and related work (direct instruction and consultation) in schools or other agencies serving children and adolescents who have physical disabilities.

**EPsy 5758. Student Teaching: Visual Impairments.** (1-6 cr [max 8 cr]; A-F only. Prereq-#)  
Supervised student teaching, or special practicum project, in schools or other agencies serving children and adolescents who have visual impairments.

**EPsy 5800. Special Topics in School Psychology.** (1-9 cr [max 9 cr])  
Current issues in school psychology or areas not normally available through regular curriculum offerings.

**EPsy 5801. Assessment and Decision Making in School and Community Settings.** (3 cr; A-F only)  
Introduction to psychological and educational assessment for individuals who work with children, especially those experiencing academic and behavior

problems. Study of standardized group and individual tests of intelligence, achievement, socio-emotional functioning, perception, reading, mathematics, adaptive behavior, and language.

**EPsy 5849. Observation and Assessment of the Preschool Child.** (3 cr)  
Introduction to assessment principles and practices, including observational assessment methods, for children (birth to 5). Intended primarily for teachers in training and others interested in basic information regarding assessment and its relationship to intervention services for young children.

**EPsy 5851. Collaborative Family-School Relationships.** (2-3 cr. Prereq-Honors senior class or grad student)  
Theoretical and empirical bases for creating collaborative family-school relationships for students' development and educational success in school. Emphasis on model programs for K-12 and practical strategies for educational personnel to address National Educational goal 8.

**EPsy 5852. Prevention and Early Intervention.** (3 cr)  
Theory/research base for school-based primary/secondary programs to promote academic/social competence of children/youth (birth to grade 12).

**EPsy 5871. Interdisciplinary Practice and Interagency Coordination in Education and Human Services.** (3 cr)  
Principles and procedures of interdisciplinary practice and interagency coordination. Examine the relative strengths of interdisciplinary approaches, develop skills for collaborating with others, and examine different approaches to interagency coordination.

**EPsy 5991. Independent Study in Educational Psychology.** (1-8 cr [max 20 cr]; A-F only. Prereq-#)  
Self-directed study in areas not covered by regular courses. Specific program of study is jointly determined by student and advising faculty member.

**EPsy 8111. Seminar: Knowledge and Skill.** (3 cr; A-F only. Prereq-Learning and cognition courses)  
Analysis of expertise in human problem solving; representation of knowledge and skill; issues in human and artificial intelligence; semantic memory; processes of acquisition; research in cognitive science useful for educational practice; design of educational environments.

**EPsy 8114. Seminar: Cognition and Learning.** (3 cr)  
Advanced study in critical analysis and application of contemporary psychological theory and research in cognition and learning for education.

**EPsy 8115. Psychology of Instruction and Technology.** (3 cr)  
Seminar including, but not limited to, learning and instructional theories, advanced and emerging technologies, and measurement and evaluation.

**EPsy 8116. Reading for Meaning: Cognitive Processes in the Comprehension of Texts.** (3 cr. Prereq-#)  
Students read primary articles on cognitive processes involved in reading comprehension. Focuses on inference making during reading and on construction of a coherent memory representation. Computational models, neurological processes, developmental/individual differences, effects of text genre (e.g., expository, narrative).

**EPsy 8117. Writing Empirical Paper and Research/Grant Proposals in Education and Psychology.** (3 cr. Prereq-#)  
Scientific writing skills. Focuses on logic/argumentation. Each student produces an empirical paper or research proposal. Breaks down the writing process into components: one component per week. Each week, students write a section of their paper/proposal and critique others.

**EPsy 8131. Development of Moral-Political Judgment.** (3 cr; A-F only)  
Current research topics in socio-political moral judgment and moral development.

**EPsy 8132. Personality Development and Socialization.**

(3 cr. Prereq–Personality or child psych course)

Major research and theoretical work. Developmental and educational influences on personality.

**EPsy 8216. Seminar: Research Processes in Psychological Foundations of Education.**

(3 cr; A-F only. Prereq–[5216, admitted to doctoral program in psych foundations] or #)

Advanced examination of research processes in educational psychology. Invited faculty discuss specific research designs. Students refine/implement research projects and present them in class.

**EPsy 8221. Psychological Scaling.**

(3 cr. Prereq–5221 or equiv, 8261–8262 or equiv)  
Elementary and advanced topics in unidimensional and multidimensional scaling: measurement theory and statistics, rating scales and other category scaling methods, magnitude estimation, paired comparisons, multi-attribute scaling, and multidimensional scaling.

**EPsy 8222. Advanced Measurement: Theory and Application.**

(4 cr. Prereq–[5221 or Psy 5862 or equiv], [8261 or 8262 or equiv])  
Generalizability theory, item response theory, factor models for test items, binomial model. Application to problems of designing, linking assessments. Includes a computer lab.

**EPsy 8261. Statistical Methods I: Probability and Inference.**

(3 cr. Prereq–[5261 or equiv], grad student)  
Advanced theory, derivations of quantitative statistics. Descriptive statistics, probability, normal distribution. One-/two-sample hypothesis tests, confidence intervals. Chi square tests. One-way analysis of variance, follow up tests.

**EPsy 8262. Statistical Methods II: Regression and the General Linear Model.**

(3 cr. Prereq–8261 or equiv)  
Analysis of variance designs (two-/three-way), repeated measures, correlation, simple/multiple regression methods, non-parametric procedures, multivariate analyses.

**EPsy 8263. Design and Analysis of Experiments.**

(3 cr. Prereq–8261, 8262 or equiv)  
Advanced treatment of various experimental designs, including completely randomized factorial, randomized block, hierarchical, repeated measures, and Latin square designs. Major computer packages used for data analyses. Univariate and multivariate approaches to these designs.

**EPsy 8264. Advanced Multiple Regression Analysis.**

(3 cr. Prereq–8261–8262, regression and ANOVA course, familiarity with a statistical analysis package)  
General linear model used as a context for regression. Matrix algebra, multiple regression, path analysis, polynomial regression, standardized regression, stepwise solutions, analysis of variance, weighted least squares, and logistic regression.

**EPsy 8265. Factor Analysis.**

(3 cr. Prereq–8262, familiarity with a statistical analysis package)  
Factor analytic techniques and applications. Component, common factor, and image analysis; general discussion of factor extraction. Estimating number of dimensions, rotation, and factor score estimation.

**EPsy 8266. Statistical Analysis Using Structural Equation Methods.**

(3 cr. Prereq–8263 or 8264)  
Quantitative techniques using manifest and latent variable approaches for analysis of educational and social science data. Introduction to structural equation modeling approaches to multiple regression, factor analysis, and path modeling. Developing, estimating, and interpreting structural equation models.

**EPsy 8281. Advanced Statistical Computing and Data Analysis.**

(3 cr. Prereq–5261 or equiv, 5281 or equiv)  
Cross-disciplinary course. Students learn to use SAS statistical package to perform data management, data analysis, and report writing.

**EPsy 8290. Special Topics: Seminar in Psychological Foundations.**

(1–6 cr [max 15 cr]. Prereq–#)  
Students formulate research designs. Learning and cognition, social psychology, measurement, and statistics.

**EPsy 8295. Problems: Evaluation.**

(1–6 cr [max 6 cr]. Prereq–5243 or EdPA 5501; #)  
Individually directed study of an issue in the theory or practice of program evaluation.

**EPsy 8296. Internship: Evaluation.**

(1–9 cr [max 9 cr]. Prereq–5243 or EdPA 5501; #)  
Hands-on experience in conducting a program evaluation in a real-world setting under supervision of an evaluation professional.

**EPsy 8300. Special Topics in Educational Psychology.**

(1–4 cr [max 9 cr])  
Issues or related coursework in areas not normally available through regular curriculum offerings.

**EPsy 8333. FTE: Master's.**

(1 cr; NGA. Prereq–Master's student, adviser and DGS consent)

**EPsy 8400. Topics: Counseling and Student Personnel Psychology.**

(1–3 cr [max 9 cr])  
Current issues in counseling and student personnel psychology, or related coursework in areas not normally available through regular curriculum offerings.

**EPsy 8402. Individual Counseling: Theory and Applications.**

(3 cr; A-F only. Prereq–Grad ed psy major with CSPP subprog or #)  
Traditional and contemporary theories of counseling and psychotherapy. Applications to various settings and populations.

**EPsy 8403. Social/Cultural Contexts: Counseling and Skills.**

(3 cr; A-F only. Prereq–Grad ed psy major with CSPP subprog or #)  
Broad personal dimensions of race, ethnicity, gender, class, beliefs, disability, age, sexual orientation, and geographic origin. Societal and personal biases and stereotypes; multicultural concepts and culturally appropriate counseling procedures.

**EPsy 8404. Group Counseling: Theory, Applications, and Skills.**

(3 cr; A-F only. Prereq–Ed psy MA or PhD student with CSPP subprog or #)  
Theories, research, and procedures of group counseling and of groups such as psychoeducational groups. Applications to various settings and populations. Ethical issues in group work. Practice of group skills and techniques, including group participation and observation.

**EPsy 8405. Career Development: Theory, Skills, and Counseling Applications.**

(3 cr; A-F only. Prereq–CSPP)  
Career development theory/practice over life span. Emphasizes career counseling for individuals/organizations, systems approaches to career programs in education/business. Traditional/contemporary theories/practices.

**EPsy 8411. Advanced Counseling Research.**

(4 cr; A-F only. Prereq–Ed psy PhD student with CSPP subprog or #)  
Focus on critically reviewing counseling research, qualitatively and quantitatively integrating research, and designing valid research.

**EPsy 8412. Seminar: Advanced Counseling Theory and Ethics.**

(4 cr; A-F only. Prereq–Ed psy PhD student with CSPP subprog or #)  
Comparative analysis of theoretical models and methods used in contemporary counseling and psychotherapy; ethical standards and models of ethical decision making for professional roles.

**EPsy 8413. Personality Assessment of Adolescents and Adults.**

(3 cr; A-F only. Prereq–[[Psy 5604H or Psy 8111 or Psy 8112], ed psy grad student] or #)  
Psychological assessment of adolescents/adults. Assessment interviews, MMPI-2, MMPI-A, DSM4, written assessment reports.

**EPsy 8431. Master's Research Seminar: CSPP.**

(4 cr; A-F only. Prereq–5261 or equiv, 5221 or equiv, ed psy MA student with CSPP subprog or #)  
Survey of research methods, data-based decision making, basic research design skills, and research simulation.

**EPsy 8435. Organization of School Counseling Comprehensive Programs.**

(3–6 cr [max 6 cr]; A-F only. Prereq–CSPP grad student in school counselor prog or #)  
Integrates learning from all courses in MA program with research in comprehensive guidance programming. Critiques of research, analyses of current trends/issues. Theories of management/organization in educational and other service settings. Literature review of comprehensive guidance programs. Students develop/demonstrate knowledge of comprehensive school counseling programming in K–12 school settings.

**EPsy 8436. Crisis Management and Consulting in School Counseling.**

(3 cr; A-F only. Prereq–CSPP grad student in school counselor program or #)  
Issues, topics, problems. Diversity in school counseling. Review, discussion, and analysis of current literature. Students develop prevention, intervention, and guidance programs for K–12 schools.

**EPsy 8444. FTE: Doctoral.**

(1 cr; NGA. Prereq–Doctoral student, adviser and DGS consent)

**EPsy 8452. Psychological Aspects of Counseling Supervision.**

(3 cr. Prereq–Ed psy PhD student with CSPP subprog or #)  
Theories, review of relevant research, demonstration, and in-class practice of supervision skills.

**EPsy 8501. Counseling Pre-Practicum.**

(3 cr; A-F only. Prereq–[CSPP or genetic counseling] grad student)  
Overview of basic helping skills through demonstration, in-class practice.

**EPsy 8502. Field Placement in Counseling and Student Personnel Psychology.**

(2 cr; S-N only. Prereq–8501 or #)  
Students participate under supervision in practitioner activities within a counseling work environment.

**EPsy 8503. Counseling Practicum I.**

(1–4 cr; A-F only. Prereq–8502 or #)  
Beginning-level supervised practice in counseling with individuals and groups; emphasizes systematic evaluation of student's counseling practice through direct observations, video, and audio tapes.

**EPsy 8504. Counseling Practicum II.**

(1–4 cr; A-F only. Prereq–8503 or #)  
Intermediate supervised practice in counseling with individuals and groups; emphasizes ethical issues with systematic evaluation of student's practice through direct observations, video, and audio tapes.

**EPsy 8509. Supervision Practicum: CSPP.**

(2 cr. Prereq–[Ed psy PhD student with CSPP subprog] or #)  
Students involved in counseling supervision of beginning courses.

**EPsy 8512. Internship: CSPP.**

(1–6 cr [max 12 cr]; A-F only. Prereq–Ed psy MA or PhD student with CSPP subprog)  
Supervised internship in counseling, counseling psychology, or student personnel psychology at sites approved by CSPP program.

**EPsy 8513. University Counseling Practicum I.**

(4 cr; S-N only. Prereq–Ed psy MA or PhD student with CSPP subprog or #)  
Integrates science of counseling psychology with supervised practice in University Counseling and Consulting Services with career, academic, and personal clients.

**EPsy 8514. University Counseling Practicum II.**

(4 cr; S-N only. Prereq–8513, #)  
Integrates science of counseling psychology with supervised practice in University Counseling and Consulting Services with career, academic, and personal clients.

**EPsy 8521. Practicum in Student Affairs and Student Development.**

(1–4 cr [max 8 cr]; A-F only. Prereq–Ed psy MA or PhD student with CSPP subprog or #)  
Supervised practice in university and college student development offices.

**EPsy 8522. Counseling Practicum: Advanced.** (3 cr [max 9 cr]. Prereq—Grad ed psy major with CSPP subprog) or #)

Advanced skills practicum in counseling, counseling psychology, or student development.

**EPsy 8600. Special Topics: Special Education Issues.** (1-3 cr [max 9 cr])

Current trends (e.g., school-wide discipline, models of collaboration, and diversity) investigated by formulating research projects. Students write a media piece describing an issue and its impact on the community.

**EPsy 8612. Seminar: Students With Academic Difficulties.** (3 cr; A-F only)

Survey, analysis, and application of relevant theories and research related to current issues. Students in course develop skills in scholarly inquiry, writing, and debate.

**EPsy 8621. Seminar on Intellectual Impairments.** (3 cr. Prereq—Grad students interested in mental retardation and related intellectual impairments)

Review of research and theories in context of relevant developmental theories; important contributions in primary sources concerning principles of cognition and behavior and applied problems. Procedures for deriving appropriate field applications; generalizing and implementing researchable questions.

**EPsy 8651. Seminar on Social and Emotional Disabilities.** (3 cr; A-F only)

Review and critical analysis of current trends and future directions of education of students with social and emotional disabilities.

**EPsy 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**EPsy 8677. Seminar: Information Acquisition for Persons With Disabilities.** (3 cr [max 6 cr]; A-F only)

Research findings from diverse disciplines on impact of hearing and visual disabilities on ability to acquire and/or access information.

**EPsy 8694. Research in Special Education.** (3 cr)

Design and implementation of research related to the unique developmental characteristics of exceptional learners.

**EPsy 8701. Doctoral Core Seminar: Special Education I.** (3 cr [max 6 cr]; A-F only. Prereq—Ed psy PhD student with spec ed subprog or #)

Required for students with a family/life span focus on social development, behavioral interaction, and cultural interactions.

**EPsy 8702. Doctoral Core Seminar: Special Education II.** (3 cr [max 6 cr]; A-F only. Prereq—8701 or #)

Required for students focusing on communication/language/academics.

**EPsy 8706. Single Case Designs in Intervention Research.** (3 cr)

Design and analysis of single-case experiments to examine effects of interventions on individual behavior in school, home, and community.

**EPsy 8772. Seminar in Early Intervention.** (2 cr)

Explores research from diverse disciplines related to education of infants, toddlers, and preschool children with disabilities and their families. Discusses practical application of this research.

**EPsy 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**EPsy 8800. Special Topics in School Psychology.** (1-4 cr [max 9 cr])

Issues or related coursework in areas not normally available through regular curriculum offerings.

**EPsy 8811. Assessment in School Psychology I: Foundations of Academic Assessment.** (3 cr; A-F only. Prereq—Grad ed psy major with school psy subprog or #)

Theories and models of psychoeducational assessment of children and adolescents within home, school, and community. Conceptual and empirical foundations of

eco-behavioral assessment that lead to efficient but comprehensive assessment of children presented from problem-solving perspective.

**EPsy 8812. Assessment in School Psychology II: Intellectual and Social-Emotional Domains.** (3 cr; A-F only. Prereq—Grad ed psy major with school psy subprog or #)

Builds on EPsy 8811. Emphasizes gathering data on a child's intellectual and social-emotional functioning and educational progress.

**EPsy 8813. Assessment Practicum in School Psychology.** (2 cr [max 4 cr]; A-F only. Prereq—8821, grad ed psy major with school psy subprog or #, #8811 or #8812)

Students administer, score, and interpret standardized tests of intellectual, adaptive, and social-emotional assessment, and assess educational progress using both formal and informal instructional assessment strategies. All measures complement other facets of assessment presented in 8811 and 8812.

**EPsy 8815. Systemic Intervention and Consultation.** (3 cr; A-F only)

Principles/models of consultation/interventions for social-emotional problems exhibited by school-aged children. Emphasizes universal intervention, competence enhancement approaches. All interventions presented from a system-level perspective.

**EPsy 8816. Individual Intervention and Consultation.** (3 cr; A-F only)

In-depth study/analysis of instructional interventions/procedures necessary to work with school personnel in developing school-wide, classroom, individual instructional interventions. Practice in developing/ applying interventions with individual students.

**EPsy 8818. Intervention Practicum in School Psychology.** (1 cr [max 2 cr]; A-F only. Prereq—Grad ed psy major with school psy subprog, #8815 or #8816)

Students design, implement, and evaluate interventions for individuals or groups of children and for system-level concerns under supervision of practicing school psychologists. Students observe school psychologists collaborate with educators and parents in intervention-related activities.

**EPsy 8821. Issues in School Psychology.** (2 cr [max 4 cr]; A-F only. Prereq—EPsy grad student with SchIPsy subprog)

School psychology as professional field of specialization in psychology/education. Historical, theoretical, and research basis of school psychology. How school systems operate. Common roles/functions of school psychologists. In-class discussion, didactic/field-based assignments.

**EPsy 8822. Seminar on Research in School Psychology.** (1 cr [max 2 cr]; S-N only. Prereq—Grad ed psy major with school psy subprog or #)

Integrative, developmental series of discussions and activities related to research in school psychology and related disciplines; assists students preparing written research and scholarly works. Students from other programs are welcome.

**EPsy 8823. Ethics and Professional Standards in School Psychology.** (2 cr; A-F only. Prereq—8821)

Ethics, law, and current educational issues applied to study/practice of school psychology. Ethical principles, state/federal laws governing educational practices. How mandates are applied to work of school psychologists in general/special populations (e.g., special education, ESL, ethnic/racial minorities). Students apply learning as researchers and practicing school psychologists in schools.

**EPsy 8831. Practicum: School Psychological Services.** (1-3 cr [max 6 cr]. Prereq—Grad ed psy major with school psy subprog)

Field placements in schools. Experiences may include consultation, assessment, direct service to individuals or groups, and report writing. Supervised on-site as well as by University through required participation in seminar.

**EPsy 8832. Clinical/Community Practice in School Psychology.** (1-3 cr [max 6 cr]. Prereq—Grad ed psy major with school psy subprog)

Supervised experience in assessment and intervention planning of children referred to psychoeducational settings; training in broad range of approaches to problems of adjustment in school-age children and their families, schools, and community settings.

**EPsy 8841. Practicum: Instruction and Supervision in School Psychology.** (2 cr [max 4 cr]; A-F only. Prereq—Grad ed psy major with school psy subprog or #)

Review of best practice literature and strategies for evaluating supervision skills. Students give lectures to and supervise school psychology students in order to learn firsthand the issues related to providing supervision and to understand responsibilities related to academic careers.

**EPsy 8842. Internship: School Psychological Services.** (1-10 cr [max 10 cr]; S-N only. Prereq—Grad ed psy major with school psy subprog, #)

Advanced field placement. Full-time supervised experience for one year or part-time for no more than two years.

**EPsy 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

**EPsy 8905. History and Systems of Psychology: Landmark Issues in Educational Psychology.** (3 cr. Prereq—Ed psy PhD student)

Critical issues in learning and cognition, statistics and measurement, counseling, school psychology, social psychology of education, and special education.

**EPsy 8993. Directed Study: Educational Psychology.** (1-10 cr [max 20 cr]; A-F only. Prereq—#)

Arranged independently with individual faculty members.

**EPsy 8994. Research Problems: Educational Psychology.** (1-6 cr [max 18 cr]; A-F only. Prereq—#)

Research methodology, techniques, and literature. Students participate in formulating/executing research proposal.

## Electrical Engineering (EE)

*Department of Electrical and Computer Engineering  
Institute of Technology*

**EE 5121. Transistor Device Modeling for Circuit Simulation.** (3 cr. Prereq—[3115, 3161] or #)

Basics of MOS, bipolar theory. Evolution of popular device models from early SPICE models to current industry standards.

**EE 5141. Integrated Sensors and Transducers.** (4 cr. Prereq—3161, 3601)

Microelectromechanical systems composed of microsensors, microactuators, and electronics integrated onto common substrate. Design, fabrication, and operation principles. Labs on micromachining, photolithography, etching, thin film deposition, metallization, packaging, and device characterization.

**EE 5163. Semiconductor Properties and Devices I.** (3 cr. Prereq—3161, 3601 or #)

Principles and properties of semiconductor devices. Selected topics in semiconductor materials, statistics, and transport. Aspects of transport in p-n junctions, heterojunctions.

**EE 5164. Semiconductor Properties and Devices II.** (3 cr. Prereq—5163 or #)

Principles and properties of semiconductor devices. Charge control in different FETs, transport, modeling. Bipolar transistor models (Ebers-Moll, Gummel-Poon), heterostructure bipolar transistors. Special devices.

**EE 5171. Microelectronic Fabrication.** (4 cr. Prereq—IT sr or grad)

Fabrication of microelectronic devices; silicon integrated circuits, GaAs devices; lithography, oxidation, diffusion; process integration of various technologies, including CMOS, double poly bipolar, and GaAs MESFET.

**EE 5173. Basic Microelectronics Laboratory.** (1 cr. Prereq—5171 or ¶5171)

Students fabricate a polysilicon gate, single-layer metal, NMOS chip, performing 80 percent of processing, including photolithography, diffusion, oxidation, and etching. In-process measurement results are compared with final electrical test results. Simple circuits are used to estimate technology performance.

**EE 5231. Linear Systems and Optimal Control.** (3 cr. Prereq—IT grad, 3015 or #)

Properties and modeling of linear systems; linear quadratic and linear-quadratic-Gaussian regulators; maximum principle.

**EE 5235. Robust Control System Design.** (3 cr. Prereq—IT grad, 3015, 5231 or #)

Development of control system design ideas; frequency response techniques in design of single-input/single-output (and MI/MO) systems. Robust control concepts. CAD tools.

**EE 5301. VLSI Design Automation I.** (3 cr. Prereq—2301 or #)

Basic graph/numerical algorithms. Algorithms for logic/high-level synthesis. Simulation algorithms at logic/circuit level. Physical-design algorithms.

**EE 5302. VLSI Design Automation II.** (3 cr. Prereq—5301 or #)

Basic algorithms, computational complexity. High-level synthesis. Test generation. Power estimation. Timing optimization. Current topics.

**EE 5323. VLSI Design I.** (3 cr. Prereq—[2301, 3115] or #)

Combinational static CMOS circuits. Transmission gate networks. Clocking strategies, sequential circuits. CMOS process flows, design rules, structured layout techniques. Dynamic circuits, including Domino CMOS and DCVS. Performance analysis, design optimization, device sizing.

**EE 5324. VLSI Design II.** (3 cr. Prereq—5323 or #)

CMOS arithmetic logic units, high-speed carry chains, fast CMOS multipliers. High-speed performance parallel shifters. CMOS memory cells, array structures, read/write circuits. Design for testability, including scan design and built-in self test. VLSI case studies.

**EE 5327. VLSI Design Laboratory.** (3 cr. Prereq—[4301, 5323 or ¶5323] or #)

Complete design of an integrated circuit. Designs evaluated by computer simulation.

**EE 5329. VLSI Digital Signal Processing Systems.** (3 cr. Prereq—5323 or ¶5323 or #)

Programmable architectures for signal/media processing. Data-flow representation. Architecture transformations. Low-power design. Architectures for two's complement/redundant representation, carry-save, and canonic signed digit. Scheduling/allocation for high-level synthesis.

**EE 5333. Analog Integrated Circuit Design.** (3 cr. Prereq—[3115, grad student] or #)

Fundamental circuits for analog signal processing. Design issues associated with MOS/BJT devices. Design/testing of circuits. Selected topics (e.g., modeling of basic IC components, design of operational amplifier or comparator or analog sampled-data circuit filter).

**EE 5361. Computer Architecture and Machine Organization.** (3 cr. §CSci 5201. Prereq—2301, 2361)

Introduction to computer architecture. Aspects of computer systems, such as pipelining, memory hierarchy, and input/output systems. Performance metrics. Examination of each component of a complicated computer system.

**EE 5371. Computer Systems Performance Measurement and Evaluation.** (3 cr. §5863.

Prereq—4364 or 5361 or CSci 4203 or 5201 or #) Tools/techniques for analyzing computer hardware, software, and system performance. Benchmark programs, measurement tools, performance metrics. Deterministic/probabilistic simulation techniques, random number generation/testing. Bottleneck analysis.

**EE 5381. Telecommunications Networks.** (3 cr. Prereq—[4501, 5531] or #)

Fundamental concepts of modern telecommunications networks, mathematical tools required for their performance analysis. Layered network architecture, point-to-point protocols/links, delay models, multiaccess communication/routing.

**EE 5391. Computing With Neural Networks.** (3 cr. Prereq—3025 or Stat 3091 or #)

Neural networks as a computational model; connections to AI, statistics and model-based computation; associative memory and matrix computation; Hopfield networks; supervised networks for classification and prediction; unsupervised networks for data reduction; associative recognition and retrieval, optimization, time series prediction and knowledge extraction.

**EE 5501. Digital Communication.** (3 cr. Prereq—4501, 3025, sr or grad in IT major or #)

Theory and techniques of modern digital communications. Communication limits; modulation and detection; data transmission over channels with intersymbol interference; optimal and suboptimal sequence detection; equalization. Error correction coding; trellis-coded modulation; multiple access.

**EE 5505. Wireless Communication.** (3 cr. Prereq—4501, [IT grad student or #]; 5501 recommended)

Introduction to wireless communication systems. Propagation modeling, digital communication over fading channels, diversity and spread spectrum techniques, radio mobile cellular systems design, performance evaluation. Current European, North American, and Japanese wireless networks.

**EE 5531. Probability and Stochastic Processes.** (3 cr. Prereq—3025, grad in IT major or #)

Probability, random variables and random processes. System response to random inputs. Gaussian, Markov and other processes for modeling and engineering applications. Correlation and spectral analysis. Basic estimation principles. Examples from digital communications and computer networks.

**EE 5542. Adaptive Digital Signal Processing.** (3 cr. Prereq—[4541, 5531] or #)

Design, application, and implementation of optimum/adaptive discrete-time FIR/IIR filters. Wiener, Kalman, and Least-Squares. Linear prediction. Lattice structure. LMS, RLS, and Levinson-Durbin algorithms. Channel equalization, system identification, biomedical/sensor array processing, spectrum estimation. Noise cancellation applications.

**EE 5545. Real-Time Digital Signal Processing Laboratory.** (2 cr. Prereq—4541)

Lab. Real-time computation of digital signal processing (DSP) functions, including filtering, sample-rate change, and differential pulse code modulation; implementation on a current DSP chip. DSP chip architecture, assembly language, arithmetic; real-time processing issues; processor limitations; I/O handling.

**EE 5549. Digital Signal Processing Structures for VLSI.** (3 cr. Prereq—4541)

Pipelining; parallel processing; fast convolution; FIR, rank-order, IIR, lattice, adaptive digital filters; scaling and roundoff noise; DCT; Viterbi coders; lossless coders, video compression.

**EE 5551. Multiscale and Multirate Signal Processing.** (3 cr. Prereq—4541, 5531, grad in IT major or #)

Multirate discrete-time systems. Bases, frames; continuous wavelet transform; scaling equations; discrete wavelet transform; applications in signal and image processing.

**EE 5581. Information Theory and Coding.** (3 cr. Prereq—5531 or #)

Source and channel models, codes for sources and channels. Entropy, mutual information, capacity, rate-distortion functions. Coding theorems.

**EE 5585. Data Compression.** (3 cr. Prereq—IT sr or grad or #)

Source coding in digital communications and recording; codes for lossless compression; universal lossless codes; lossless image compression; scalar and vector quantizer design; loss source coding theory; differential coding, trellis codes, transform and subband coding; analysis/synthesis schemes.

**EE 5601. Introduction to RF/Microwave Engineering.** (3 cr. Prereq—4601, [IT sr or grad])

Fundamentals of EM theory and transmission lines concepts. Transmission lines and network analysis. CAD tool. Lumped circuit component designs. Passive circuit components. Connectivity to central communication theme.

**EE 5602. RF/Microwave Circuit Design.** (3 cr. Prereq—5601 or equiv)

Transmission lines, network analysis concepts. CAD tools for passive/active designs. Diode based circuit designs (detectors, frequency multipliers, mixers). Transistor based circuit design (amplifiers, oscillators, mixer/doubler).

**EE 5607. Wireless Hardware System Design.** (3 cr. Prereq—3015, 3115, 3601)

Review of random processes, noise, modulation, and error probabilities. Basis antenna operation, power transfer between antennas, rf propagation phenomena, transmitters/receivers, transmission lines, effect of antenna performance on system performance, rf/microwave device technologies, small-signal amplifiers, mixers, power amplifiers, rf oscillators.

**EE 5611. Plasma-Aided Manufacturing.** (4 cr. §ME 5361. Prereq—Grad or upper div IT, ME 3321, ME 3322 or equiv)

Manufacturing using plasma processes; plasma properties as a processing medium; plasma spraying, welding and microelectronics processing; process control and system design; industrial speakers; a cross-disciplinary experience between heat transfer design issues and manufacturing technology.

**EE 5613. RF/Microwave Circuit Design Laboratory.** (2 cr. Prereq—5601)

Scattering parameters, planar lumped circuits, transmission lines, RF/microwave substrate materials, matching networks/tuning elements, resonators, filters, combiners/dividers, couplers. Integral lab.

**EE 5616. Antenna Theory and Design.** (3 cr. Prereq—5601 or concurrent registration in 5601)

Antenna performance parameters, vector potential/radiation integral, wire antenna structures, broadband antenna structures, microstrips/aperture theory, antenna measurements.

**EE 5621. Physical Optics.** (3 cr. Prereq—3015 or #)

Physical optics principles, including Fourier analysis of optical systems and images, scalar diffraction theory, interferometry, and coherence theory. Applications discussed include diffractive optical elements, holography, astronomical imaging, optical information processing, and microoptics.

**EE 5622. Physical Optics Laboratory.** (1 cr. Prereq—5621 or ¶5621)

Fundamental optical techniques. Diffraction and optical pattern recognition. Spatial and temporal coherence. Interferometry. Speckle. Coherent and incoherent imaging. Coherent image processing. Fiber Optics.

**EE 5624. Optical Electronics.** (4 cr. Prereq—3601 or Phys 3002 or #)

Fundamentals of lasers, including propagation of Gaussian beams, optical resonators, and theory of laser oscillation. Polarization optics, electro-optic, acousto-optic modulation, nonlinear optics, and phase conjugation.

- EE 5627. Optical Fiber Communication.** (3 cr. Prereq-3015, 3601 or #)  
Components and systems aspects of optical fiber communication. Modes of optical fibers. Signal degradation and dispersion. Optical sources and detectors. Digital and analog transmissions systems. Direct detection and coherent detection. Optical amplifiers. Optical soliton propagation.
- EE 5629. Optical System Design.** (2 cr. Prereq-IT sr or grad)  
Elementary or paraxial optics. Non-paraxial, exact ray tracing. Energy considerations in instrument design. Fourier optics and image quality. Design examples: telescopes, microscopes, diffraction-limited lenses, projectors, and scientific instruments.
- EE 5632. Photonic Communication Devices and Systems.** (3 cr. Prereq-5163 or 5624 or equiv or #)  
Primary solid-state components using optical communication systems. Semiconductor lasers, detectors, and optical fibers. Basic optoelectronic properties of III-V semiconductors: band structure, optical transitions, heterostructures. LEDs, semiconductor lasers, detectors. Optical network components/systems: fibers, amplifiers, power, system architectures.
- EE 5653. Physical Principles of Magnetic Materials.** (3 cr. Prereq-IT grad or #)  
Physics of diamagnetism, paramagnetism, ferromagnetism, antiferromagnetism, ferrimagnetism; ferromagnetic phenomena; static and dynamic theory of micromagnetics, magneto-optics, and magnetization dynamics; magnetic material applications.
- EE 5655. Magnetic Recording.** (3 cr. Prereq-IT grad or #)  
Magnetic fundamentals, recording materials, idealized models of magnetic records/reproduction, analytic models of magnetic record heads, sinusoidal magnetic recording, digital magnetic recording, magnetic recording heads/media, digital recording systems.
- EE 5657. Physical Principles of Thin Film Technology.** (4 cr. Prereq-IT sr or grad student or #)  
Physical principles of deposition, characterization, and processing of thin film materials. Materials science, vacuum science, and technology. Physical vapor deposition techniques. Properties of thin films and metallurgical/protective coatings. Modification of surface films. Emerging thin film materials/applications. Lab. Demonstration experiments.
- EE 5657W. Physical Principles of Thin Film Technology.** (4 cr. Prereq-IT sr or grad student or #)  
Physical principles of deposition, characterization, and processing of thin film materials. Materials science, vacuum science, and technology. Physical vapor deposition techniques. Properties of thin films and metallurgical/protective coatings. Modification of surface films. Emerging thin film materials/applications. Lab. Demonstration experiments.
- EE 5705. Advanced Electric Drives.** (3 cr. Prereq-4701)  
D-q axis analysis of salient-pole synchronous motor drives; vector-controlled induction motor drives, sensor-less drives, voltage space-vector modulation techniques, current-source inverter drives, reluctance drives; power quality issues. Integrated software lab.
- EE 5721. Power Generation Operation and Control.** (3 cr. Prereq-4721)  
Engineering aspects of power system operation; economic analysis of generation plants and scheduling to minimize total cost of operation; scheduling of hydro resources and thermal plants with limited fuel supplies; loss analysis and secure operation; state estimation and optimal power flow; power system organizations.
- EE 5725. Power Systems Engineering.** (3 cr. Prereq-4721)  
Reliability analysis of large power generation and transmission systems; writing programs for state-by-state analysis and Monte Carlo analysis; power system protection systems, circuit current calculations, short circuit detection, isolating faulted components; characteristics of protection components.
- EE 5741. Advanced Power Electronics.** (3 cr. Prereq-4741)  
Physics of solid-state power devices, passive components, magnetic optimization, advanced topologies. Unity power factor correction circuits, EMI issues, snubbers, soft switching in dc/ac converters. Practical considerations. Very low voltage output converters. Integrated computer simulations.
- EE 5811. Biomedical Instrumentation.** (3 cr. Prereq-IT sr or life-science sr or grad student)  
Biological signal sources. Electrodes, microelectrodes, other transducers. Characteristics of amplifiers. Noise in biological signals. Filtering, recording, display. Protection of patients from electrical hazards. Experiments in neural/muscle stimulation, EKG/EMG recording, neuron simulation, filtering, and low-noise amplifiers.
- EE 5821. Biological System Modeling and Analysis.** (3 cr. Prereq-IT sr or life science sr or grad)  
Purpose of biological system modeling; advantages, limitations, special problems. Models of nerve excitation and propagation. Biological control systems; respiratory and cardiovascular systems. Sensory organs and theories of perception. Limbs and locomotion.
- EE 5863. Computer Systems Performance Analysis.** (2 cr. \$5371. Prereq-4363 or 5361 or #)  
Basic performance measurement/simulation techniques necessary for experimental computer science/engineering. Hands-on performance evaluation techniques using simulations/measurements of existing systems. Using measured data to compare computer systems or to judge how much a new architectural feature improves systems performance.
- EE 5940. Special Topics in Electrical Engineering I.** (1-4 cr. Prereq-#)  
Special topics in electrical and computer engineering. Topics vary.
- EE 5950. Special Topics in Electrical Engineering II.** (1-4 cr. Prereq-#)  
Special topics in electrical and computer engineering. Topics vary.
- EE 5960. Special Topics in Electrical Engineering III.** (1-4 cr. Prereq-#)  
Special topics in electrical and computer engineering. Topics vary.
- EE 5990. Curricular Practical Training.** (1-2 cr [max 6 cr]; S-N only. Prereq-#)  
Industrial work assignment involving advanced electrical engineering technology. Review by faculty member. Final report covering work assignment.
- EE 8141. Advanced Heterojunction Transistors.** (3 cr. Prereq-5664 or #)  
Recent developments in device modeling with emphasis on bipolar junction transistors. High-level effects in base and collector regions and their interrelationship.
- EE 8161. Properties of Semiconductors I.** (3 cr. Prereq-#)  
Modern solid-state theory applied to specific semiconductor materials; influence of band structure and scattering mechanisms upon semiconductor properties; plasma effects in semiconductors; mathematical treatments of generation-recombination kinetics, carrier injection, drift, and diffusion; use of semiconductor properties in devices of current importance.
- EE 8162. Properties of Semiconductors II.** (3 cr. Prereq-8161 or #)  
Modern solid-state theory applied to specific semiconductor materials; influence of band structure and scattering mechanisms upon semiconductor properties; plasma effects in semiconductors; mathematical treatments of generation-recombination kinetics, carrier injection, drift and diffusion; use of semiconductor properties in devices of current importance.
- EE 8163. Quantum Electronics.** (3 cr; A-F only. Prereq-5632 or #)  
Quantum theory of light/laser systems. Planck's radiation law, Einstein's coefficients. Quantum mechanics of atom-radiation interaction. Quantized radiation field. Interaction of quantized field with atoms. Generation/amplification of light. Nonlinear optics. Specific laser systems. Semiconductor lasers.
- EE 8190. Electronics Seminar.** (1 cr [max 3 cr]; S-N only. Prereq-#)  
Current literature, individual assignments.
- EE 8210. System Theory Seminar.** (1 cr [max 3 cr]; S-N only)  
Current literature, individual assignments.
- EE 8213. Advanced System Theory.** (3 cr. Prereq-IT grad student, #)  
Generalized linear systems; applications, structural properties, computational approaches, classification, functional behavior, and synthesis.
- EE 8215. Nonlinear Systems.** (3 cr. Prereq-#)  
Current topics in stability analysis of nonlinear systems, design of controllers for nonlinear systems, discrete-time and stochastic nonlinear systems.
- EE 8230. Control Theory Seminar.** (1 cr [max 3 cr]; S-N only)  
Current literature, individual assignments.
- EE 8231. Optimization Theory.** (3 cr. Prereq-#)  
Introduction to optimization in engineering; approximation theory. Least squares estimation, optimal control theory, and computational approaches.
- EE 8235. Advanced Control Topics.** (3 cr. Prereq-#)  
Adaptive and learning systems, optimal and robust control and stabilization, and stability of dynamic systems.
- EE 8301. Advanced Topics in Design Automation.** (3 cr; A-F only)  
Advanced topics in state-of-the-art automated design tools used for electronic system design. Topics vary.
- EE 8331. CMOS Data Converters: A/D and D/A.** (3 cr; A-F only. Prereq-5333)  
Data converters, low power low voltage analog circuits. Basic background in design of CMOS analog-to-digital and digital-to-analog converters. Special circuit design techniques for low power design. Students design/test several design problems.
- EE 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)
- EE 8337. Analog Circuits for Wire/Wireless Communications.** (3 cr; A-F only. Prereq-5333)  
Basic background, advanced design concepts necessary to design integrated CMOS RF circuits. Emphasizes CMOS and RF. Where appropriate, mention is made of bipolar circuits and applications to other communications areas.
- EE 8360. Computer Systems Seminar.** (1 cr [max 3 cr]; S-N only)  
Current literature, individual assignments.
- EE 8365. Advanced Computer Architecture.** (3 cr. \$CSci 8203. Prereq-5361 or CSci 5201 or #)  
Instruction set architecture, processor microarchitecture, and memory and I/O systems. Interactions between computer software and hardware; methodologies of computer design.
- EE 8367. Parallel Machine Organization.** (3 cr. \$CSci 8367. Prereq-5364 or CSci 5204)  
Design/implementation of multiprocessor systems. Parallel machine organization, system design. Differences between parallel, uniprocessor machines. Programming models. Synchronization/communication. Topologies, message routing strategies. Performance optimization techniques. Compiler, system software issues.
- EE 8370. Computer Aided Design Seminar.** (1 cr [max 3 cr]; S-N only. Prereq-[EE or CompE or CSci] grad major or #)  
Current literature, individual assignments.

**EE 8444. FTE: Doctoral.** (1 cr; NGA. Prereq–Doctoral student, adviser and DGS consent)

**EE 8500. Seminar: Communications.** (1 cr [max 3 cr]; S-N only)  
Current literature, individual assignments.

**EE 8541. Image Processing and Applications.** (3 cr. Prereq–4541, 5581 or #)  
Two-dimensional digital filtering and transforms; application to image enhancement, restoration, compression, and segmentation.

**EE 8581. Detection and Estimation Theory.** (3 cr. Prereq–5531 or #)  
Risk theory approach to detection and estimation, random process representation, signal parameter estimation. Waveform estimation; detection of phase, frequency, and delay in signals. Applications to communications and radar-sonar signal design and processing.

**EE 8591. Predictive Learning from Data.** (3 cr. Prereq–IT grad student or #)  
Basic elements and application areas of artificial intelligence (AI) related to design and implementation of expert systems (ES). Knowledge representation, reasoning under uncertainty, ES and their environment, planning, natural language processing (NLP), intelligent computer-aided instruction (ICAI), and AI tools (software and hardware).

**EE 8601. Advanced Electromagnetic Theory.** (3 cr; A-F only. Prereq–4601 or equiv)  
Aspects of electromagnetic theory. Review of introductory material. Scattering theory, geometric theory of diffraction, integral equation methods, Green's functions.

**EE 8610. Seminar: Electronics, Fields, and Photonics.** (1 cr [max 3 cr]; S-N only. Prereq–EE grad major or #)  
Students are assigned readings from current literature and make individual presentations to class. From time to time outside speakers present research papers.

**EE 8611. Plasma Physics.** (3 cr. Prereq–#)  
Plasma theory and charged particle transport phenomena: collision processes, orbit theory, kinetic theory, Boltzmann transport equation, moment (continuity) equations, magnetohydrodynamics, transport properties. Applications of plasma theory to modeling of dc, rf, and microwave discharges.

**EE 8660. Seminar: Magnetics.** (1 cr [max 3 cr]; S-N only)  
Current literature, individual assignments.

**EE 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq–Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**EE 8725. Advanced Power System Analysis and Economics.** (3 cr. Prereq–4721, IT grad student or #)  
Solving sets of equations that involve large sparse matrices. Sparse matrix storage, ordering schemes, application to power flow, short circuit calculation, optimal power flow, and state estimation.

**EE 8741. Power Electronics in Power Systems.** (3 cr. Prereq–4741, IT grad student or #)  
Impact of power electronics loads on power quality. Passive and active filters. Active input current wave shaping. HVDC transmission. Static VAR control, energy storage systems. Interconnecting photovoltaic and wind generators. Static phase shifters and circuit breakers for flexible AC transmission (FACTS).

**EE 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq–Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**EE 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer; 24 cr required)

**EE 8940. Special Investigations.** (1-3 cr. Prereq–1-3 cr [may be repeated for cr]; IT grad student or #)  
Studies of approved theoretical or experimental topics.

**EE 8950. Advanced Topics in Electrical and Computer Engineering.** (1-3 cr [max 12 cr]. Prereq–Cr ar [may be repeated for cr]; #)  
Topics vary according to needs and staff availability.

**EE 8961. Plan B Project I.** (3 cr. Prereq–Grad EE or CompE major)  
Project topic(s) arranged between student and adviser. Written report(s).

**EE 8963. Plan B Project II.** (1-2 cr. Prereq–EE grad student; may be taken to satisfy requirement for Plan B master's degree, may appear on master's program but may not be applied toward minimum cr in major field, no cr toward PhD)  
Project topic(s) arranged between student and adviser. Written report(s).

**EE 8970. Graduate Seminar I.** (1 cr [max 3 cr]; S-N only. Prereq–Grad student)  
Recent developments in electrical engineering, related disciplines.

**EE 8980. Graduate Seminar II.** (1 cr [max 3 cr]; S-N only)  
Recent developments in electrical engineering, related disciplines.

## English: Creative and Professional Writing (EngW)

*Department of English Language and Literature  
College of Liberal Arts*

**EngW 5102. Advanced Fiction Writing.** (4 cr [max 8 cr]. Prereq–Δ)  
Advanced workshop for graduate students with considerable experience in writing fiction.

**EngW 5103. Advanced Fiction Writing.** (4 cr [max 8 cr]. Prereq–Δ)  
Advanced workshop for students with considerable experience in writing fiction.

**EngW 5104. Advanced Poetry Writing.** (4 cr [max 8 cr]. Prereq–Δ)  
Advanced workshop for graduate students with considerable experience in writing poetry. An opportunity to explore new poetic possibilities and to read widely in contemporary poetry and poetics.

**EngW 5105. Advanced Poetry Writing.** (4 cr [max 8 cr]. Prereq–Δ)  
Advanced workshop for students with considerable experience in writing poetry. An opportunity to explore new poetic possibilities and to read widely in contemporary poetry and poetics.

**EngW 5106. Advanced Literary Nonfiction Writing.** (4 cr [max 8 cr]. Prereq–Δ)  
Advanced workshop for graduate students with considerable experience in writing literary nonfiction.

**EngW 5107. Advanced Nonfiction Writing.** (4 cr [max 16 cr]. Prereq–Δ)  
Advanced workshop for students with considerable experience in writing literary nonfiction.

**EngW 5110. Topics in Advanced Fiction Writing.** (4 cr [max 16 cr]. Prereq–Δ)  
Special topics in fiction writing. Topics specified in *Class Schedule*.

**EngW 5120. Topics in Advanced Poetry.** (4 cr [max 16 cr]. Prereq–Δ)  
Special topics in poetry writing. Topics specified in *Class Schedule*.

**EngW 5130. Topics in Advanced Creative Writing.** (4 cr [max 16 cr]. Prereq–#)  
Workshop. Might include work in more than one genre.

**EngW 5201. Journal and Memoir Writing.** (3 cr)  
Using memory in writing, from brainstorming to drafting to revising, in several genres (poems, traditional memoir essays, fiction). How diverse cultures shape memory differently.

**EngW 5202. Journal and Memoir Writing.** (3 cr)  
Using memory in writing, from brainstorming to drafting to revision, in several genres (poems, traditional memoir essays, fiction). How diverse cultures shape memory differently.

**EngW 5204. Playwriting.** (4 cr [max 8 cr]. Prereq–[Jr or sr], one EngW 3xxx course, Δ [permission number available in creative writing office])  
Advanced workshop. Contact creative writing program for specific description.

**EngW 5205. Screenwriting.** (4 cr. Prereq–[Jr or sr], one EngW 3xxx course, Δ [permission number available in creative writing office])  
Advanced workshop. Contact creative writing program for specific description.

**EngW 5210. Topics in Advanced Literary Nonfiction.** (4 cr [max 16 cr]. Prereq–Δ)  
Special topics in essay writing (e.g., arts reviewing, writing about public affairs, writing in personal voice). Topics specified in *Class Schedule*.

**EngW 5310. Reading as Writers.** (4 cr [max 8 cr]. Prereq–Grad student, Δ)  
Special topics in reading fiction, literary nonfiction, poetry. Topics specified in *Class Schedule*.

**EngW 5501. Minnesota Writing Project Selective Institute.** (1-3 cr [max 3 cr]. Prereq–Competitive selection for 20 educators [K-college])  
Emphasizes participants' teaching each other best practices in writing instruction. Participants attend a retreat before beginning.

**EngW 5502. Minnesota Writing Project Open Institute.** (2 cr. Prereq–Teacher [K-college], [school district sponsorship or MWP approval])  
Summer workshop to refine skills in writing instruction.

**EngW 5570. Minnesota Writing Project Directed Studies.** (1-3 cr [max 3 cr]; A-F only)  
Current theories of writing and writing pedagogy. Topics vary. Workshop.

**EngW 5606. Literary Aspects of Journalism.** (3 cr; A-F only. \$Jour 5606)  
Literary aspects of journalism as exemplified in and influenced by works of English/American writers past/present. Lectures, discussions, weekly papers.

**EngW 5993. Directed Study in Writing.** (1-4 cr [max 18 cr]. Prereq–#, Δ, □)  
Projects in writing poetry, fiction, drama, and nonfiction, or study of ways to improve writing.

**EngW 8101. Reading Across Genres.** (4 cr; S-N only. Prereq–Creative writing MFA student, Δ)  
Contemporary writing in fiction, poetry, and creative nonfiction. Primarily a reading course rather than a writing course.

**EngW 8110. Seminar: Writing of Fiction.** (4 cr [max 16 cr]. Prereq–Δ)  
Focuses on full-length book (e.g., novel, short story collection). Assignments in common. Individual project.

**EngW 8120. Seminar: Writing of Poetry.** (4 cr [max 8 cr]. Prereq–Δ)  
Focuses on exploration and practice of various styles. Assignments in common and individual project.

**EngW 8130. Seminar: Writing of Literary Nonfiction.** (4 cr [max 8 cr]. Prereq–Δ)  
Advanced workshop. Assignments in common and individual projects.

**EngW 8140. Fiction: Manuscript Preparation.** (4 cr [max 8 cr]. Prereq–8110, creative writing MFA student, #)  
For students working on their creative project.

**EngW 8150. Poetry: Manuscript Preparation.** (4 cr [max 8 cr]. Prereq–8120, creative writing MFA student, #)  
For students working on their creative project.

**EngW 8160. Literary Nonfiction: Manuscript Preparation.** (4 cr [max 8 cr]. Prereq–8130, creative writing MFA student, #)  
For students working on their creative project.

**EngW 8170. Mixed Genre: Manuscript Preparation.** (4 cr [max 8 cr]. Prereq–8130, creative writing MFA student, #)  
Students work on their creative project.

**EngW 8310. Topics in Creative Writing.** (4 cr [max 8 cr]. Prereq–[English or creative writing] grad major or Δ)  
Special topics in fiction, literary nonfiction, poetry. Topics specified in *Class Schedule*.

**EngW 8333. FTE: Master's.** (1 cr; NGA. Prereq–Master's student, adviser and DGS consent)

**EngW 8990. MFA Creative Thesis.** (2-8 cr [max 48 cr]. Prereq–8140, 8150, 8160, creative writing MFA student, #)  
For students working on their creative project.

## English: Literature (EngL)

*Department of English Language and Literature*  
*College of Liberal Arts*

**EngL 5001. Introduction to Methods in Literary Studies.** (3 cr. Prereq–Grad or #)  
Ends/methods of literary research, including professional literary criticism, analytical bibliography, and textual criticism.

**EngL 5002. Introduction to Literary and Cultural Theory.** (3 cr. Prereq–Grad or #)  
Approaches to practical/theoretical problems of literary history/genre.

**EngL 5030. Readings in Drama.** (3 cr [max 9 cr]. \$5330. Prereq–Grad student or #)  
Wide reading in literature of a given period or subject. Prepares students for work in other courses/seminars. Relevant scholarship/criticism. Topics specified in *Class Schedule*.

**EngL 5090. Readings in Special Subjects.** (3-4 cr [max 9 cr]. \$5100. Prereq–Grad student or #)  
General background preparation for advanced study. Diverse selection of literatures written in English, usually bridging national cultures and time periods. Readings specified in *Class Schedule*.

**EngL 5100. Readings in Special Subjects.** (3-4 cr [max 9 cr]. Prereq–Grad student or #)  
General background preparation for advanced study. Diverse selection of literatures written in English, usually bridging national cultures and time periods. Readings specified in *Class Schedule*.

**EngL 5110. Readings in Middle English Literature and Culture.** (3 cr [max 9 cr]. \$5210. Prereq–Grad student or #)  
Wide reading in literature of period. Relevant scholarship/criticism. Topics vary. See *Class Schedule*.

**EngL 5121. Readings in Early Modern Literature and Culture.** (3 cr [max 9 cr]. \$5230. Prereq–Grad student or #)  
Topical readings in early modern poetry, prose, fiction, and drama. Attention to relevant scholarship or criticism. Preparation for work in other courses or seminars.

**EngL 5130. Readings in American Minority Literature.** (3 cr [max 9 cr]. Prereq–Grad or #)  
Contextual readings of 19th-/20th-century American minority writers. Topics specified in *Class Schedule*.

**EngL 5151. Readings in 19th-Century Literature and Culture.** (3 cr [max 9 cr]. \$5250. Prereq–Grad student or #)  
Topics may include British Romantic or Victorian literatures, American literature, important writers from a particular literary school, a genre (e.g., the novel). Readings.

**EngL 5170. Readings in 20th-Century Literature and Culture.** (3 cr [max 9 cr]. \$5270; Prereq–Grad student or #)  
British, Irish, or American literatures, or topics involving literatures of two nations. Focuses either on a few important writers from a particular literary school or on a genre (e.g., drama). Topics specified in *Class Schedule*.

**EngL 5180. Readings in Contemporary Literature and Culture.** (3 cr. \$5291. Prereq–Grad student or #)  
Multi-genre reading in contemporary American, British, Anglophone literature. Relevant scholarship/criticism. Topics vary. See *Class Schedule*.

**EngL 5200. Readings in American Literature.** (3 cr [max 9 cr]. \$5120. Prereq–Grad student or #)  
General background/preparation for advanced graduate study. Readings cover either a wide historical range (e.g., 19th century), a genre (e.g., the novel), or a major literary movement (e.g., Modernism).

**EngL 5300. Readings in American Minority Literature.** (3 cr [max 9 cr]. \$5130. Prereq–Grad student or #)  
Contextual readings of 19th-/20th-century American minority writers. Topics specified in *Class Schedule*.

**EngL 5400. Readings in Post-Colonial Literature.** (3 cr [max 9 cr]. \$5140. Prereq–Grad student or #)  
Topics specified in *Class Schedule*.

**EngL 5510. Readings in Criticism and Theory.** (3 cr [max 9 cr]. \$5150. Prereq–Grad student or #)  
Major works of classical criticism in the English critical tradition from Renaissance to 1920. Leading theories of criticism from 1920 to present. Theories of fiction, narratology. Feminist criticisms. Marxist criticisms. Psychoanalytic criticisms. Theories of postmodernism.

**EngL 5593. The Afro-American Novel.** (3 cr)  
Contextual readings of 19th-/20th-century black novelists, including Chesnut, Hurston, Wright, Baldwin, Petry, Morrison, and Reed.

**EngL 5597. Harlem Renaissance.** (3 cr. \$Afr 5597)  
Multidisciplinary review of Jazz Age's Harlem Renaissance: literature, popular culture, visual arts, political journalism, major black/white figures.

**EngL 5602. Gender and the English Language.** (3 cr. Prereq–Grad student or #)  
Introduction to features of English that are gender-marked or gender-biased. Connections between language theory and social structures, including class and ethnicity. Patterns of women's/men's speech in specific social contexts. Gender and writing. Sociolinguistics and sexual orientation.

**EngL 5603. World Englishes.** (3 cr. Prereq–Grad student or #)  
Historical background, psychosocial significance, and linguistic characteristics of diverging varieties of English spoken around world, especially in postcolonial contexts (Caribbean, Africa, Asia). Development of local standards/vernaculars. Sociolinguistic methods of analysis.

**EngL 5605. Social Variation in American English.** (3 cr. Prereq–Grad student or #)  
Description/analysis of English language variation from sociohistorical perspective in the United States and the Caribbean. Social history of voluntary/enforced migrations leading to development of regional/rural dialects, pidgins, creoles, and urban varieties.

**EngL 5612. Old English I.** (3 cr. \$3612. Prereq–Grad student or #)  
Introduction to the language through A.D. 1150. Anglo-Saxon culture. Selected readings in prose/poetry.

**EngL 5613. Old English II.** (3 cr. \$3613. Prereq–[[3612 or 5612], grad student] or #)  
Critical reading of texts, introduction to versification. Reading of Beowulf.

**EngL 5621. Modern Irish Language I.** (4 cr. Prereq–Grad student or #)  
Grammatical structures of modern Irish dialect of Connemara, Co. Galway. Development of oral/written language skills: vocabulary, manipulation of grammatical structures, speaking, listening, reading, writing. Modern Gaelic culture.

**EngL 5622. Modern Irish Language II.** (5 cr. Prereq–5621 or #)  
Grammatical structures of modern Irish dialect. Development of oral/written language skills: vocabulary, manipulation of grammatical structures, speaking, listening, reading, writing. Modern Gaelic culture.

**EngL 5690. Minnesota Writing Project: Directed Studies.** (1-3 cr [max 30 cr]. Prereq–#)  
Workshops. Theories of writing and writing pedagogy. Writing for publication. Research topics in applied literacy.

**EngL 5711. Introduction to Editing.** (4 cr. \$5401)  
Editor-writer relationship, manuscript reading, author querying, rewriting, style. Some discussion of copy editing. Students develop editing skills by working on varied writing samples.

**EngL 5712. Advanced Editing.** (4 cr. \$5402. Prereq–5401, Δ)  
Editing long text. Fiction, children's literature, translations, indexes. Workshop/seminar.

**EngL 5742. Theories of Writing and Instruction.** (3 cr. \$5630. Prereq–Grad student or #)  
Introduction to major theories that inform teaching of writing in college and upper-level high school curriculums. Topics specified in *Class Schedule*.

**EngL 5743. History of Rhetoric and Writing.** (3 cr. \$5631. Prereq–Grad student or #)  
Assumptions of classical/contemporary rhetorical theory, especially as they influence interdisciplinary field of composition studies.

**EngL 5790. Topics in Rhetoric, Composition, and Language.** (3 cr. \$5650. Prereq–Grad student or #)  
Topics specified in *Class Schedule*.

**EngL 5800. Practicum in the Teaching of English.** (2 cr [max 9 cr]; S-N only. Prereq–Grad student or #)  
Discussion of and practice in recitation, lecture, small-groups, tutoring, individual conferences, and evaluation of writing/reading. Emphasizes theory informing effective course design/teaching for different disciplinary goals. Topics vary. See *Class Schedule*.

**EngL 5805. Writing for Publication.** (3 cr. \$8621. Prereq–Grad student in Engl or #)  
Conference presentations, book reviews, revision of seminar papers for journal publication, and preparation of a scholarly monograph. Style, goals, and politics of journal and university press editors/readers. Electronic publication. Professional concerns.

**EngL 5992. Directed Readings, Study, or Research.** (1-15 cr [max 15 cr]. Prereq–#, □)

**EngL 8110. Seminar in Medieval Literature and Culture.** (3 cr [max 12 cr])  
Sample topics: Chaucer; “Piers Plowman”; Middle English literature, 1300-1475; medieval literary theory; literature/class in 14th-century; texts/heresies in late Middle Ages.

**EngL 8120. Seminar in Early Modern Literature and Culture.** (3 cr [max 12 cr]; A-F only. Prereq–Engl major or grad student or #)  
British writers/topics, from Reformation to French Revolution. In first half of period (which divides at 1640), a typical topic is Spenser and epic tradition; in second half, women historians before Wollstonecraft.

**EngL 8150. Seminar in Shakespeare.** (3 cr [max 9 cr]. Prereq–Engl major or grad student or #)  
Perspectives/works vary with offering and instructor's emphases. Characteristically on text, performance, interpretation, criticism, feminism, intellectual history. Recent topics: Shakespeare at comedy, “Elegy by W.S.” (Is it Shakespeare's?), Roman political tragedies. Topics specified in *Class Schedule*.

**EngL 8170. Seminar in 19th-Century British Literature and Culture.** (3 cr [max 12 cr]. Prereq–Engl major or grad student or #)  
Advanced study in 19th-century British literature/culture. Sample topics: Romantic poetry, Victorian poetry, Englishness in Victorian novel, Victorian cultural criticism, text/image in 19th-century British culture. Topics specified in *Class Schedule*.

**Engl 8180. Seminar in 20th-Century British Literature and Culture.** (3 cr [max 12 cr]; A-F only. Prereq–Grad student or #)  
Sample topics: modernism, Bloomsbury Group, working-class/immigrant literature. Topics specified in *Class Schedule*.

**Engl 8190. Seminar in 20th-Century Anglophone Literatures and Cultures.** (3 cr [max 12 cr]. Prereq–Grad student in Engl or #)

Topics in Anglophone literatures of Canada, Africa, the Caribbean, India and Pakistan, and the Pacific. Sample topics: Stuart Hall and Black Britain; Salman Rushdie and cosmopolitan literatures; national literatures and partitioned states. Topics specified in *Class Schedule*.

**Engl 8200. Seminar in American Literature.** (3 cr [max 12 cr]. Prereq–Grad student in Engl or #)

American literary history. Sample topics: first American novels, film, contemporary short stories and poetry, American Renaissance, Cold War fiction, history of the book. Topics specified in *Class Schedule*.

**Engl 8290. Topics, Figures, and Themes in American Literature.** (3 cr [max 12 cr]. Prereq–Grad student in Engl or #)

Sample topics: Dickinson, 19th-century imperialism, Faulkner, San Francisco poets, humor, Chaplin, Hitchcock, and popular culture. Topics specified in *Class Schedule*.

**Engl 8300. Seminar in American Minority Literature.** (3 cr [max 12 cr]. Prereq–Grad student in Engl or #)

Sample topics: Harlem Renaissance, ethnic autobiographies, Black Arts movement. Topics specified in *Class Schedule*.

**Engl 8333. FTE: Master's.** (1 cr; NGA. Prereq–Master's student, adviser and DGS consent)

**Engl 8400. Seminar in Post-Colonial Literature, Culture, and Theory.** (3 cr [max 12 cr]. Prereq–Grad student in Engl or #)

Sample topics: Marxism and nationalism; modern India; feminism and decolonization; "the Empire Writes Back"; Islam and the West. Topics specified in *Class Schedule*.

**Engl 8444. FTE: Doctoral.** (1 cr; NGA. Prereq–Doctoral student, adviser and DGS consent)

**Engl 8510. Seminar in Criticism and Theory.** (3 cr [max 12 cr]. Prereq–Grad student in English or #)

Developments within critical theory that have affected literary criticism, either by altering conceptions of its object ("literature") or by challenging conceptions of critical practice. Topics specified in *Class Schedule*.

**Engl 8520. Seminar in Cultural Theory and Practice.** (3 cr [max 12 cr]. Prereq–Grad student in Engl or #)

Content varies, might focus on a body of theory/use. Sample topics: semiotics applied to perspective paintings, numbers, and money; analysis of a particular set of cultural practices by applying various theories to them.

**Engl 8530. Seminar in Feminist Criticism.** (3 cr [max 12 cr]. Prereq–Grad student in Engl or #)

Brief history of feminist criticism, in-depth treatment of contemporary perspectives/issues. Topics specified in *Class Schedule*.

**Engl 8600. Seminar in Language, Rhetoric, Literacy, and Composition.** (3 cr [max 9 cr]. Prereq–Grad student)

Students read/conduct research on theories/literature relevant to cross-disciplinary fields committed to writing and to teaching writing.

**Engl 8610. Seminar in Language and Discourse Studies.** (3 cr [max 12 cr]. Prereq–Grad student in Engl or #)

Current theoretical/methodological issues in discourse analysis. Social/psychological determinants of language choice (class, ethnicity, gender) in various English-speaking societies. Application to case studies, review of scholarship.

**Engl 8621. Writing for Publication.** (3 cr. Prereq–Grad student in Engl or #)

Conference presentations, book reviews, revision of seminar papers for journal publication, and preparation of a scholarly monograph. Style, goals, and politics of journal and university press editors/readers. Electronic publication. Professional concerns.

**Engl 8625. Dissertation Seminar.** (3 cr. Prereq–[PhD student, passed prelim exams] or #)

Bridges gap between taking coursework for preliminary examination and writing the dissertation. Conceptualizing the dissertation (using model of Graduate School doctoral Dissertation Fellowship application). Producing a draft of a chapter. Students work with faculty mentors (e.g., advisers, members of their committees) and peer writing groups to develop research/writing strategies.

**Engl 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq–Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Engl 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer; 24 cr required)

**Engl 8910. Seminar in Special Subjects.** (3 cr [max 12 cr]. Prereq–Grad student in Engl or #)

Sample topics: literature of World War II, writings of the Holocaust, literature of English Civil War, advanced versification.

**Engl 8992. Directed Reading in Language, Literature, Culture, Rhetoric, Composition, or Creative Writing.** (1-9 cr [max 15 cr]. Prereq–#, Δ)

## English: Writing, Rhetoric, and Language (EngC)

Department of English Language and Literature  
College of Liberal Arts

**EngC 5051. Graduate Research Writing Practice for Non-native Speakers of English.** (3 cr. Prereq–Grad student)

Graduate-level writing techniques/formats for summaries, critiques, research, and abstracts. Persuasion, documentation, structure, grammar, vocabulary, field-specific requirements. Writing through several drafts, using mentor in specific field of study. Revising/editing to meet graduate standards. Discussions.

**EngC 5052. Graduate Research Presentations and Conference Writing for Non-Native Speakers of English.** (3 cr. Prereq–[5051, grad student, non-native speaker of English] or #)

Practice in writing/presenting graduate-level research for conferences or professional seminars. Delivery of professional academic presentations to U.S. audiences. Conference abstract, paper, and poster presentation. Communication in research process. Students select topics from their own research/studies. Format, style, transitions, topic narrowing, non-verbal presentation skills.

## Entomology (Ent)

Department of Entomology  
College of Agricultural, Food and Environmental Sciences

**Ent 5011. Insect Structure and Function.** (4 cr; A-F only. Prereq–3005 or #)

Comparative study of insect structures/functions from evolutionary perspective. Introduction to physiology of digestion, respiration, other organ systems.

**Ent 5021. Insect Taxonomy and Phylogeny.** (4 cr. Prereq–3001 or equiv)

Identification of families of adult insects; evolution and classification of insects; techniques of collecting and curating insects; principles of phylogeny reconstruction.

**Ent 5031. Insect Physiology.** (2 cr; A-F only. Prereq–5011, biochem course or #)

Essential processes of insects. Nerve and muscle mechanisms, energy metabolism, respiration, nutrition and digestion, excretion, regulation and interactions of processes, sensory mechanisms, and behavior. Reproductive behavior, embryology, and postembryonic development of insects.

**Ent 5041. Insect Ecology.** (3 cr. Prereq–Biol 5041 or EBB 5122 or #; offered fall 1998 and alt yrs)

Synthetic analysis of the causes of insect diversity and of fluctuations in insect abundance. Focus on abiotic, biotic, and evolutionary mechanisms influencing insect populations and communities.

**Ent 5051. Scientific Illustration of Insects.** (3 cr) Traditional/computer-assisted techniques of scientific illustration. Emphasizes insects. Pencil, pen/ink, color (water color, acrylics, colored pencil). Vector/raster illustration using Adobe Illustrator and Adobe Photoshop. Digital photography, microscopy, photomontage, traditional/electronic publication.

**Ent 5211. Insect Pest Management.** (3 cr. Prereq–3005 or #)

Prevention or suppression of injurious insects by integrating multiple control tactics, e.g., chemical, biological, cultural. Strategies to optimize the dynamic integration of control methodologies in context of their economic, environmental, and social consequences.

**Ent 5241. Ecological Risk Assessment.** (3 cr. Prereq–#)

Evaluating current/potential impact of physical, chemical, biological agents on ecosystems. Identifying ecological stressors, assessing level of exposure, measuring ecological responses, communicating/managing risks. Class participation, two reaction papers, final exam, small-group project.

**Ent 5275. Medical Entomology.** (3 cr. Prereq–3005 or #; offered 1998 and alt yrs)

Biology of arthropod vectors of human disease. Emphasis on disease transmission and host, vector, and pathogen interactions.

**Ent 5311. Sampling Biological Populations.** (3 cr. Prereq–Stat 5021 or equiv)

Sampling plans for study of field/lab populations. Statistical distributions/techniques for detecting/coping with aggregation. Randomization, required sample size, optimal allocation for common probability design. Sequential plans for making decisions.

**Ent 5321. Ecology of Agricultural Systems.** (3 cr; A-F only. \$Agro 5321. Prereq–[[3xxx or above] course in [Agro or AnSc or Hort], [3xxx or above] course in [Ent or PIPa or Soil]] or #)

Ecological approach to problems in agricultural systems. Formal methodologies of systems inquiry are developed/applied.

**Ent 5341. Biological Control of Insects and Weeds.** (3-4 cr; A-F only. Prereq–3001, Biol 1009, EEB 3001 or grad)

Biological control of arthropod pests and weeds. Analysis of relevant ecological theory and case studies; biological control agents. Lab includes natural enemy identification, short experiments, and computer exercises.

**Ent 5351. Insect Pathology.** (2 cr. Prereq–5011)

Major pathogenic microorganisms that cause diseases in insects. Routes of infection of insects. Lab propagation of disease agents. Factors in application of disease to pest insect control. Safety considerations.

**Ent 5361. Aquatic Insects.** (4 cr [max 8 cr]; A-F only. Prereq–#)

Taxonomy, natural history of aquatic insects including their importance in aquatic ecology, water resource management, recreation, and conservation.

Emphasizes family-level identification of immatures/adults. Field trips scheduled to local aquatic habitats. A collection is required.

**Ent 5371. Principles of Systematics.** (3 cr. Prereq-#; offered alt yrs)  
Theoretical/practical procedures of biological systematics. Phylogeny reconstruction, including computer assisted analyses, morphological/molecular approaches, species concepts, speciation, comparative methods, classification, historical biogeography, nomenclature. Use/value of museums.

**Ent 5381. Lepidopterozoology.** (2-3 cr. Prereq-Ent course or #, one course each in ecology and genetics recommended)  
Overview of Lepidoptera with emphasis on processes and phenomena such as polymorphism, mimicry, and individual quality that are well demonstrated by this insect order.

**Ent 5481. Invertebrate Neurobiology.** (2-3 cr. SNSc 5481)  
Fundamental principles/concepts underlying cellular bases of behavior/systems neuroscience. Particular invertebrate preparations.

**Ent 5900. Basic Entomology.** (1-6 cr. Prereq-#)  
For graduate students who need to make up certain deficiencies in their biological science background.

**Ent 5910. Special Problems in Entomology.** (1-6 cr [max 10 cr]. Prereq-#)  
Individual field, lab, or library studies in various aspects of entomology.

**Ent 5920. Special Lectures in Entomology.** (1-3 cr)  
Lectures or labs in special fields of entomological research. Given by visiting scholar or regular staff member.

**Ent 8041. Advanced Insect Genetics.** (2 cr. Prereq-[5011, basic genetics course] or #; offered alt yrs)  
Molecular genetic techniques and their applications. Emphasizes insect species other than *Drosophila*. Application of genetic techniques to physiological processes.

**Ent 8051. Toxicology.** (2 cr. Prereq-[5011, [organic, inorganic] chem courses, biochem course] or #)  
Chemistry, mode of action of conventional insecticides. Insect growth regulators, microbial pesticides. Transgenic viruses, genetically modified plants. Offered alternate years.

**Ent 8200. Colloquium in Social Insects.** (1-3 cr. Prereq-3020 or 3200)  
Current research on bees, wasps, ants, and termites. Student critiques and research reports.

**Ent 8210. Colloquium in Insect Evolution.** (1-3 cr. Prereq-5371 or #)  
Research issues in systematics and evolution. Comparative biology, biogeography, and molecular evolution. Students may re-enroll as topics alternate. Students critique papers from primary literature.

**Ent 8240. Colloquium in Insect Ecology.** (1-2 cr. Prereq-5041 or #)  
Advanced topics.

**Ent 8300. Graduate Seminar.** (1 cr; S-N only. Prereq-#)  
Oral and written reports on and discussion by students of selected topics from current literature.

**Ent 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**Ent 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**Ent 8594. Research in Entomology.** (1-16 cr [max 36 cr]; S-N only)  
Directed research.

**Ent 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Ent 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Ent 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

## Entrepreneurship (Entr)

For courses in this designator, see the online course database at <www.semesters.umn.edu/tc/>.

## Environmental Science (ES)

*Department of Soil, Water, and Climate  
College of Agricultural, Food and Environmental Sciences*

**ES 5211. Environmental Biophysics and Ecology.** (2 cr; A-F only. Prereq-[[Biol 1009 or equiv], Math 1271, Phys 1101, [upper div or grad student]] or #)  
Basic concepts of environmental variables such as temperature, humidity, wind, and radiation. Mechanics of heat/mass transfer between a living organism and its surrounding environment. Set of practical examples to integrate concepts and transport processes.

**ES 5212. Environmental Biophysics and Ecology Laboratory.** (1 cr; A-F only. Prereq-Biol 1009, Math 1271, Math 1282, Phys 1101)

Introduces experimental techniques in environmental biophysics and ecological studies. Measuring biophysical parameters of plants, animals, and their surrounding environments. Defining/describing physical status of a living organism, determining the rate of mass/energy exchange.

**ES 5232. Vadose Zone Hydrology.** (3 cr. Prereq-[Math 1271 or equiv], [Phys 1042 or equiv])

Basic soil physical properties/processes governing transport of mass/energy in soils. Emphasizes water/solute transport through unsaturated root/vadose zones, their impact on subsurface hydrology and on water quality. Lectures, hands-on laboratory exercises, discussion of real world problems, problem solving.

**ES 5402. The Atmospheric Boundary Layer.** (3 cr. Prereq-Math 1271, Phys 1201, Stat 3011)

Calculus-based introduction to the atmospheric boundary layer (ABL), the interface between the earth's surface and the atmosphere. Topics include ABL development and turbulence, surface energy balance, ABL clouds, air quality, microclimate, and observational and modeling methods.

**ES 5421. Introduction to Atmospheric Science.** (3 cr [max 3 cr]. Prereq-Math 1271, Phys 1201, Stat 3011)  
Calculus-based, introductory description of the atmosphere including atmospheric dynamics, radiation, thermodynamics, chemical composition, and cloud processes. Discuss applications to climate, meteorology, the hydrologic cycle, air quality, and biogeochemical cycles.

**ES 5555. Wetland Soils.** (2-3 cr; A-F only. Prereq-1125 or 2125 or equiv or #; #4511 recommended)

Morphology, chemistry, hydrology, formation of mineral/organic soils in wet environments. Soil morphological indicators of wet conditions, field techniques of identifying hydric soils for wetland delineations. Peatlands. Wetland benefits, preservation, regulation, mitigation. Field trips, lab, field hydric soil delineation project.

**ES 5601. Principles of Waste Management.** (3 cr; A-F only. Prereq-1125 or 2125, Biol 1002/1009 or Chem 1021, Stat 3011, ApEc 1101 or #)

Waste and waste management principles. Issues, problems, and solutions in remedying waste stream. MSW and yard waste composting. WTE incineration operation, ash disposal, recycling, land fill requirements, direct land disposal, regulatory trends, and case studies.

## Experimental and Clinical Pharmacology (ECP)

*College of Pharmacy*

**ECP 5610. Pharmacoepidemiology.** (2 cr. Prereq-[PubH 5320, PubH 5330] or #)

Application of epidemiologic principles to study, use, and beneficial/adverse outcomes of drugs in human populations.

**ECP 8100. Seminar.** (1 cr [max 8 cr]. Prereq-SACP grad major in ECP track or #)  
Selected topics in experimental and clinical pharmacology.

**ECP 8200. Research Problems.** (1-8 cr [max 16 cr]. Prereq-Grad SACP major (ECP Track) or #)  
Individually designed research experience directed at contemporary problems related to drug use.

**ECP 8210. Clinical Therapeutics.** (3 cr. Prereq-SACP grad major in ECP track or #)  
Topics in clinical pharmacology that illustrate continuum of pathophysiology of a disease state, its contemporary treatment, problems or controversial issues with treatment approaches, strategies to advance therapy. Lectures, readings.

**ECP 8220. Experimental and Clinical Pharmacology.** (3 cr. Prereq-SACP grad major (ECP track) or #)  
Theory of advanced methodologies, applications, and evaluation techniques used to determine efficacy/toxicity of new drug therapies. Techniques for collecting/evaluating data.

**ECP 8290. Clinical Clerkship.** (2 cr. Prereq-Grad SACP major in ECP track or #)  
Supervised study of pharmaceutical services at Fairview-University Medical Center or affiliated institutions.

**ECP 8400. Pharmacometrics.** (3 cr. Prereq-SACP grad major in ECP track or #)  
Theory/application of contemporary methods for analysis of concentration-time data and exposure-response relationships.

**ECP 8410. Population Pharmacokinetic Modeling.** (2 cr; A-F only)  
Theoretical background for using mixed effects model in population analysis. Building fixed/random effects into a pharmacostatistical model. Project allows students to become familiar with a contemporary population pharmacokinetic analysis program.

**ECP 8420. Clinical Trial Simulation.** (2 cr. Prereq-SACP grad major in ECP track or #)  
Theory/application of contemporary methods of using simulations to design more efficient/informative clinical trials.

**ECP 8900. Advanced Topics in Experimental and Clinical Pharmacology.** (1-4 cr [max 8 cr]. Prereq-SACP grad major in ECP track or #)  
Topic varies depending on faculty teaching course.

**ECP 8992. Directed Readings in Experimental and Clinical Pharmacology.** (1-2 cr [max 4 cr])

**ECP 8993. Directed Study in Experimental and Clinical Pharmacology.** (1-4 cr [max 4 cr])

## Family Education (FE)

*Department of Work, Community, and Family Education*

*College of Education and Human Development*

**FE 5001. Family Education Perspectives.** (3 cr; A-F only)  
Origins, evolution, and critique of alternative perspectives on family education. Implications for clients, programs, and educators.

**FE 5003. Contemporary Family Education.** (3 cr; A-F only)  
Transitions in family life examined, with emphasis on preparing educators and educational programs.

**FE 5200. Special Topics in Family Education.** (1-4 cr [max 20 cr])

Topics either not covered in available courses or not covered in sufficient breadth/depth to meet student needs/interests. Topics vary.

**FE 5201. Family and Work Relationships.** (3 cr; A-F only)

Examination of the interactions of work and family to prepare professionals for improving work and family relationships.

**FE 5202. Sexuality Education.** (3 cr; A-F only. Prereq—Human sexual behavior course, family ed course)  
Preparation to develop, deliver, and evaluate sexuality education. Strategies to help children and adults acquire information, form values, develop interpersonal skills, and exercise personal responsibility in the sexual dimensions of individual and family life.

**FE 5203. Family Communication Education.** (3 cr; A-F only)

Knowledge and skills needed to develop, deliver, and evaluate educational programs about family communications. Examination of family communications principles and issues. Development of appropriate teaching methods and materials.

**FE 5301. Program Planning in Family Education.** (3 cr; A-F only)

Exploration of curriculum research and theory; examination and critique of alternative perspectives and their concomitant implications for families; development and evaluation of family education curriculum and programs.

**FE 5302. Family Education Curriculum in Secondary Schools.** (3 cr; A-F only. Prereq—STEPP student)

Examination, development, and implementation of family and consumer science curriculum in secondary schools. Emphasizes curricular perspectives from social reconstruction and cognitive processes.

**FE 5303. Instructional Strategies in Family Education.** (3 cr; A-F only. Prereq—STEPP student)

Theory/research relevant to methods of teaching. Emphasizes methods that support families taking technical, communicative, and emancipatory action.

**FE 5698. Introduction to Parent Education: History and Philosophy.** (1 cr; A-F only)

History, philosophy, and implementation of parent education programs.

**FE 5701. Practice of Parent Education I.** (3 cr; A-F only)

Examination of parent education in community settings; consideration of parents as adult learners with diverse backgrounds; development of group facilitation skills; observation and interviewing in community settings; reflection on and critique of the practice of parent education.

**FE 5702. Practice of Parent Education II.** (3 cr; A-F only. Prereq—5701 or Δ)

Development of curriculum for parent education; consideration of teaching groups and individuals; consideration of ethics in parent education; evaluation of parent education programs; development of curriculum and teaching portfolio; reflection on and critique of the practice of parent education.

**FE 5703. Advanced Practice of Parent Education.** (3 cr. Prereq—5702 or Δ)

Evolving perspectives of parent education. Emphasis on psycho-dynamic, conceptual-change approaches. Reflective and dialogic approaches for working with parents in understanding beliefs and examining their origins and consequences. Examination of issues related to diversity, self-awareness, ethics, and evaluation.

**FE 5712. Parent-Child Interactions.** (3 cr; A-F only)

Preparation to assess/apply theories/practices for everyday parent child relationships.

**FE 5796. Parent Education Practicum.** (1-4 cr [max 4 cr]. Prereq—5702 or Δ)

Supervised parent education field assignments designed according to licensure requirements and individual student needs, interests, and prior competencies.

**FE 5993. Directed Study in Family Education.** (1-3 cr [max 9 cr]; A-F only. Prereq—Δ)

Self-directed study in areas not covered by regular courses. Specific program of study is jointly determined by student and advising faculty member.

**FE 5996. Internship in Family Education.** (1-6 cr [max 6 cr]. Prereq—Δ)

Planned work experience focusing on educational competencies in family education settings. Nature and extent of responsibilities are defined by the position student assumes.

**FE 8900. Family Education Colloquium.** (1-4 cr [max 4 cr]; S-N only. Prereq—Δ)

In-depth discussion about current issues not covered or covered as thoroughly in available courses. For family education graduate students, faculty, and community professionals.

**FE 8994. Directed Research in Family Education.** (1-6 cr [max 6 cr]; A-F only. Prereq—Family ed student doing Plan B research, Δ)

## Family Practice and Community Health (FPCH)

*Department of Family Practice and Community Health  
Medical School*

**FPCH 5201. Clinical Family Medicine.** (12 cr [max 108 cr]. Prereq—Fam practice resident or #)

Supervised care for patients of all ages on a continuous, primary, preventive, and general diagnostic basis. Diagnosis, methods of treatment, and problem-solving devices for benefit of patient and family, emphasizing health hazard appraisal. New and refined methods of recording, documentation, and retrieval of clinical data.

**FPCH 5345. Curriculum Design and Teaching Strategies for Medical Education I.** (3 cr.

Prereq—#5346, #)

Identifying/developing course goals. Developing course, teacher, learner evaluations.

**FPCH 5346. Curriculum Design and Teaching Strategies for Medical Education II.** (1 cr.

Prereq—#5345, #)

Lecture, demonstration, small-group discussion, clinical teaching, computer-assisted instruction.

**FPCH 5564. Family Practice Seminar.** (1 cr [max 9 cr]. Prereq—MD or DO degree.)

Knowledge, skills, and attitudes in biomedical and behavioral sciences that form foundation for academic discipline of family medicine; medical decision making, common problems and procedures, family theory and assessment, clinical pharmacy, human sexuality.

**FPCH 5650. Principles of Geriatrics I.** (1 cr [max 5 cr]; S-N only. Prereq—Medical School or dental school or GNP School graduate)

First in two-course sequence. Survey of major topics in geriatric medicine. Epidemiology, etiology, diagnosis, and treatment of major geriatric syndromes and illnesses.

**FPCH 5651. Principles of Geriatrics II.** (1 cr [max 5 cr]; S-N only. Prereq—Medical School or dental school or GNP school graduate)

Second in two-course sequence. Survey of major topics in geriatric medicine. Epidemiology, etiology, diagnosis, and treatment of major geriatric syndromes and illnesses.

**FPCH 5950. Clinical Issues in Human Sexuality.** (2 cr. Prereq—Enrollment in health sci grad programs in CSPP, Psy, PubH, SW or FSoS or #)  
Assessment and treatment techniques pertaining to common sexual problems.

**FPCH 5955. Directed Study.** (1-10 cr. Prereq—#; qualified students may arrange for work on a tutorial basis.)  
Studies on special topics as arranged between student and faculty.

**FPCH 5960. Basic Research Methods in Family Practice.** (3 cr. Prereq—#)

## Family Social Science (FSoS)

*Department of Family Social Science  
College of Human Ecology*

**FSoS 5101. Family Systems.** (3 cr. \$3102. Prereq—Grad student)

Family systems and other family theories focusing on the dynamics and processes relevant to family life. Diversity issues related to gender, ethnicity, sexual orientation, and disability. Issues related to divorce, single parenthood, and remarriage are covered. Family strengths and family problems are integrated.

**FSoS 5150. Special Topics in Family Social Science.** (1-4 cr [max 12 cr]. Prereq—[Varies by topic], #)

Review of research/scholarly thought. Topics specified in *Class Schedule*.

**FSoS 5193. Directed Study in Family Social Science.** (1-6 cr [max 6 cr]. Prereq—FSoS or grad student in related field)

**FSoS 5426. Alcohol and Drugs: Families and Culture.** (3 cr. \$3426)

Overview of psychology/sociology of drug use/abuse. Life-span, epidemiological, familial, cultural data regarding use. Fundamentals of licit/illicit drug use behavior. Gender, ethnicity, social class, sexuality, sexual orientation, disability.

**FSoS 5429. Counseling Skills Practicum I.** (3 cr. \$3429)

Basic counseling skills. Counselor needs/motivations, non-verbal communication, basic/advanced empathy, identifying strengths, maintaining focus, challenging discrepancies, use of self. Emphasizes building from client strengths, learning through role-playing.

**FSoS 5431. Counseling Skills Practicum II.** (3 cr. \$3431. Prereq—3429, 5429)

Advanced therapeutic methods, processes of change. Identifying, reinforcing, challenging core beliefs. Reframing, paradox, trance, guided imagery. Cognitive-behavioral, solution-focused, narrative therapies. Emphasizes non-pathologizing models of therapy.

**FSoS 5432. Chemical Abuse and Families: an Overview.** (3 cr. \$3432)

Relationships, family systems with particular application to families in which alcohol or drug use is a problem. Family types, family of origin, models of family therapy, family systems theory, alcoholism. Review of literature.

**FSoS 8001. Conceptual Frameworks in the Family.** (3 cr. Prereq—Family course or #)

Major theoretical models about families, emphasizing sociohistorical context.

**FSoS 8013. Qualitative Family Research Methods.** (3 cr)

Approaches to qualitative family research evaluation. Phenomenological, feminist, grounded theory, content analytic, ethnomethodological, ethnographic, program evaluation. Theory, research examples, student projects.

**FSoS 8014. Quantitative Family Research Methods.** (3 cr. Prereq—8001 or equiv, 2 stat courses or #)

Builds on basic understanding of quantitative research in behavioral sciences by focusing on special issues

associated with conducting research on the family as the unit of analysis. Proposal writing and analysis of secondary data.

**FSoS 8031. Family of Origin.** (3 cr; S-N only. Prereq—Preference given to marriage and fam therapy students) In-depth study of each student's family of origin in a group of other students and a clinical faculty therapy supervisor.

**FSoS 8032. Theories of Marital and Family Therapy.** (3 cr) General systems theory and cybernetics; influence of, application to family systems, historical roots, and theoretical and clinical models they have influenced. How change processes affect interactional patterns, information processing, family structure, family belief systems, and family life cycle transitions.

**FSoS 8033. Clinical Issues in Marriage and Family Therapy.** (3 cr; A-F only. Prereq—8032 or equiv) Family therapy assessment and treatment approaches to problems such as depression, alcoholism, and sexual abuse, and to challenges of varying family structures, such as single-parent and remarried families.

**FSoS 8034. Marriage and Family Therapy Supervision.** (3 cr. Prereq—FSoS 8032 or #) For marriage and family therapists who want to become supervisors, this course is designed to meet didactic and interactional course requirements for the Approved Supervisor designation as stipulated by the American Marriage and Family Therapy Association (AAMFT). Topics included are theories of supervision, structures for supervision, methods of supervision, the evaluation process, and legal/ethical issues. Also covered are the therapist-client-supervisor relationships, potential problems, and contextual issues.

**FSoS 8035. Assessment of Couples and Families.** (3 cr; A-F only. Prereq—8014 or equiv or #) Issues in research and clinical assessment. Assumptions and values underlying assessment approaches. Specific assessment techniques discussed, evaluated, and administered. Ethical, legal, and practical issues.

**FSoS 8036. Couple and Family Therapy Research.** (3 cr; A-F only. Prereq—8013, 8014) Strengths and limitations of current couple and family outcome research; methodological approaches, including qualitative and quantitative.

**FSoS 8037. Ethical, Legal, and Professional Issues in Mental Health Practice: Issues with Couples and Families.** (2-10 cr [max 10 cr]; A-F only. Prereq—[8032, practicum or internship exper] or [grad student in cooperating mental hlth practice prog who has completed 1 course on therapy with children or couples or families, practicum or internship exper] or #) Boundaries and triangles, gender inequities, family law, confidentiality and reporting requirements, dual roles, client diversity, and value clashes.

**FSoS 8039. Clinical Interventions for Couples.** (3 cr; A-F only. Prereq—8032 or equiv or #) Interventions into problems faced by couples at various ages and stages of their relationship. Developing and implementing effective strategies for problem solving, relationship maintenance, and partner growth, including integration of sex therapy into ongoing couple therapy.

**FSoS 8043. Family Theory Development: A Systemic Perspective.** (3 cr. Prereq—8001 or equiv or #, FSoS PhD student beyond 1st yr) Concepts and principles of systems and ecosystems and their applications in family science; emphasizes theoretical integration and development of research models with appropriate methodologies.

**FSoS 8047. Integrative Research Seminar.** (3 cr. Prereq—8001 or equiv, 8013 or equiv, 8014 or equiv) For advanced doctoral students primarily in family social science who are working on independent research projects. Giving and receiving of constructive

criticism and support in integrating theories, methods, and applications in order to create a totality that is logically coherent and conceptually and methodologically sound.

**FSoS 8101. Family Stress, Coping, and Adaptation.** (3 cr. Prereq—8001 or equiv, research methods course) Helping families become more resilient to stress by decreasing vulnerability to crises and traumatic stress disorders. Students develop research or intervention proposal on family stress, coping, adaptation, crisis, trauma, or resilience.

**FSoS 8102. Seminar in Gender Roles.** (3 cr. Prereq—Two grad family courses or #) Theory and research on gender roles in families. Gender issues in roles of mothers, fathers, marital partners, and same-sex partners. Issues of race, ethnicity, and social class as they intersect with gender.

**FSoS 8103. Family Decision Making.** (3 cr. Prereq—Two grad family courses or #) Analysis and assessment of methodological and theoretical approaches to studying problem-solving and decision-making processes of individuals and family groups.

**FSoS 8104. Family Policy Research.** (3 cr. Prereq—4003 or equiv or #) Seminar identifies characteristics distinguishing family policy research from other family research; conceptual frameworks, methods, and roles family policy research can play in policy-making and knowledge-building processes.

**FSoS 8105. Family Gerontology.** (3 cr. Prereq—4154 or equiv or #) Integrates gerontology and family studies; new lines of inquiry, qualitative and quantitative, into aging families. Family gerontological research, family relationships, family and long-term care institutions, theoretical frameworks and research methods, and research and interventions.

**FSoS 8106. Family Research from Economic Perspectives.** (3 cr. Prereq—8013 or equiv, 8014 or equiv or #) Seminar integrates conceptual and methodological perspectives of family social science with economic approaches to studying families. Family investments in human and social capital. Diversities in families; interface of public policies and family economic well-being.

**FSoS 8107. Family Values Research: Theories and Critical Methods.** (3 cr. Prereq—8013 or equiv, 8014 or equiv or #; WCFE 8920 recommended) Interdisciplinary seminar on critical modes of inquiry in the family domain that require designing studies using normative theories, examining values as units of observation, and solving practical problems by collaborative strategies designed to encourage change.

**FSoS 8150. Topics in Family Social Science.** (1-6 cr [max 6 cr]. Prereq—Graduate student or #) Special seminars on timely topics suited to the needs of students.

**FSoS 8193. Directed Study in Family Social Science.** (1-6 cr [max 6 cr]. Prereq—Doctoral student in FSoS or related field) Directed study.

**FSoS 8200. Process Seminar for Family.** (1 cr; S-N only. Prereq—#) Required of all first-year family social science students (orientation to graduate program); not open to other students.

**FSoS 8201. Teaching Family Courses in Higher Education I.** (3 cr; S-N only. Prereq—12 FSoS grad cr; teaching assistant exper recommended) Students cooperatively plan, administer, and evaluate (with a graduate faculty supervisor) an undergraduate core course. Improvement of teaching and evaluation methods, and conceptualization and presentation of research-based course in family studies.

**FSoS 8202. Teaching Family Courses in Higher Education II.** (3 cr; S-N only. Prereq—8201 or equiv) Under faculty supervision, students teach an undergraduate course in family social science for which they have appropriate academic preparation and professional experience.

**FSoS 8275. Clinical Consultation with Couples and Families.** (3 cr; S-N only. Prereq—#; required for grad FSoS majors in marriage and family therapy prog) Supervised students serve as a consultation group working with community clinicians and their clients, utilizing a one-way window and observation room; opportunities for cotherapy.

**FSoS 8295. Family Therapy Practicum.** (1-12 cr [max 12 cr]; S-N only. Prereq—Marriage and family therapy student) Clinical placement doing marriage and family therapy in a community setting.

**FSoS 8296. Family Therapy Internship.** (1-21 cr [max 21 cr]; S-N only. Prereq—8295, marriage and family therapy student) Full-time clinical placement doing marriage and family therapy in a community setting.

**FSoS 8297. Supervision of Supervision.** (1-3 cr [max 12 cr]; S-N only. Prereq—MFT student, #) Hands-on practicum to gain AAMFT-approved supervisor status.

**FSoS 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**FSoS 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**FSoS 8550. Advanced Topics in Family Social Science.** (1-6 cr [max 6 cr]; A-F only. Prereq—FSoS PhD student) Special seminars on topics suited to student needs.

**FSoS 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**FSoS 8755. Master's Paper: Plan B Project.** (1-6 cr [max 6 cr]; S-N only. Prereq—FSoS MS student) Graduate faculty work with students on research for Plan B paper.

**FSoS 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**FSoS 8794. Directed Research in Family Social Science.** (1-6 cr [max 6 cr]. Prereq—Grad FSoS major) Directed research.

**FSoS 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

## Finance (Fina)

### Department of Finance

#### Curtis L. Carlson School of Management

**Fina 8801. Theory of Capital Markets.** (4 cr. Prereq—Econ 8101, Econ 8102, business admin PhD student or #) Expected utility theory, discrete theory, continuous theory, theory of the term structure, measures of risk, portfolio choice, aggregation and separation, linear pricing.

**Fina 8811. Corporate Finance.** (4 cr. Prereq—Econ 8103, Econ 8104, business admin PhD student or #) Theoretical and empirical works in five major areas of corporate finance: capital structure, payout policy, mergers and corporate control, capital acquisition process, and corporate risk management. Theoretical frameworks are used to understand empirical evidence.

**Fina 8821. Empirical Methods in Finance.** (4 cr. Prereq—8801, business admin PhD student or #) Introduction to commonly used econometric methods in the empirical financial markets area. Econometric tests of linear pricing models, tests of market efficiency, event studies.

**Fina 8892. Independent Study in Finance.** (1-8 cr [max 16 cr]. Prereq–Business admin PhD student or #) Problems or developments of special interest to the student.

**Fina 8894. Directed Research in Finance.** (1-8 cr [max 16 cr]. Prereq–Business admin PhD student specializing in finance or #) Individualized directed research on a project of interest to the student, approved and advised by faculty.

## Fisheries and Wildlife (FW)

*Department of Fisheries, Wildlife, and Conservation Biology*

*College of Natural Resources*

**FW 5003. Human Dimensions of Biological Conservation.** (3 cr. Prereq–[Biol 1001 or Biol 1009], Biol 3407) Survey of social, psychological, economic, policy aspects of managing/conserving wildlife, fisheries, and related resources.

**FW 5051. Analysis of Populations.** (3-4 cr. Prereq–[[Biol 1001 or Biol 1009], [FW 4001 or Stat 3011 or Stat 5021]] or #) Factors involved in regulation, growth, general dynamics of populations. Data needed to describe populations, population growth, population models, regulatory mechanisms.

**FW 5411. Aquatic Toxicology.** (3 cr. Prereq–Intro chem, intro ecol, #) Pollution assessment approaches, biological effects, fate/flow of contaminants in aquatic systems, major types of pollutants.

**FW 5455. Sustainable Aquaculture.** (3 cr; A-F only. Prereq–Biol 2012, Chem 1021, Math 1031) or #) Role of aquaculture in fisheries management, biodiversity rehabilitation, and food production around the world. Implications for sustainability of human-environment interactions in different societies. Principles of fish husbandry.

**FW 5571. Avian Conservation and Management.** (3 cr. Prereq–EEB 4134 or grad or #) Current problems in avian conservation/management. Nongame, wetland, game birds.

**FW 5601. Fisheries Population Analysis.** (3 cr; A-F only. Prereq–[4001 or Stat 5021], Biol 3407, [Math 1142 or Math 1271]) Introduction to theory/methods for estimating vital statistics of fish populations. Using microcomputers/statistical software to describe, analyze, model attributes of fish populations. Case studies from literature of marine/freshwater fisheries management.

**FW 5603W. Habitats and Regulation of Wildlife.** (3 cr; A-F only. Prereq–Biol 3407) Environmental interactions of wildlife at population/community levels. Environmental threats from human activities. Habitat management practices. Objectives, policies, regulations in population management.

**FW 5604W. Fisheries Ecology and Management.** (3 cr. Prereq–EEB 4601) Managed species/systems. Applied aquatic/fish ecology related to fisheries. Role of planning in fisheries management. Application of management tools, assessment of their efficacy.

**FW 5625. Wildlife Handling and Immobilization for Research and Management.** (2 cr; S-N only. Prereq–General biology, [grad student or vet med student or FW sr], Δ) Practical techniques to maximize human/animal safety and encourage effective operations. Preparation procedures, legal responsibilities, capture drugs/delivery systems, safety measures, ethical issues, basic veterinary procedures for handling wildlife. Field course. Uses live animals.

**FW 8200. Seminar.** (1-4 cr; S-N only) Oral and written student reports on selected topics from current literature in fisheries biology and management and wildlife. Lectures by and discussions with faculty and visiting specialists.

**FW 8333. FTE: Master's.** (1 cr; NGA. Prereq–Master's student, adviser and DGS consent)

**FW 8394. Research in Fisheries.** (1-4 cr) Directed research.

**FW 8444. FTE: Doctoral.** (1 cr; NGA. Prereq–Doctoral student, adviser and DGS consent)

**FW 8448. Fishery Science.** (3 cr. Prereq–Grad student [in fisheries or wildlife conserv or conserv biol or ecology] or #) Applying ecological theory to study/manipulation of fish populations. Dynamics of growth, mortality, and yield of fish stocks. Field assessment methodology. Simulation applied to management problems. Web-assisted course. Students produce a publishable (print or electronic) project.

**FW 8452. Conservation Biology.** (3 cr; A-F only) Seminar examining population- to system-level biological issues (genetics; demographic processes; community, ecosystem, and landscape scale interaction; restoration ecology; ex situ strategies for restoration and recovery) and societal issues (social, economic, cultural perspectives; sustainable development strategies; roles of institutions; international and U.S. policies).

**FW 8459. Stream and River Ecology.** (3 cr. Prereq–Limnology course or #) Structure/dynamics of running waters from ecosystem perspective. Historical perspective, basic hydrology/fluvial geomorphology, terrestrial-aquatic interactions, detrital dynamics, metabolism, drift, trophic relations, biotic/abiotic interactions, ecosystem experiments and natural alterations, stability/succession, ecosystem dynamics in a watershed.

**FW 8461. Advanced Topics in Fish Physiology.** (1 cr. Prereq–Vertebrate physiology course or #) Lectures, discussion, current literature. Complements 5459.

**FW 8462. Advanced Topics in Fish Behavior.** (1 cr. Prereq–5459 or behavior course or #) Current literature. Complements 5459.

**FW 8465. Fish Habitats and Restoration.** (3 cr. Prereq–Intro ecology course or #) Mechanisms underlying physiology/behavior that shape fish community structure in specific north temperate habitats. Techniques and planning procedures for restoring lakes/streams.

**FW 8494. Research in Wildlife.** (1-4 cr. Prereq–#) Directed research.

**FW 8576. Biology and Management of Large Mammals.** (2 cr; A-F only. Prereq–[Ecology course, [wildlife, forestry, and ecology grad student]] or #) Ungulates. Ecology, population dynamics, energy, nutrition, predation, disease/parasites, social behavior. Research approaches, management implications/practices. Key information on North American species.

**FW 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq–Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**FW 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq–Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**FW 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer; 24 cr required)

## Food Science and Nutrition (FScN)

*Department of Food Science and Nutrition*

*College of Agricultural, Food and Environmental Sciences*

**FScN 5411. Food Biotechnology.** (2 cr. Prereq–4121) Genetic tools as applied to food biotechnology. Improvement of microbes used in food production by modern biotechnological approaches. Discuss need for stringent regulation of modern biotechnology as well as ethical and legal issues.

**FScN 5421. Introduction to Food Law.** (3 cr. Prereq–1102) Analysis of the federal legal requirements affecting the production processing, packaging, marketing, and distribution of food and food products using case law studies and regulatory history.

**FScN 5431. Physicochemistry of Food.** (2 cr. Prereq–4111) Surface phenomena, colloidal interactions, liquid dispersions, gels, emulsions and foams, and functionality of food macromolecules in these systems.

**FScN 5441. Introduction to New Product Development.** (2 cr. Prereq–4111, 4331) Interactive course that introduces students to the principles of new product development, from identification and testing of new product concepts, through prototype testing, to basic process design using examples from industry.

**FScN 5451. Structure and Function in Foods: Quantitative Analysis.** (2 cr. Prereq–4312) Introduction to various procedures for analysis of structure and organization in raw and processed food.

**FScN 5461. Food Packaging.** (2 cr. Prereq–1102, 3102, Phys 1102 or Phys 1302) Materials, principles, and procedures of packaging as they apply to food products. Emphasis is on consumer products, but the principles also apply to bulk and institutional foods and ingredients.

**FScN 5471. Advanced Food Chemistry.** (3 cr. Prereq–4111) Chemical reactions taking place in formation, stability, and degradation of important food constituents. Examples of reactions for major chemical changes occurring in food systems.

**FScN 5481. Sensory Evaluation of Food Quality.** (2 cr; A-F only. Prereq–3102, Stat 3011) Fundamentals of sensory perception. Test designs and methods used in studying sensory qualities of foods. Current issues in sensory evaluation. Group research project.

**FScN 5511. Meat, Poultry, and Seafood Protein Processing.** (2 cr. Prereq–1102, Chem 2302) Industrial processing of meat, poultry, and seafood products with emphasis on protein systems: comminuted products, nutraceutical products, thermal processing optimization, pasteurization, least cost analysis, and color stability.

**FScN 5531. Grains: Introduction to Cereal Chemistry and Technology.** (2 cr. Prereq–Biol 1009, Chem 1022) Origins, structure, biochemistry, and cellular properties of major cereal grains as they relate to primary processing (milling) and secondary processing (production of cereal products).

**FScN 5621W. Nutrition and Metabolism.** (4 cr. Prereq–4612, BioC 3021, Phsl 3051) Carbohydrate, lipid, and protein metabolism. Uses “systems” or “holistic” approach to emphasize how metabolic pathways interrelate.

**FScN 5622. Vitamin and Mineral Biochemistry.** (3 cr. Prereq–4612, BioC 3021, Phsl 3051) Nutritional, biochemical, and physiological aspects of vitamins/essential minerals in human/experimental-animal models.

**FScN 5623. Regulation of Energy Balance.** (2 cr. Prereq=5621 or 15621)  
Regulation of energy balance in humans, including regulation of food intake and of energy expenditure.

**FScN 5631. Dietary Supplements: Regulatory, Scientific, and Cultural Perspectives.** (3 cr)  
Concepts/principles of dietary supplements-RDA, dose-response, risk assessment. Laws/regulations, their interpretation concerning dietary supplements. Vitamins/minerals. Philosophy/use of botanicals/nutraceuticals in Western medicine in contrast to other cultures. Use of herbal supplements in Western medicine.

**FScN 8310. General Seminar.** (1 cr [max 2 cr]; S-N only. Prereq=#)  
Presentations by faculty, graduate students, and outside speakers.

**FScN 8318. Current Issues in Food Science.** (2 cr [max 4 cr]; A-F only. Prereq=4111, 4121, Δ)  
Current issues, how they impact food industry.

**FScN 8320. Advanced Topics in Food Science.** (1-3 cr [max 6 cr]. Prereq=#)  
Recent research or special topics.

**FScN 8330. Research Topics.** (1 cr [max 6 cr]. Prereq=#)  
Seminar in which faculty member or group of faculty/graduate students discuss research progress or review/discuss current research literature.

**FScN 8331. Food Proteins.** (3 cr. Prereq=4111, 4312)  
Basic protein biochemistry as applied to food systems and food processing. Emphasizes forces that determine protein structure. Techniques for isolation/characterization of food proteins. Protein structure function relationships in regard to handling/processing specific food protein systems (cereal, meat, dairy).

**FScN 8333. FTE: Master's.** (1 cr; NGA. Prereq=Master's student, adviser and DGS consent)

**FScN 8334. Reaction Kinetics of Food Deterioration.** (2 cr. Prereq=Chem 3501)  
Basis for use of applied chemical kinetics to deteriorative reactions occurring in processing and storage of foods and drugs. Systems include enzymatic reactions, lipid oxidation, nonenzymatic browning, acid base catalysis, and microbial growth and death. Application of these kinetics to study of accelerated shelf-life testing of foods, drugs, and biologics.

**FScN 8335. Carbohydrate Chemistry in Food and Nutrition.** (2 cr. Prereq=4111)  
Current methods of carbohydrate and polysaccharide analysis, including structural and chemical characterization methods, polymer reactions, and modifications.

**FScN 8336. Lipid Chemistry and Rancidity of Foods.** (2 cr. Prereq=4111)  
Chemistry of food lipid oxidation and rancidification, and protective functions of antioxidants.

**FScN 8337. Flavor Chemistry.** (2 cr. Prereq=4111)  
Chemistry involved in formation, analysis, and release of flavoring materials in foods.

**FScN 8338. Antioxidants in Food: Practical Applications.** (2 cr. Prereq=4111, BioC 3021, food chemistry, organic chemistry, biochemistry)  
Mechanisms of antioxidant activities in food systems. Free radical scavengers, hydroperoxide stabilizers, synergists, metal chelators, singlet oxygen quenchers, substance reducing hydroperoxides. Practical applications of antioxidants in various food systems, effect of antioxidants on health/diseases.

**FScN 8391. Independent Study: Food Science.** (1-4 cr [max 6 cr]. Prereq=Δ)  
Includes written reports.

**FScN 8444. FTE: Doctoral.** (1 cr; NGA. Prereq=Doctoral student, adviser and DGS consent)

**FScN 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq=Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**FScN 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq=Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**FScN 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq=Max 18 cr per semester or summer; 24 cr required)

## Forest Resources (FR)

### Department of Forest Resources

#### College of Natural Resources

**FR 5104. Forest Ecology.** (4 cr; A-F only. Prereq=[Knowledge of basic [botany, plant biology], grad student] or #)  
Form/function of forests as ecological systems.

Characteristics/dynamics of species, populations, communities, landscapes, and ecosystem processes. Examples applying ecology to forest management. Weekly discussions on research topics, exercises, current issues in forest resource management. Required weekend field trip.

**FR 5114. Hydrology and Watershed Management.** (3 cr. Prereq=Grad student or #)

Introduction to hydrologic cycle and water processes in upland/riparian systems. Applications of hydrological concepts to evaluate impacts of forest management and other land use patterns/activities on water yield, stormflow, erosion, sedimentation, and water quality. Concepts, principles, and applications of riparian/watershed management. Economic/social factors. National/global examples. Emphasizes forest ecosystems.

**FR 5118. Physiological Ecology of Woody Plants.** (3 cr; A-F only. Prereq=Grad student or #)  
Plant-water relations. Relations of biology to ecology and management. How physiological factors affect ecological processes and management decisions.

**FR 5131. Geographical Information Systems (GIS) for Natural Resources.** (4 cr; A-F only. Prereq=Grad student or #)

Introduction to GIS. Focuses on natural resources. Data structures, sources, collection, and quality. Lab exercises introduce geodesy, map projections, spatial analyses, and cartographic modeling.

**FR 5142. Tropical Forest Ecology.** (3 cr. Prereq=3xxx ecology course)

Ecological principles related to form, function, and development of wet/dry tropical forests at organismal, community, and ecosystem scales. Ecophysiology, succession, productivity, biodiversity, sustainability, agroforestry, social forestry, and management alternatives. Natural distribution of forest types. Causes, consequences, and extent of deforestation.

**FR 5146. Biological Implications of Global Change.** (3 cr. Prereq=3xxx ecology course)

Implications of global change for wild/cultivated vegetation. Forests, grasslands, agricultural ecosystems. Responses at scales from immediate organismal physiological responses through changes in communities to ecosystem shifts on a geologic times scale. Potential for climate change. Atmospheric concentrations of carbon dioxide, ozone, and other trace gases. Impacts of acid deposition and other pollutant issues.

**FR 5153. Forest and Wetland Hydrology.** (3 cr. Prereq=Basic hydrology course or #)

Field identification of common trees, shrubs, and nonwoody vascular plants. Plant communities, soil site relationships, wildlife values. Natural history of northern/boreal forests in terms of soils, ecological characteristics of trees, community-environment relationships, stand development, succession, and regeneration ecology. Land survey, tree/forest stand measurement, forest sampling techniques. Taught at Cloquet Forestry Center.

**FR 5161. Northern Forest Field Course.** (2 cr; A-F only. Prereq=#)

Field identification of common trees, shrubs, and nonwoody vascular plants. Plant communities, soil site relationships, wildlife values. Natural history of northern/boreal forests in terms of soils, ecological characteristics of trees, community-environment relationships, stand development, succession, and regeneration ecology. Land survey, tree/forest stand measurement, forest sampling techniques. Taught at Cloquet Forestry Center.

**FR 5203. Forest Fire and Disturbance Ecology.** (3 cr; A-F only. Prereq=[Grad student or #], course fee)  
Ecology, history, management, and control of fire, wind, insect infestation, browsing, and other disturbances in forests. Disturbance regimes of boreal, northern hardwood, and other major forest types of North America. Influence of disturbance on wildlife habitat, urban/wildland interfaces, forest management, and stand/landscape dynamics. Guest speakers on fire organization, training, and operations. Two-day field trip.

**FR 5218. Measuring and Modeling Forests.** (3 cr; A-F only. Prereq=Grad student or #)

General sampling design and survey techniques to assess current resource conditions. Application of metrics/sampling methods to forest vegetation. Calculation of tree/stand volume, selection of modeling approaches. Case studies of modeling to project future growth. Landscape processes, characterization, and modeling.

**FR 5228. Advanced Assessment and Modeling.** (3 cr; A-F only. Prereq=3218, Math 1272, Stat 5021)

Application of recently developed mathematics, computer science, and statistics methodologies to natural resource functioning, management, and use problems. Specific topics, software, and methodologies vary.

**FR 5262. Remote Sensing of Natural Resources and Environment.** (4 cr. Prereq=Grad student or #)

Principles/techniques of remote sensing. Mapping/monitoring land/water resources from local to global scales. Forest and natural resource inventory. Forest cover and soil mapping. Land use/global change analysis. Lab provides hands-on experience working with aerial photography and digital sensing imagery.

**FR 5264. Advanced Forest Management Planning.** (3 cr. Prereq=3471 or #)

Applied models for forest planning to integrate forest resource conditions/uses. Stand-level management. Forest-wide/landscape-level planning. Regional timber supply analysis. Optimization models and heuristic techniques as tools. Integrating sustainable timber production with desirable future conditions and spatial structure for biodiversity. Problems, case studies involving recent large-scale applications.

**FR 5403. Teaching About Natural Resources.** (1-2 cr. Prereq=NRES major or elementary teacher or #)

Forest community, tools used by natural resource managers, management practices. Natural-resource-related indoor/outdoor activities that can be translated for classroom use. One intensive weekend required.

**FR 5411. Silviculture: Managing Forest Ecosystems.** (4 cr. Prereq=Grad student or #)

Management of forest stands, habitats, and ecosystems in a landscape context. Philosophical approaches, silvicultural systems, methods/tools for reforestation, restoration techniques, intermediate stand treatments. Ramifications of management choices on quality, production, wildlife habitat, disturbance potential, aesthetics, old-growth development, and forest health. Lab. Weekend field trip required.

**FR 5412. Digital Remote Sensing.** (3 cr. Prereq=3262 or grad student or #)

Physical basis and practical applications of digital remote sensing. Energy-matter interactions. Measurements and sensors. Digital image processing/analysis. Experience working with remote sensing data, image processing, and models.

**FR 5431. Timber Harvesting and Road Planning.** (2 cr. Prereq–Grad student or #)  
Forest operations. Terminology, engineering, equipment/harvesting system options, productivity/costs. Relationship to forest management and silviculture. Road planning, forest management guidelines. Mitigating potential impacts to soil/water resources. Environmental implications of method/equipment choices. Selling timber. Sale design, layout, and administration. Two all-day field trips.

**FR 5471. Forest Planning and Management.** (3 cr; A-F only. Prereq–Grad student or #)  
Processes/techniques for scheduling forest management. Goals of landowners, industry, government, and society. Issues/policies/regulations that influence management. Predicting outcomes, financial analysis, regulation, mathematical models, linear programming, economic analysis. Landscape-level management, historical range of variability, wildlife management, carbon sequestration, resource monitoring, certification, adaptive management.

**FR 5480. Topics in Natural Resources.** (1-3 cr [max 12 cr]. Prereq–#)  
Lectures in special fields of natural resources given by visiting scholar or regular staff member. Topics specified in *Class Schedule*.

**FR 5501. Urban Forest Management: Managing Green Spaces for People.** (3 cr. Prereq–Grad student or #)  
Management concepts for green infrastructure of cities, towns, and communities. Urban forest as social/biological resource. Emphasizes management of urban forest ecosystem to maximize benefits. Tree selection, risk assessment, cost-benefit analysis, landscape planning, values, perceptions. How urban forestry can be a tool to improve community infrastructure.

**FR 5611. Field Silviculture.** (3 cr. Prereq–3104, 3411)  
Collection of field data to prepare/write silvicultural prescriptions for regeneration, thinning, and harvesting in context of landscape, watershed, and wildlife habitat issues. Field exercises in forest entomology, pathology, tree improvement, and non-timber forest products. Tree planting. Marking stands for harvest. Taught at Cloquet Forestry Center. Field trips to forests managed by state/industry.

**FR 5615. Field Remote Sensing and Resource Survey.** (2 cr; A-F only. Prereq–3218, 3262)  
Field applications of remote sensing, sampling/measurement methods to inventory/mapping of forest and other natural resources. Offered at Cloquet Forestry Center.

**FR 5621. Field Timber Harvesting and Road Planning.** (2 cr. Prereq–[3411, 3431] or #)  
Design, layout, and administration of timber sales. Forest road planning and design. Protecting residual trees during harvesting operations. Dealing with protesters. Field trips and on-site evaluations of timber harvesting systems. Timber appraisal, forest management guidelines. Road location and profiling. Planning/layout considerations. Taught at Cloquet Forestry Center.

**FR 5700. Colloquium in Natural Resources.** (1-3 cr. Prereq–#)  
Colloquium in specialized topics in natural resources.

**FR 8101. Research Problems: Physiological Ecology.** (1-5 cr [max 10 cr]. Prereq–#)  
Independent research under faculty guidance.

**FR 8102. Research Problems: Forest-Tree Genetics.** (1-5 cr)  
Independent research under faculty guidance.

**FR 8103. Research Problems: Forest Hydrology.** (1-5 cr)  
Independent research under faculty guidance.

**FR 8104. Research Problems: Forest Ecology.** (1-5 cr)  
Independent research under faculty guidance.

**FR 8105. Research Problems: Silviculture.** (1-5 cr)  
Independent research under faculty guidance.

**FR 8106. Research Problems: Urban Forestry—Biology and Management.** (1-5 cr)  
Independent research under faculty guidance.

**FR 8107. Seminar: Forest Resources.** (1 cr)  
Assigned topics, problem analyses, and research reports.

**FR 8201. Research Problems: Forest Economics.** (1-5 cr)  
Independent research under faculty guidance.

**FR 8202. Research Problems: Forest Biometry and Measurements.** (1-5 cr)  
Independent research under faculty guidance.

**FR 8203. Research Problems: Forest Recreation.** (1-5 cr)  
Independent research under faculty guidance.

**FR 8204. Research Problems: Forest Policy.** (1-5 cr)  
Independent research under faculty guidance.

**FR 8205. Research Problems: Spatial Data Analysis.** (1-5 cr [max 10 cr]. Prereq–#)  
Independent research under faculty guidance.

**FR 8206. Research Problems: Forest Management.** (1-5 cr)  
Independent research under faculty guidance.

**FR 8207. Economic Analysis of Natural Resource Projects.** (2 cr; A-F only. Prereq–#)  
Economics of public/private forestry/watershed management projects. Commercial profitability analysis, cost-benefit analysis, preparing feasibility studies. Case studies developed/presented.

**FR 8208. Research Problems: Environmental Learning and Leadership.** (1-5 cr. Prereq–#)  
Independent research under faculty guidance.

## French (Fren)

### Department of French and Italian College of Liberal Arts

**Fren 5250. Promenades Poétiques: The Subject in Motion.** (3 cr [max 9 cr]. Prereq–3111 or above)  
The search for the subject in poetry and poetic prose as revealed through the motif of the “promenade” and experimentation with literary forms.

**Fren 5260. The Returns of Tragedy.** (3 cr [max 9 cr]. Prereq–3111 or above)  
Tragedy as dramatic form in relation to social order, myth and history, and theatre.

**Fren 5270. “To Change or not to Change?”: Speculations on (Post) Modern French Texts.** (3 cr [max 9 cr]. Prereq–3111)  
The meaning and purpose of the notion of “change” in French novels. Explore how a multiplicity of causes produces major changes in an individual’s personal and public life. The notion of change as it relates to financial and intellectual speculation.

**Fren 5301. Critical Issues in French Studies.** (3 cr. Prereq–# for undergrads)  
Introduces the methods of interpretation and critical debates that have shaped and continue to define the discipline of French studies. Provides a practical introduction to graduate-level literary research.

**Fren 5350. Topics in Literature and Culture.** (3 cr [max 12 cr]. Prereq–3101 or equiv)  
Problem, period, author, or topic of interest. See *Class Schedule*.

**Fren 5470. Post/Colonial Francophone Literatures.** (3 cr [max 9 cr]. Prereq–3111 or above)  
Francophone literature from North Africa, Africa, and the Caribbean of the colonial and/or post-colonial eras in the light of relevant literary and cultural theories.

**Fren 5501. Structure of French: Phonology.** (3 cr. \$3501. Prereq–[Ling 3001 or Ling 5001], grad student)  
Advanced study of sound system of contemporary French.

**Fren 5502. Structure of French: Morphology and Syntax.** (3 cr. \$3502. Prereq–5501 or #)  
Linguistic study of contemporary French word forms (inflectional and derivational morphology); introduction to French syntax (linguistic study of grammar) and characteristic syntactic constructions.

**Fren 5531. Sociolinguistics of French.** (3 cr. \$3531. Prereq–Ling 3001 or 5001, grad)  
Explores variation in the use of French associated with factors such as medium (oral/written), style (formal/informal), region, social and economic groups.

**Fren 5995. Directed Teaching.** (1-6 cr [max 24 cr]; S-N only. Prereq–#)  
Directed teaching.

**Fren 8110. Topics in Early Medieval French Literature.** (3 cr [max 9 cr]. Prereq–8111)  
Introduction to epic, romance, allegory, and theatre in Old French readings (12th-13th centuries). Specific topics/texts studied vary. Taught in French.

**Fren 8111. Introduction to Old French.** (3 cr)  
Studies in medieval French: instruction in reading Old French, sources of bibliography, and topics in medieval studies (language and literature). Taught in French.

**Fren 8114. Old Provençal Language and Literature.** (3 cr)  
Language and literature of Old Occitan (Old Provençal), chiefly troubadours’ poems. Some language instruction, reading of poems and other works, and consideration of nature and origins of “courtly love.” Knowledge of French, Spanish, or Italian desirable. Taught in English.

**Fren 8120. Topics in Later Medieval French Literature.** (3 cr [max 9 cr]. Prereq–8110 or #)  
Problems presented by texts written in France ca. 1300-1500. Evolution of Middle French language. Specific topics/texts vary. Taught in French.

**Fren 8210. Narrative, History, and Memory: Topics.** (3 cr [max 9 cr])  
Significance of narrative paradigm in literature, history, and cultural memory. Specific topics/texts treated vary. Taught in French.

**Fren 8220. Staging Modernity: Seminar in Problems of 20th-Century Theatre.** (3 cr [max 9 cr])  
Developments in 20th-century drama/performance in relation to French theatrical tradition. Post-1945 avant-garde innovation, interculturalism in contemporary theater. Specific topics/texts vary. Taught in French.

**Fren 8250. Critical Issues: Poetry.** (3 cr [max 12 cr])  
Significant critical issues relating to poetic writing of selected authors or periods.

**Fren 8260. Critical Issues: Theatre.** (3 cr [max 12 cr])  
Significant critical issues relating to dramatic writing of selected authors or periods.

**Fren 8270. Critical Issues: Prose.** (3 cr [max 12 cr])  
Significant critical issues relating to prose writing of selected authors or periods.

**Fren 8271. The Novel of the Ancien Regime.** (3 cr)  
Considers major novels of the 17th and 18th centuries in connection with developments in such areas as esthetic theory, intellectual currents, social transformations, and reading practices.

**Fren 8290. Critical Issues: Perspectives on an Author.** (3 cr [max 12 cr])  
In-depth study of major author’s writing, critical tradition this writing has occasioned, and theoretical issues upon which this writing may be brought to bear.

**Fren 8291. Jean Genet’s Writings and French Institutions.** (3 cr)  
Jean Genet’s writings at the crossroads of several disciplines (politics, psychoanalysis, religion, and law). Genet’s novels, dramas, and political essays explore the power of institutional settings and strategies imagined by individuals to short-circuit their impact.

**Fren 8333. FTE: Master’s.** (1 cr; NGA. Prereq–Master’s student, adviser and DGS consent)

**Fren 8371. The Rule of Reason, The Reign of Madness: Readings in Early Modern France.** (3 cr)  
Relationship between construction of reason and madness in philosophy, legitimization of political rule, and the institution of literature in early modern France.

**Fren 8410. Topics in Quebecois Literature.** (3 cr [max 9 cr])  
Quebecois in relation to other North American literatures and to Francophone literature produced elsewhere in the world. Specific topics/texts vary. Taught in French.

**Fren 8420. Critical Issues: Francophone Literature.** (3 cr [max 9 cr])  
Critical issues relating to literature of Francophone world. Specific topics/texts vary. Taught in French.

**Fren 8444. FTE: Doctoral.** (1 cr; NGA. Prereq–Doctoral student, adviser and DGS consent)

**Fren 8521. History of the French Language.** (3 cr)  
History of French from its origins in Latin to the present day. Aspects of diachronic phonology (sound change), morphology, syntax. Taught in French.

**Fren 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq–Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Fren 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq–Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Fren 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer; 24 cr required)

**Fren 8980. Directed Teaching.** (1-5 cr [max 25 cr])

**Fren 8992. Directed Readings for Graduate Students.** (1-5 cr [max 25 cr]. Prereq–#)

**Fren 8994. Directed Research.** (1-5 cr [max 25 cr]. Prereq–#, may be taken as tutorial with #)

## French and Italian (FrIt)

*Department of French and Italian  
College of Liberal Arts*

**FrIt 5257. Passionate Beings: Literary and Medical Problematics in Italy and France from 1800 to the Present.** (4 cr)  
Literary and medical representations of the passions in France and in Italy from 1800 to the present. Texts range from theatrical works to medical treatises on the passions as ways for exploring notions of subjectivity, responsibility, order. Taught in English.

**FrIt 5850. Topics in French and Italian Cinema.** (3 cr [max 9 cr]. Prereq–Knowledge of [French or Italian] helpful but not required)  
Focuses on a theme, problem, period, filmmaker, or other topic of interest in French or Italian cinema. See *Class Schedule*. Taught in English.

**FrIt 5999. Teaching of French and Italian: Theory and Practice.** (3 cr)  
Theoretical and practical aspects of language learning and teaching applied to French and Italian. Includes history of foreign language teaching in 20th-century United States. Taught in English.

## Genetics, Cell Biology, and Development (GCD)

*Department of Genetics, Cell Biology, and Development  
College of Biological Sciences*

**GCD 5036. Molecular Cell Biology.** (3 cr. Prereq–Biol 4004 or #; [sr or grad student] recommended)  
Modern, integrative approaches combining cell/molecular biology, biochemistry, and genetics to investigate cell organization/function. Membranes,

signaling, extracellular matrix, secretion, endocytosis, cytoskeleton, nucleus. Analysis of scientific papers to illustrate new concepts in and experimental approaches to cell organization/function.

**GCD 8008. Mammalian Gene Transfer and Expression.** (2 cr; A-F only. Prereq–#)  
Current gene transfer technology. Applications of genetic modifications in animals, particularly transgenic animals and human gene therapy.

**GCD 8073. Advanced Human Genetics.** (3 cr. Prereq–8121 or #)  
Application of molecular, biochemical, chromosomal, and population genetics to human variation and disease. Abnormal chromosome number and structure; abnormal enzyme, structural protein, receptor and transport; analysis of inheritance patterns; behavioral genetics; genetic basis of common disease. Current research articles in human genetics.

**GCD 8103. Human Histology.** (5 cr. Prereq–Undergrad [biology, chemistry, math, physics] courses, #)  
Light/electron microscopic anatomy of tissues and their organization into human organs. Emphasizes integrating structure, its relationship to function at levels from molecules to organs. Lecture, lab.

**GCD 8121. Advanced Molecular Genetics.** (3 cr. Prereq–Biol 4003, BioC 3021 or BioC 4331)  
Action of gene in molecular, cellular, and organismal development. Mechanisms of information transfer and regulation of these processes in various biological systems; examination of original research.

**GCD 8131. Advanced Genetics.** (3 cr. Prereq–3022 or Biol 4003, BioC 3021 or BioC 4331 or #)  
Literature-based course covering modern genetic analysis, including mutant screens, characterization of multiple alleles, gene mapping and cloning, genome sequencing, intergenic interactions, transposable elements, genetic mosaics, and molecular mechanisms of recombination.

**GCD 8136. Techniques of Biological Electron Microscopy.** (4 cr. Prereq–#)  
Theory and methodology of transmission and scanning electron microscopy.

**GCD 8151. Advanced Cell Biology.** (3 cr. Prereq–Biol 4004, GCD 4034 or GCD 8121 or BioC 8002 or #)  
Eukaryotic systems with emphasis on structure, function, and chemistry of cell organelles; selected specialized cells. Membranes, secretion, trafficking, cytoskeleton, cell motility, cell cycle, nucleus, and compartmentalization.

**GCD 8161. Advanced Developmental Biology.** (3 cr. Prereq–Biol 4004, [GCD 8131 or Biol 4003], GCD 4034 or GCD 8121 or BioC 8002 or #)  
Current concepts of and experimental approaches taken to understand basic mechanisms of development. Model organisms. Embryology, cell fate determination, differentiation, pattern formation, polarity, cell migration, and cell interactions. Analysis of original research articles.

**GCD 8171. Literature Analysis.** (2 cr; A-F only. Prereq–Grad MCDG major)  
Critical reading and evaluation of current literature. May include evaluation of both excellent and flawed papers. Intensive and in-depth discussions of selected papers in molecular biology, genetics, cell biology, and developmental biology.

**GCD 8212. Selected Topics in Cell and Developmental Biology.** (3 cr. Prereq–[8121 or BioC 8002], GCD 8151, [GCD 4161 or GCD 8161 or #])  
Reading and discussion of papers from current literature. Topics selected from research areas of cell biology and developmental biology and experimental approaches taken in these fields. Topics vary annually.

**GCD 8213. Selected Topics in Molecular Biology.** (4 cr. \$BioC 8213. Prereq–8121 or BioC 8002 or #)  
Sample topics: DNA replication, recombination and gene conversion, regulation of gene expression in prokaryotes, regulation of gene expression in eucaryotes, chromatin structure and transcription, organellar gene expression. Lectures, readings, discussions.

**GCD 8900. Seminar.** (1 cr [max 4 cr]; S-N only. Prereq–Grad MCDG major or #)  
Current scientific research.

**GCD 8910. Journal Club.** (1 cr [max 4 cr]; S-N only. Prereq–Grad MCDG major or #)  
Critical evaluation of selected current literature.

**GCD 8912. Genetic Counseling in Practice.** (4 cr; A-F only. Prereq–MCDG MS student with genetic counseling specialization or #)  
Practical genetic counseling, communicating genetics and medical information to the family, helping families with decision making.

**GCD 8913. Psychosocial Issues in Genetic Counseling.** (3 cr; A-F only. Prereq–MCDG MS student with genetic counseling specialization or #)  
Interviewing skills, supportive counseling, and case-study analysis specific to genetic counseling.

**GCD 8914. Ethical and Legal Issues in Genetic Counseling.** (3 cr; A-F only. Prereq–MCDG MS student with genetic counseling specialization or #)  
Professional ethics; ethical and legal concerns with new genetic technologies.

**GCD 8920. Special Topics.** (1-4 cr [max 8 cr]. Prereq–Grad MCDG major or #)  
Special topics.

**GCD 8993. Directed Studies.** (1-5 cr [max 15 cr]. Prereq–#)  
Directed studies.

**GCD 8994. Research.** (1-5 cr [max 20 cr]; S-N only. Prereq–#)  
Independent research determined by student's interests, in consultation with faculty mentor.

## Geographic Information Science (GIS)

*Department of Geography  
College of Liberal Arts*

**GIS 5571. Introduction to Arc/Info.** (3 cr. Prereq–Geog 5561 or equiv, status in MGIS program, familiarity with computer operating systems or #)  
Introductory overview of the Arc/Info system. Topics include data capture, geometric transformations and map projections, topology, editing systems, database management and map production.

**GIS 5572. Advanced Arc/Info.** (3 cr. Prereq–5571, Geog 5561 or equiv, status in MGIS program or #)  
Advanced course in Arc/Info providing in-depth exploration of the topics emphasized in GIS 5571 as well as advanced topics including dynamic segmentation, address matching, and macro language programming.

**GIS 5573. Desktop Mapping.** (1.5 cr. Prereq–Geog 5561 or equiv, Geog 3511 or equiv, status in MGIS program or #)  
Introduction to desktop mapping systems such as ArcView, MapInfo and Mapitude. Emphasizes the application of these systems to the display and analysis of geographical data.

**GIS 5574. GIS and the Internet.** (1.5 cr. Prereq–Geog 5561 or equiv, status in MGIS program or #)  
The role of the Internet in GIS applications. Topics include GIS data sources on the Internet, the role of the Internet in information dissemination, Internet capabilities for interactive mapping and issues surrounding the development of GIS-related Web sites.

**GIS 5575. Surveying and the Global Positioning System (GPS).** (2 cr. Prereq–Geog 5561 or equiv, status in MGIS program or #)  
Introduction to GPS (Global Positioning System) and other surveying techniques of use to GIS professionals. Topics include geodesy, data adjustment, datums, ellipsoids, coordinate systems, and transformations.

**GIS 5577. Spatial Data Administration.** (3 cr.  
Prereq—Geog 5561, Geog 5563 or equivs, status in MGIS program, familiarity with computer operating systems or #)

Theory and application for the administration of geographic databases including the topics of quality assurance, development planning and management, maintenance, access and distribution, and documentation.

**GIS 5590. Special Topics in GIS.** (1-3 cr [max 6 cr]. Prereq—#)

Special topics in geographic information science (GIS). Topics vary according to student needs, technological developments in field.

**GIS 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**GIS 8501. Survey of Geographic Information Science: Past, Present, and Future Trends and Activities.** (3 cr. Prereq—MGIS student or #)

Major trends and activities in geographic information science; university, local, state, and federal-level initiatives. History of GIS and its various disciplinary roots as well as major GIS-related resources (e.g., data sources, Web resources).

**GIS 8990. MGIS Capstone Project.** (2-6 cr [max 6 cr]; A-F only. Prereq—MGIS, #)

Project of sufficient scope/complexity to document student's ability to analyze issues and address them. Written summary of work. Done under supervision of faculty member and, where appropriate, workplace supervisor.

## Geography (Geog)

*Department of Geography  
College of Liberal Arts*

**Geog 5143. Geography of West Africa.** (3 cr)

West Africa from Senegal to Cameroon; social geography of resource use, population, settlement, economic development, and international relations.

**Geog 5145. Development in Africa.** (3 cr. \$Afro 5145)

Economic, political, and social development in Africa from independence to the present. Emphasis on reordering colonial landscapes, bases for North-South relations, big power intervention, and participation in the world economy.

**Geog 5181. Russia and Environs.** (3 cr. \$3181)

Physical and human geography of Russia and former Soviet republics. Legacy of central planning on regional economies, city systems and city structure. Economic and cultural links among regions and republics. Conflicts rooted in religion, ethnicity and tradition. Relations with nearby states and regions. Physical environmental problems.

**Geog 5211. East Asia.** (3 cr. \$3211, \$EAS 3211)

Open to graduate students in East Asian studies and other disciplines who wish to study the region from a geographical perspective. Research paper. Meets with 3211.

**Geog 5215. Geography of China.** (3 cr. \$3215)

Open to graduate students in East Asian studies and other disciplines who wish to study the region from a geographical perspective. Research paper. Meets with 3215.

**Geog 5361. Geography and Real Estate.** (4 cr)

Origins and evolution of land ownership in the United States.

**Geog 5371W. American Cities I: Population and Housing.** (4 cr. \$PA 5201)

Emergence of North American cities; residential building cycles, density patterns; metropolitan housing stocks, supply of housing services; population and household types; neighborhood-level patterns of housing use; housing prices; intraurban migration; housing submarkets inside metro areas; emphasis on linking theory, method, case studies.

**Geog 5372W. American Cities II: Land Use, Transportation and the Urban Economy.** (4 cr; A-F only. \$PA 5202)

Urban economy, its locational requirements. Central place theory. Transportation, urban land use: patterns/conflicts. Industrial/commercial land blight. Real estate redevelopment. Historic preservation. Emphasizes links between land use, transportation policy, economic development, local fiscal issues. U.S.-Canadian contrasts.

**Geog 5374W. The City in Film.** (4 cr. \$3374;

Prereq—Grad student or #)

Cinematic portrayal of changes in 20th-century cities worldwide. Social/cultural conflict, political/economic processes, changing gender relationships, rural versus urban areas, population/development issues (especially as they affect women/children). Meets concurrently with 3374. Additional weekly meeting discusses films, readings. Project on a topic selected in consultation with instructor.

**Geog 5385. Globalization and Development: Political Economy.** (4 cr. Prereq—5r or grad or #)

Nature/scope of modern world system (capitalism), its impact on regional development processes. Roles of state and of international financial institutions.

**Geog 5411W. Geography of Health and Health Care.** (3 cr. \$3411)

Application of human ecology, spatial analysis, political economy, and other geographical approaches to analyze problems of health and health care. Topics include distribution and diffusion of disease; impact of environmental, demographic, and social change on health; distribution, accessibility, and utilization of health practitioners and facilities.

**Geog 5421. Introduction to Atmospheric Science.**

(3 cr. \$Soil 5401. Prereq—Familiarity with fundamentals of physics, calculus, and statistics, including differential and integral calculus and basic differential equations and basic thermodynamics, mechanics, and the electromagnetic spectrum)  
Calculus-based introduction to atmospheric dynamics, radiation, thermodynamics, chemical composition, and cloud processes. Applications to climate, meteorology, the hydrologic cycle, air quality, and biogeochemical cycles.

**Geog 5423. Climate Models and Modeling.** (3 cr.

Prereq—3401 or #)

Survey of development and research with simple and complex (three-dimensional) climate models. Environmental processes and their numerical representation in climate models; evaluation of model sensitivity and accuracy; coupling between atmosphere, biosphere, hydrosphere, and cryosphere; assessment of model predictions for climate change.

**Geog 5426. Climatic Variations.** (3 cr. Prereq—1425 or 3401 or #)

Theories of climatic fluctuations and change at decadal to centuries time scales; analysis of temporal and spatial fluctuations especially during the period of instrumental record.

**Geog 5431. Plant and Animal Geography.** (3 cr. \$3431)

Introduction to biogeography. Focuses on patterns of plant/animal distributions at different scales over time/space. Evolutionary, ecological, and applied biogeography. Paleobiogeography, vegetation-environment relationships, vegetation dynamics/disturbance ecology, human impact on plants/animals, nature conservation. Discussions, group/individual projects, local field trips.

**Geog 5441. Quaternary Landscape Evolution.** (3 cr.

Prereq—3401 or grad student or #)

Roles of climate change, geomorphic history, vegetation change, and soil development in the evolution of landscape patterns during the Quaternary Period, with emphasis on North America.

**Geog 5444. Water Resources, Individuals and Institutions.** (3 cr. \$ WRS 5101. Prereq—1402 or 3401 or grad or #)

How water resources are controlled by natural system functions, user actions, and the influence of social and political institutions. Explore how these three levels of control vary in space and time, paying particular attention to the complexities of each of these controls and the feedbacks among them.

**Geog 5511. Advanced Cartography.** (3 cr. Prereq—3511 or #)

Advanced topics on data sources for mapping; history of thematic cartography (focused on 19th-century European activity); multivariate classification and symbolization; models for cartographic generalization, spatial interpolation, and surface representation; principles of animated and multimedia cartography.

**Geog 5512. Cartography: Topics.** (3 cr. Prereq—3511 or 3531 or #)

Selected topics include the system of cartographic communication, map design, map reading, map analysis, history of cartography.

**Geog 5530. Cartography Internship.** (2-7 cr [max 10 cr]; S-N only. Prereq—#)

Provides intensive hands-on experience in contemporary map production and design, ranging from GIS applications to digital prepress. Strong computer skills essential.

**Geog 5531. Numerical Spatial Analysis.** (4 cr; A-F only. \$3531)

Applied/theoretical aspects of geographical quantitative methods for spatial analysis. Emphasizes analysis of geographical data for spatial problem solving in human/physical areas.

**Geog 5561. Principles of Geographic Information Science.** (4 cr. Prereq—Grad)

Introduction to the study of geographic information systems (GIS) for geography and non-geography students. Topics include GIS application domains, data models and sources, analysis methods and output techniques. Lectures, reading, and hands-on experience with GIS software.

**Geog 5562. Geographic Information Science and Analytical Cartography.** (3 cr. Prereq—3561 or 5561 and 3511; or #)

Topics include algorithms and data structures for digital cartographic data, topological relationships, surface modeling and interpolation, map projections and geometric transformations, numerical generalization, and raster and vector processing. Hands-on experience using a variety of software packages.

**Geog 5563. Advanced Geographic Information Science.** (3 cr. Prereq—B or better in 3561 or 5561 or #)

Advanced study of geographic information systems (GIS). Topics include spatial data models, topology, data encoding, data quality, database management, spatial analysis tools and visualization techniques. Hands-on experience using an advanced vector GIS package.

**Geog 5564. Urban Geographic Information Science and Analysis.** (3 cr. Prereq—3561 or 5561)

Core concepts in urban geographic information science including sources for urban geographical and attribute data (including census data), urban data structures (focusing on the TIGER data structure), urban spatial analyses (including location-allocation models), geodemographic analysis, network analysis, and the display of urban data.

**Geog 5565. Geographical Analysis of Environmental Systems and Global Change.** (3 cr. Prereq—3561 or 5561 or FR 4131 or LA 5573 or one intro GIS course or grad or #)

Applications of geographic information systems and other spatial analysis tools to the analysis of environmental systems patterns, dynamics, and interactions. Focus on global to landscape databases developed to analyze atmospheric, hydrospheric, geomorphic, pedologic, biologic, and human land use systems.

**Geog 5588. Multimedia Cartography.** (3 cr.  
Prereq—Minimum of three geog courses, including one cartography course or advanced standing in an allied field such as landscape architecture or #)  
Conceptualizing geographic topics in animatable form, selecting appropriate animation metaphors for specific ideas, using standard graphic software to prepare images for computer display and animation.

**Geog 5605V. Honors: Geographical Perspectives on Planning.** (4 cr. \$3605W. Prereq—Honors or grad student)  
Role of planning in reshaping 19th-/20th-century cities in Europe, North America, selected Third World countries. History of planning. Societal change, interest groups, power relations in planning process. Citizen participation/practice in planning. Meets with 3605. Includes additional weekly seminar-style meeting, bibliography project on topic selected in consultation with instructor.

**Geog 5605W. Geographical Perspectives on Planning.** (4 cr. \$3605)  
Open to graduate students and undergraduates wishing Honors credits. Includes one additional weekly seminar-style meeting and a bibliography project on a topic selected in consultation with the instructor. Meets with 3605.

**Geog 5701. Field Research.** (3 cr. Prereq—9 cr in geog, #)  
Field investigation in physical, cultural, and economic geography; techniques of analysis and presentation; reconstruction of environments.

**Geog 5724. Meanings of Place.** (3 cr; A-F only. \$Arch 5724. Prereq—Jr or sr or grad)  
Analysis of the messages and meanings of our natural and built surroundings. Considers place-based responses to urban and rural settings based on aesthetic, historic, social, personal, and design perspectives. Uses extensive project and field work components and involves significant writing.

**Geog 5775. Geographic Education.** (3 cr. Prereq—Three courses in geography or history or social sciences or education or #)  
Teaching geography from middle school up; pedagogical use of geographical themes; methods for effective teaching of multiple cognitive domains—facts, theories, analytical skills, and evaluations; designing audio-visual aids, independent projects, simulations, etc. to meet National Standards in geography.

**Geog 5900. Topics in Geography.** (3 cr [max 9 cr]. Prereq—Sr or grad, #)  
Special topics and regions. Course offered by visiting professors in their research fields.

**Geog 8001. Problems in Geographic Thought.** (3 cr; A-F only)  
Currents of geographic thought in biophysical, GIS, human, cultural, and human-environment subfields. Focuses on concepts/paradigms through which geographers have attempted to unify/codify the discipline, around which debate has flourished, and about which interdisciplinary histories can be traced.

**Geog 8002. Research Methods in Geography.** (3 cr; A-F only)  
Seminar. Overview of research designs/methods in geography. Relationships between different research paradigms (modes of inquiry), research designs, and methods. Critical readings. Analyses of research projects.

**Geog 8005. Proseminar: Population Geography.** (3 cr. Prereq—#)  
Conceptual literature and empirical studies on fertility, mortality, and migrations in different parts of the world.

**Geog 8006. Proseminar: Research Methods in Geography.** (3 cr. Prereq—#)  
Introduction to research design, strategies, methods of data collection, analysis, interpretation, and representation in contemporary geographic research.

**Geog 8007. Proseminar: Theories of Development and Change.** (3 cr. Prereq—#)  
Recent research themes and questions in geography and related social sciences on Third World development; development theories, conceptually grounded case studies, and grassroots-based research.

**Geog 8020. Research Seminar: Economic Geography.** (3 cr. Prereq—#)  
Contemporary research. Advanced topics, which vary with interests of faculty offering course.

**Geog 8101. Proseminar: Nature and Society.** (3 cr. Prereq—#)  
Interconnectedness of environment and people, nature and society. Conceptual literature and empirical studies in human/cultural/political ecology.

**Geog 8102. Proseminar: The State, the Economy, and Spatial Development.** (3 cr. Prereq—#)  
Introduction to research in economic, political, and urban geography: conceptual research addressing interrelationship between political and economic processes and spatial dynamics of urban and regional development; empirical research documenting nature and extent of this interrelationship at different spatial scales.

**Geog 8103. Proseminar: Physical Geography.** (3 cr; S-N only. Prereq—#)  
Historical development of research in physical geography, current research trends, and transfer of current research to undergraduate education.

**Geog 8105. Proseminar: Historical Geography.** (3 cr. Prereq—#)  
Introduction to conceptual research and empirical studies.

**Geog 8106. Seminar: Social and Cultural Geography.** (3 cr. Prereq—#)  
Role of space and place in constitution of social and cultural life, social relations, and social identities; class, space, and place; geography of race and racism; environmental racism; geography of gender and sexuality; nationalism, national identity, and territory.

**Geog 8107. Geographic Writing.** (3 cr; S-N only. Prereq—#)  
Analysis of organization and presentation of geographic research. Critiques of selected examples of geographic writing.

**Geog 8201. Explorations in the Geography of Minnesota.** (3 cr; S-N only. Prereq—#)  
Physical environment, agriculture, forestry, mining, land survey, population, recreation, cities/towns, transportation. Sources of information about the state. Students make short oral/written reports. Might provide springboard for a Plan B paper, thesis, or dissertation. Two or three Saturday field trips.

**Geog 8211. Environmental Policy.** (3 cr. Prereq—#)  
U.S. environmental policies at federal/state level. Policy formulation, implementation, and evaluation.

**Geog 8212. Africa.** (3 cr. Prereq—#)  
Advanced topics. Topics vary with interests of faculty offering course.

**Geog 8213. East Asia and China.** (3 cr. Prereq—#)  
Contemporary research, advanced topics. Topics vary with interests of faculty offering course.

**Geog 8214. South Asia.** (3 cr)  
Advanced topics. Topics vary with interests of faculty offering course.

**Geog 8220. Agrarian Change and Rural Development.** (3 cr; A-F only)  
Contours of agricultural/rural development in Third World. Theories of agrarian transformation and of rural development. Role of agriculture in economic development. Peasant economy. Nature/role of state intervention in rural sector.

**Geog 8230. Theoretical Geography.** (3 cr. Prereq—#)  
Advanced topics. Topics vary with interests of faculty offering course. Contemporary theoretical/philosophical themes transcending subdisciplines of human/physical geography.

**Geog 8240. Medical Geography.** (3 cr. Prereq—5411 or #)  
Geographic inquiry concerning selected problems of health and health care.

**Geog 8260. Seminar: Physical Geography.** (3 cr. Prereq—#)  
Topics of contemporary research. Topics vary with interests of faculty offering course.

**Geog 8270. Seminar: Climatology.** (3 cr; A-F only. Prereq—#)  
Sample topics: climate modeling; climatic variability; climate change and predictability; severe local storms; drought; energy balance; urban climate; statistical climatology.

**Geog 8290. Seminar in GIS and Cartography.** (3 cr. Prereq—#)  
Selected concepts/methods. Topics, which vary yearly, include spatial analysis methods in GIS; advanced visualization methods; data quality and error propagation in GIS; generalization methods in GIS and cartography; role of time in GIS; interactive/animated cartography; incorporation of uncertainty.

**Geog 8291. Seminar in GIS, Technology, and Society.** (3 cr. Prereq—#)  
Relationships between practice of GIS and political, economic, legal, institutional structures of society. Effects of GIS on society. Nontraditional spaces in GIS. GIS and local decision making. Privacy issues.

**Geog 8302. Research Development.** (3 cr; S-N only. Prereq—#)  
Students in geography and related social sciences are guided in key steps to effective research proposal writing.

**Geog 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**Geog 8336. The Developmental State.** (3 cr; A-F only. Prereq—#)  
Why certain interventionist states in third world countries have been able to guide their economies to overcome legacy of underdevelopment while most have failed to induce development. Internal/external conditions that facilitated such departure from underdevelopment. Comparative national/provincial case studies: Taiwan, South Korea, Botswana, Brazil, India. Applying theoretical approaches to policy issues.

**Geog 8350. Seminar: World Population.** (3 cr. Prereq—#)  
Contemporary research in world population development and problems. Topics vary with interests of faculty offering course.

**Geog 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**Geog 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Geog 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Geog 8800. Seminar: Development of Geographic Thought.** (3 cr. Prereq—#)  
Topics vary with interests of faculty offering course.

**Geog 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

**Geog 8970. Directed Readings.** (1-5 cr)

**Geog 8980. Topics in Geography.** (1-3 cr [max 15 cr]. Prereq—#)  
Seminar offered by visiting or regular faculty. Topics vary with interests of faculty.

**Geog 8990. Research Problems in Geography.** (1-5 cr)  
Individual research projects.

# Geological Engineering (GeoE)

Department of Civil Engineering  
Institute of Technology

**GeoE 5311. Experimental Geomechanics.** (3 cr; A-F only. Prereq—IT upper division or grad student; 4301, CE 4301, or #)  
Machine stiffness; closed-loop testing. Small-strain theory. Measurement of deformation; strain gages, LVDTs, accelerometers, and associated circuits. Direct and indirect testing. Material behavior: experiments on anisotropic, damaged, and fluid-filled solids.

**GeoE 5321. Geomechanics.** (3 cr; A-F only. Prereq—IT upper division or grad student; 4301, CE 4301 or #)  
Review of elasticity theory and solution of some elastic boundary value problems relevant to geomechanics. Wave propagation in unbounded elastic media. Elements of fracture mechanics and applications. Elements of poroelasticity and applications.

**GeoE 5331. Geomechanics Modeling.** (3 cr; A-F only. Prereq—IT upper division or grad student, 4301 or CE 4301)  
Soil and rock response in triaxial testing; drained and undrained behavior; elastic and plastic properties. Modeling stresses, strains, and failure in geomechanics problems.

**GeoE 5341. Wave Methods for Nondestructive Testing.** (4 cr; A-F only. SCE 5341. Prereq—[AEM 2021, AEM 3031] or #)  
Introduction to contemporary methods for nondestructive characterization of objects of civil infrastructure (e.g., highways, bridges, geotechnical sites). Imaging technologies based on propagation of elastic waves: ultrasonic and resonant frequency methods, seismic surveys, acoustic emission monitoring. Lecture, lab.

**GeoE 8300. Seminar: Geomechanics.** (1 cr [max 4 cr]. Prereq—#)  
Presentations on various topics.

**GeoE 8301. Fracture of Geomaterials.** (3 cr; A-F only. Prereq—5331, CE 5331 or #, IT grad student)  
Crack tip stress and displacement fields; stress intensity factors. Energy principles of fracture; compliance method. Process zone models. J integral. Mixed-mode fracture. Behavior of cracked solids. Numerical and experimental approaches.

**GeoE 8302. Soil/Rock Plasticity and Limit Analysis.** (4 cr; A-F only. Prereq—[IT grad student, CE 4300] or #)  
Plasticity of soils and rocks. Yield conditions, flow rules. Theorems of limit analysis. Static solutions, method of characteristics. Kinematic solutions, hodograph. Energy balance. Applications to soil/rock engineering problems.

**GeoE 8311. Advanced Rock Mechanics.** (3 cr; A-F only. Prereq—5331, CE 5331 or #, IT grad student)  
Stress transformations; principal stresses and directions. Friction and behavior of rock joints; stability of frictional sliding. Elastic waves; acoustic emission and seismic measurements. Fragmentation and rock breakage.

**GeoE 8321. Thermoporoelasticity.** (4 cr; A-F only. Prereq—5321, CE 5321 or #, IT grad student)  
Micro-mechanical description of porous media. Thermodynamics foundations. Linear theory of thermoporoelasticity: constitutive, transport, and balance laws; field equations. Determination of material constants. Singular solutions. Methods of solution: integral transform, method of singularities, finite and boundary element method.

**GeoE 8322. Storage and Flow of Granular Materials.** (3 cr; A-F only. Prereq—CE 4301 or #, IT grad student)  
Plasticity of soils and rocks. Yield conditions, flow rules. Theorems of limit analysis. Static solutions, method of characteristics. Kinematic solutions, hodograph. Energy balance. Applications to soil/rock engineering problems.

**GeoE 8331. Modeling Geomechanical Processes.** (3 cr; A-F only. Prereq—5321 or CE 5321 or #, IT grad student)  
Data-limited nature of problems in geomechanics. Dimensional analysis. Regimes of solution. Similarity solutions. Elements of fracture mechanics, elastoplasticity, poroelasticity. Geomechanical applications to stability of underground excavations, fluid flow in fracture, tool-rock interaction, hydraulic fracturing.

**GeoE 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**GeoE 8336. Boundary Element Methods I.** (3 cr; A-F only. Prereq—IT grad student or #)  
Introduction to boundary element methods for elastostatics; stress discontinuity method; displacement discontinuity method; direct boundary integral method. Derivation of basic mathematical solutions from the theory of elasticity. Applications of boundary element methods in geomechanics.

**GeoE 8337. Boundary Element Methods II.** (3 cr; A-F only. Prereq—8336, CE 8336 or #)  
Transient and nonlinear problems.

**GeoE 8351. Advanced Groundwater Mechanics I.** (3 cr; A-F only. Prereq—CE 4351, IT grad student or #)  
Solute transport; shallow flow in leaky aquifers; complex variable methods in groundwater flow; analytic element method: potentials for line sinks, line doublet, line dipoles, area sinks, and special analytic elements; singular Cauchy integrals; analytic elements in domains with closed boundaries.

**GeoE 8352. Advanced Groundwater Mechanics II.** (3 cr; A-F only. Prereq—4351 or CE 4351, IT grad student or #)  
Applying complex methods, including conformal mapping, in groundwater mechanics; solving problems with free boundaries using the hodograph method; drains in aquifers with free boundaries; superposition of solutions with drains; singular Cauchy integrals; boundary elements.

**GeoE 8361. Engineering Model Fitting.** (3 cr; A-F only. Prereq—IT grad student or #)  
Parameter estimation and inverse modeling for civil and geological engineering. Formulating engineering model fitting problems; comparing and selecting various fit criteria; implementing numerical algorithms; analyzing and interpreting results using both statistical and qualitative tools; designing future measurement plans.

**GeoE 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**GeoE 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**GeoE 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**GeoE 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

# Geology and Geophysics (Geo)

Department of Geology and Geophysics  
Institute of Technology

**Geo 5001. Earth Systems Science for Teachers.** (3 cr. \$1001. Prereq—Educ degree)  
Solid Earth, hydrosphere, atmosphere, biosphere, their interconnections in natural cycles of material/energy. Consequences of natural cycles for land-water-atmosphere-life environments/Earth's habitability. Human impact on natural cycles. Evidence for global environmental changes. Required project.

**Geo 5002. Earth History for Teachers.** (4 cr. \$1002. Prereq—Ed degree)  
Evolution of life on Earth. Interrelationships of plate tectonism, climate change, and organic evolution leading to present ecosystem. Impact of hominid evolution on Earth systems and geological processes on human society. Required project designed to enhance ability to teach Earth history to K-12 students.

**Geo 5003. Dinosaur Evolution for Teachers.** (3 cr. \$1003. Prereq—Ed degree)  
Dinosaurs and Mesozoic Earth used to introduce evolution, plate tectonics, climate change, and Earth systems. History of theories about dinosaurs illustrates principles and social aspects of scientific investigation. Required project designed to enhance ability to teach dinosaur evolution to K-12 students.

**Geo 5006. Oceanography for Teachers.** (3 cr. \$1006. Prereq—Ed degree)  
How various processes in the ocean interact. Marine biology, waves, tides, chemical oceanography, marine geology, and human interaction with the sea. Labs include study of live marine invertebrates, manipulation of oceanographic data, and discussion using videos showing unique aspects of ocean research. Required design of modules for presenting course material to elementary or secondary school students.

**Geo 5108. Principles of Environmental Geology.** (3 cr. Prereq—Geology majors: core curriculum through 4501 or #; nonmajors: 1001 or #)  
Human impact on geological environment and effect of geology/geologic processes on human life from an ecosystems and biogeochemical cycles perspective. Geologic limits to resources and carrying capacity of Earth. Land use planning, environmental impact assessment, ecogeologic world models. Field project and trip.

**Geo 5201. Time-Series Analysis of Geological Phenomena.** (3 cr; A-F only. Prereq—Math 2263 or #)  
Time-series analysis of linear and nonlinear geological and geophysical phenomena. Examples drawn from ice age cycles, earthquakes, climatic fluctuations, volcanic eruptions, atmospheric phenomena, thermal convection and other time-dependent natural phenomena. Modern concepts of nonlinear dynamics and complexity theory applied to geological phenomena.

**Geo 5202. Geological Thermomechanical Modeling.** (3 cr; A-F only. Prereq—Math 2263 or #)  
Concept of heat and mass transfer processes in Earth's crust and mantle. Quantitative study of thermomechanical phenomena. Emphasis on analytical and modern numerical techniques.

**Geo 5203. Mineral and Rock Physics.** (3 cr. Prereq—2201, Phys 1302)  
Physical properties of minerals and rocks as related to the composition and dynamics of the Earth's crust, mantle, and core.

**Geo 5301. Aqueous Environmental Geochemistry.** (3 cr. Prereq—Chem 3501 or #)  
General principles of solution chemistry applied to geology. Solution-mineral equilibria. Redox processes in natural waters. Geochemistry of hydrothermal fluids. Environmental geochemistry.

**Geo 5302. Isotope Geology.** (3 cr; A-F only. Prereq—2303 or #)  
Theory and uses of radioactive, radiogenic, and stable isotopes in geology. Radioactive dating, geothermometry, and tracer techniques in geologic processes.

**Geo 5353. Electron Microprobe Theory and Practice.** (2-3 cr. Prereq—2301, one yr chem and physics or #)  
Theory and practice of characterizing solid materials with electron beam instrumentation, including the reduction of X-ray data to chemical compositions.

**Geo 5502. Advanced Structural Geology.** (3 cr.

Prereq-4501 or #)  
Analysis of structures and fabric of deformed rocks. Determination of states of stress and strain in rocks and of evolution of these with time. Deformation mechanisms. Extensive reading in journal literature. Field trips.

**Geo 5601. Advanced Sedimentology.** (4 cr.

Prereq-4602 or #)  
Modern techniques of sedimentary basin analysis focusing on interactions among the lithosphere, atmosphere, and hydrosphere. Sedimentary facies of modern and ancient systems, petrology of clastic and carbonate deposits, tectonic and paleoclimatic interpretations, paleocurrent analysis, diagenetic effects on subsurface fluid flow, and volcanic sedimentation.

**Geo 5602. Depositional Mechanics.** (3 cr. Prereq-4602, Math 2243 or #)

Elementary mechanics of sediment transport applied to quantitative interpretation of sedimentary rocks.

**Geo 5701. General Hydrogeology.** (3 cr. Prereq-Chem 1022, Math 1271, Phys 1201, Geo majors-core curriculum through 2402 or #)

Theory of groundwater geology, hydrologic cycle, watershed hydrology, Darcy's law, governing equations of groundwater motion, flow net analysis, analog models, and groundwater resource evaluation and development. Applied analysis of steady and transient equations of groundwater motion and chemical transport. Chemistry of natural waters.

**Geo 5702. Regional Aquifer Systems of North America.** (3 cr. Prereq-5701 or #)

Geologic controls on flow patterns within aquifer systems. Case histories and specific examples from glaciated terrains and Paleozoic basins in Minnesota. Analysis of basin-scale regional aquifer systems of North America. Survey of famous aquifer systems of the world.

**Geo 5703. Regional Geomorphology.** (2 cr [max 6 cr]. Prereq-4501 or #)

Geology of a particular region of the country, emphasizing its geomorphology. One-week field trip to the area is taken during spring break. May be taken for credit more than once if regions are different.

**Geo 5704. Glaciology.** (3-4 cr. Prereq-Math 2263 or #)

Theories of glacier flow. Internal structures and heat flow in glaciers and ice sheets. Geomorphic features produced by glaciers. Reading assignments and problems.

**Geo 5705. Limnogeology and Paleoclimate.** (3-4 cr. Prereq-1001, 4601 or #)

Systems study of modern and ancient lakes of the world as archives of environmental history, as natural resources, as biogeochemical and physical process models, and as basins in geologic history. Includes many case studies and examines aquatic signatures for interpreting paleoclimate.

**Geo 5713. Tracers and Karst Hydrogeology.** (3 cr. Prereq-5701, #)

Karst hydrogeology and application of tracers to determine source, age, and mixing parameters of water in various natural reservoirs. Physical and chemical principles and processes operating in karst hydrogeology; use of natural and synthetic chemical and isotopic labels or tracers to follow movement and mixing of water through hydrologic cycle.

**Geo 5802. Scientific Visualization.** (3 cr. Prereq-CSci 1107 or CSci 1113 or #)

Visualization hardware and software, three-dimensional graphics, representation of scientific data, modeling, user interface techniques, output, commonly used algorithms, animation, case studies and examples.

**Geo 8243. Principles of Rock Magnetism.** (1-3 cr. Prereq-4204 or #)

Remanent magnetizations, their classification and origins. Fundamentals of fine particle magnetism; magnetic minerals; separation of multicomponent magnetizations; effects of chemical change on magnetization; magnetic proxies of climatic and environmental change; biomagnetism.

**Geo 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**Geo 8351. Geochemical Modeling of Aqueous Systems.** (3 cr. Prereq-5301 or #)

Using mass transfer reaction path models to assess chemical evolution of natural fluids, hydrothermal alteration processes, and formation of hydrothermal ore deposits.

**Geo 8353. Phase Equilibrium in Mineral Systems.** (3 cr. Prereq-4301, Chem 3501, Math 2243)

Principles of homogeneous and heterogeneous equilibria and their application to problems in petrology. Emphasis on derivations from first principles and formulation of algebraic and graphical methods essential to multicomponent systems.

**Geo 8354. Igneous Petrology.** (3 cr. Prereq-4301 or #)

Igneous rocks and processes, emphasizing geochemistry of melts and minerals. Content varies with instructor and student interest.

**Geo 8355. Metamorphic Petrology.** (3 cr. Prereq-8353)

Metamorphic processes; relation of theory and observation to current problems. Relation of fundamental concepts and techniques to progressive development of mineral assemblages. Term paper required.

**Geo 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**Geo 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Geo 8712. Transport Phenomena and Analytical Geohydrology.** (3-4 cr. Prereq-5701 or CE 3502 or #)

Microscopic flow parameters, momentum, mass and energy transport through porous media. Geologic factors in aquifer performance, equations for groundwater flow, and analysis of pump tests.

**Geo 8718. Numerical Methods in Hydrogeology.** (4 cr; A-F only. Prereq-5701, CSci 1107 or #)

Introduction to finite difference and finite element methods in hydrogeology. Students develop one- and two-dimensional models of diffusion and advection-dispersion equations.

**Geo 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Geo 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

**Geo 8970. Seminar: Current Topics in Geology and Geophysics.** (1-4 cr [max 30 cr]; A-F only. Prereq-#)

**Geo 8980. Seminar: Current Topics in Geology and Geophysics.** (1-4 cr [max 30 cr]; S-N only. Prereq-#)

**Geo 8994. Research in Geology and Geophysics.** (1-4 cr [max 30 cr]. Prereq-#)

Independent research under faculty supervision.

## German (Ger)

### Department of German, Scandinavian, and Dutch College of Liberal Arts

**Ger 5011. Advanced Conversation and Composition.** (3 cr. Prereq-3012)

Helps graduate and advanced undergraduate students achieve high proficiency in writing and speaking professional and academic German.

**Ger 5016. Advanced Translation: Theory and Practice.** (3 cr. Prereq-3016 or #)

Translation theory, related issues in stylistics, philosophy of language; sample translations; student production of translations with methodological commentary.

**Ger 5101. Analysis of German.** (3 cr. Prereq-1004, Ling 3001 or Ling 5001 or #)

Phonology, morphology, and syntax of standard German.

**Ger 5410. Topics in German Literature.** (3 cr [max 9 cr]. Prereq-3104 or equiv)

Topic may focus on a specific author, group of authors, genre, period, or subject matter. Topics specified in *Class Schedule*.

**Ger 5510. Topics in Contemporary German Culture.** (3 cr [max 9 cr]. Prereq-3104 or equiv)

A single topic of contemporary German culture explored in depth.

**Ger 5610. German Literature in Translation.** (3 cr [max 9 cr]. Prereq-No knowledge of German required; cr toward major or minor requires reading in German)

Study in depth of authors or topics from various periods in German literature. Requires no knowledge of German.

**Ger 5630. Topics in German Cinema.** (3 cr [max 9 cr]. Prereq-3xxx film course or #)

Topics chosen may focus on specific directors, genres, film production or reception, and/or other formal, theoretical, historical, or political issues.

**Ger 5711. History of the German Language I.** (3 cr. Prereq-#3012)

Historical development of German from the beginnings to 1450.

**Ger 5712. History of the German Language II.** (3 cr. Prereq-5711)

Historical development of German from 1450 to 2000.

**Ger 5721. Introduction to Middle High German.** (3 cr)

Introduction to Middle High German language and literature. Study of grammar through formal description of Middle High German phonology, morphology, and syntax. Normalized MHG texts read.

**Ger 5722. Middle High German: Advanced Readings.** (3 cr. Prereq-5721)

Acquisition of fluency in reading Middle High German normalized as well as non-normalized texts, both poetry and prose.

**Ger 5731. Old High German I.** (3 cr)

Study of the monuments of Old High German. Detailed investigation of Old High German in comparison with the other Germanic languages.

**Ger 5732. Old High German II.** (3 cr. Prereq-5731)

Study of the monuments of Old High German. Detailed investigation of Old High German in comparison with the other Germanic languages.

**Ger 5734. Old Saxon.** (3 cr)

Study of the poetry of Old Saxon. Detailed investigation of Old Saxon in comparison with the other Old Germanic languages.

**Ger 5740. Readings in Philology.** (3 cr [max 9 cr])

Philological analysis of a chosen text in any medieval Germanic language.

**Ger 5771. Early New High German.** (3 cr)

Reading and analysis of Early New High German texts. Formal description of Early New High German phonology, morphology, syntax.

**Ger 5781. Varieties of Modern German.** (3 cr. Prereq-5101)

Lexical, syntactic, and phonological variations examined using contemporary methods of dialectology and sociolinguistics.

**Ger 5801. German Script Since 1500: Readings.** (3 cr)

Handwriting and printed book scripts will be read, 1500-2000.

**Ger 5993. Directed Studies.** (1-4 cr [max 12 cr]. Prereq-#, Δ, □)

Guided individual reading or study.

**Ger 8002. Basic Seminar in German Studies.** (3 cr)

Theory and methods applicable in study of German literature and culture; introduction to bibliography and research skills; guided research projects.

**Ger 8200. Seminar in Medieval German Literature and Culture.** (3 cr [max 9 cr]. Prereq-5721)

Topics on specific author, group of authors, genre, or subject matter in German literature, ca. 800-1450.

**Ger 8210. Seminar in Early Modern German**

**Literature and Culture.** (3 cr [max 9 cr])  
Topics on specific author, group of authors, genre, or subject matter in German literature, 1450-1750.

**Ger 8220. Seminar in 18th-Century German**

**Literature and Culture.** (3 cr [max 9 cr])  
Literary, philosophical, and aesthetic texts emerging from major 18th-century literary trends, 1720-1810. Cultural and historical contexts of Enlightenment and Weimar Classicism.

**Ger 8230. Seminar in 19th-Century German**

**Literature and Culture.** (3 cr [max 9 cr])  
Examination of an author, issue, or movement, using a variety of critical approaches.

**Ger 8240. Seminar in 20th-Century German**

**Literature and Culture.** (3 cr [max 9 cr]; A-F only)  
Topics on literature, film, or other forms of "high" and popular culture.

**Ger 8300. Topics in Literature and Cultural Theory.**

(3 cr [max 9 cr])  
Authors, themes, movements, and social issues from 1700 to present. Focus varies each semester.

**Ger 8700. Philological Seminar.**

(3 cr [max 9 cr])  
Sample topics: history of Germanic tribes, history of scholarship in Germanic philology, Germanic dialects.

**Ger 8701. Philological Proseminar I: Bibliography.**

(3 cr; A-F only)  
Introduction to bibliography emphasizing Germanic medieval languages and literatures and medieval Latin. See Scan 8702.

**Ger 8741. Gothic and Methods of Comparative Reconstruction I.**

(3 cr)  
The oldest extant Germanic language and the prehistory of Germanic group of languages.

**Ger 8742. Gothic and Methods of Comparative Reconstruction II.**

(3 cr; Prereq-8741)  
Continuation of study of the oldest extant Germanic language and the prehistory of Germanic group of languages.

**Ger 8751. Paleography: Medieval Manuscript Readings.**

(3 cr; A-F only)  
Introduction to techniques of reading and transcribing medieval German and Latin manuscripts.

**Ger 8752. Medieval Text Editing.**

(3 cr)  
Introduction to techniques of historical text-critical editing of medieval Germanic and Latin manuscripts.

**Ger 8793. Germanic Philology Directed Study.**

(1-3 cr [max 12 cr]; Prereq-#, Δ)

**Ger 8810. Feminist Literary Theory and History.**

(3 cr [max 9 cr])  
Cultural, historical, and literary examination of writings of German women, 18th-20th centuries, and feminist theoretical tools used to analyze their work.

**Ger 8820. Seminar: Advanced Theory.**

(3 cr [max 9 cr])  
Topic in critical thought, e.g., the Frankfurt School, hermeneutics, reception theory.

**Ger 8994. Directed Research.**

(1-3 cr [max 12 cr]; Prereq-#, Δ; may be taken as tutorial with #)

## German, Scandinavian, and Dutch (GSD)

*Department of German, Scandinavian, and Dutch  
College of Liberal Arts*

**GSD 5103. Teaching of Germanic Languages.** (4 cr)  
Second language acquisition theory, methods, testing, and technology applicable to teaching of modern Germanic languages.

**GSD 8333. FTE: Master's.** (1 cr; NGA; Prereq-Master's student, adviser approval, Δ)

**GSD 8444. FTE: Doctoral.** (1 cr; NGA; Prereq-Doctoral student, adviser approval, Δ)

**GSD 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA; Prereq-Doctoral student who has not passed prelim oral)

**GSD 8801. Dissertation Seminar.**

(3 cr)  
For doctoral students in German and Scandinavian studies who are beginning to establish topics and do research for their dissertations. Discussion of a variety of topics related to this process as well as presentation of some written work.

**GSD 8802. Dissertation Writing Seminar.**

(3 cr; S-N only; Prereq-8801, completion of doctoral preliminary examinations)  
Critical, supportive forum for discussion of problems/issues related to dissertation research/writing. Shaping/controlling one's topic. Developing chapter outlines. Questions of audience. Careful uses of language. Turning a dissertation into a book.

**GSD 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA)

## Gerontology (Gero)

*School of Public Health*

**Gero 5105. Multidisciplinary Perspectives on Aging.**

(3 cr)  
Sociological, psychological aspects of aging; theories of aging; death and bereavement; issues and problems of older adults in America; human services and their delivery systems (health, nutrition, long-term care, education); public policy and legislation; environment and housing; retirement.

**Gero 5110. Biology of Aging.**

(3 cr)  
Biological changes that occur with aging. Methods for studying aging, descriptions of population aging, theories on how/why we age. Process of aging in each body system, variation between individuals/populations. Clinical implications of biological changes with age. Guest lecturers from different disciplines.

**Gero 8020. Seminar in Gerontology.**

(2 cr; Prereq-#)  
Meets weekly. Students present and discuss new or completed research projects on aging; conduct formal reviews using NIH formats; critique published papers using formal review criteria employed by gerontologic journals; become familiar with large database in aging and describe how that database has been used in research for secondary analyses.

## Global Studies (GloS)

*Institute of International Studies*

*College of Liberal Arts*

**GloS 5103. Colonialism and Modernity.**

(3 cr; A-F only; Prereq-[3101, Area 3144] or #)  
How modern world has been constituted by colonial encounter. Role of colonialism in construction of the west. Images of non-western societies. Modernity in colonial/postcolonial societies. Problems/potential of universal categories such as democracy, gender, history, human rights. globalization at the margins.

**GloS 5114. International Perspectives—U.S.-Mexico Border Cultures.**

(3 cr; Prereq-Grad student)  
The relations of Mexico and the United States from an international perspective with a central focus on the cultural interchange in the border lands between the two countries. Uses both literary and historical materials.

**GloS 5301. Environment and Empire.**

(3 cr; A-F only; Prereq-[3101, Area 3144] or #)  
Key issues in environmental history. Emphasizes global/colonial processes that have made modern environment. Global spread of diseases, modern remaking of world's flora/fauna, idea of nature. New technologies and the environment. Conservationist ideology.

**GloS 5410. Interactive Global and Local Studies.**

(3 cr; A-F only; Prereq-#)  
Global studies topics, locally in the Twin Cities and Minnesota, and internationally through linked communication with classes at cooperating universities in other countries. Students communicate with counterparts abroad through e-mail to develop comparative/interactive elements. Possible topics: role of river in local history, grain storage/processing, manufacturing/trade, growth of metropolitan area.

**GloS 5602. Other Worlds: Globality and Culture.** (3 cr; A-F only; Prereq-[3101, Area 3144, grad student] or #)  
Interconnectedness of world. Considering not one world, but many. Colonialism, consumption, diasporic conditions, global media, nationalism, supra-national governance. How globality is experienced/contested locally/specifically.

**GloS 5603. Socialist/Post-socialist Transformations.**

(3 cr; A-F only)  
Transformations underway in post-socialist societies of Eastern Europe, former Soviet Union. Ramifications of abandonment of state socialism, introduction of market relations. Effect of former system, new market system on cultural institutions/identities.

**GloS 5801. International Development: Critical Perspectives on Theory and Practice.**

(3 cr; A-F only; Prereq-Admission to MSID prog, grad student)  
Interdisciplinary approaches to development. Assumptions, competing paradigms, analysis of policies, projects, problems. Globalization, societal crisis, indigenous alternatives to dominant paradigm. Partially taught in separate sections to deepen understanding of particular topic (e.g., environment, health, education).

**GloS 5802. Cross-Cultural Perspectives on Work.**

(3 cr; A-F only; Prereq-Admission to MSID prog, grad student)  
Intercultural communication concepts/skills. U.S. cultural/value system. Stages of adjustment. Coping strategies for crossing cultural boundaries. Host-country cultural characteristics. Emphasizes work, family, community, views of development.

**GloS 5803. MSID Country Analysis.**

(3 cr; A-F only; Prereq-Admission to MSID prog, grad student)  
Multidisciplinary study of host country. Emphasizes social sciences and history, especially concepts/information regarding development issues.

**GloS 5805. Grassroots Development Internship.**

(3 cr; A-F only; Prereq-Admission to MSID prog, grad student)  
Grassroots internship with a host-country development agency or project through Minnesota Studies in International Development. Community characteristics, development strategies/problems, organizational structure/culture, cross-cultural communication issues.

**GloS 5806. Topics: Case Studies in International Development.**

(3 cr; A-F only; Prereq-Admission to MSID prog, grad student)  
Development issues illustrated in students' local-level projects through MSID. Focuses on a particular sector as it relates to development of country. Sample topics: environment and development; health and development; education, literacy, and development; women and development.

**GloS 5807. Applied Field Methods.**

(3 cr; A-F only; Prereq-Admission to MSID program)  
Application of selected field research methods in rural/urban settings in Asia, Africa, and Latin America. Analysis of practical, ethical, and theoretical issues raised through small field assignments and individual research projects.

**GloS 5808. MSID Directed Research.**

(3 cr [max 4 cr]; A-F only; Prereq-Admission to MSID prog, grad student)  
Research project based on field work in Ecuador, India, Kenya, or Senegal through Minnesota Studies in International Development (MSID).

**GloS 5900. Topics in Global Studies.**

(1-3 cr)  
Proseminar. Selected issues in global studies. Topics specified in *Class Schedule*.

**GloS 5910. Topics in East Asian Studies.** (1-3 cr)

Description varies with topic title.

**GloS 5920. Topics in European Studies.** (3 cr)

Description varies with topic title.

**GloS 5930. Topics in Latin American Studies.** (3 cr)

Description varies with topic title.

**GloS 5940. Topics in Middle Eastern Studies.** (3 cr)

Description varies with topic title.

**GloS 5950. Topics in Russian Area Studies.** (3 cr)

Description varies with topic title.

**GloS 5960. Topics in South Asian Studies.** (3 cr)

Description varies with topic title.

**GloS 5993. Directed Studies.** (1-4 cr [max 12 cr].

Prereq-#, Δ, □)

Guided individual reading or study. Open to qualified students for one or more semesters.

**GloS 5994. Directed Research.** (1-4 cr [max 12 cr].

Prereq-#, Δ, □)

Qualified students work on a tutorial basis.

**GloS 8061. Scope and Methods of Area Studies.** (3 cr; A-F only)

Introduction to subfields, problems, and methodologies. Scholarly norms and ethics of cross-cultural academic research.

## Graduate School (Grad)

### Graduate School

**Grad 8101. Teaching in Higher Education.** (3 cr)

Teaching methods/techniques. Focuses on active learning, critical thinking, practice teaching, and preparing a portfolio to document/reflect upon teaching. Readings, discussion, peer teaching, e-mail dialog, reflective writing, co-facilitation of course.

**Grad 8102. Practicum for Future Faculty.** (3 cr; S-N only. Prereq-[8101 or equiv], #)

Collegial support for teaching, faculty mentorship at regional college or university, investigation of faculty role at variety of institutions, classroom observation/feedback, preparation for academic job search. Non-native English speakers must pass University requirements for international teaching assistants.

## Greek (Grk)

### Department of Classical and Near Eastern Studies College of Liberal Arts

**Grk 5012. Prose Composition.** (3 cr)

Moving step by step through Ancient Greek grammar, starting with simple sentences and progressing to complex ones. Course ends with students translating short passages of modern English prose into Greek.

**Grk 5013. Advanced Composition.** (3 cr. Prereq-5012 or #)

Detailed study of English-to-Greek verse composition and/or the writing styles of individual Greek authors.

**Grk 5032. Text Criticism.** (3 cr. Prereq-Greek 3114)

Theory and practice. Elements of paleography and manuscript study. Basic tools for analyzing a textual apparatus with some independence; constructing a critical edition of a literary text.

**Grk 5121. Biblical and Patristic Greek.** (3 cr.

Prereq-3114 or 3120)

Septuagint, Philo, Josephus, New Testament, Apostolic Fathers, and other patristic literature to 5th century C.E. Reading and discussion of selected texts in the major genres.

**Grk 5310. Greek Literature: Oratory.** (3 cr [max 9 cr])

One or more appropriate authors studied in a given course.

**Grk 5320. Greek Literature: Tragedy.** (3 cr [max 9 cr])

Reading of Greek tragedy on advanced level.

**Grk 5330. Greek Literature: Comedy.** (3 cr [max 9 cr])

Advanced readings in Greek comedy.

**Grk 5340. Greek Literature: History.** (3 cr [max 9 cr])

Advanced readings from the Greek historians; traditions of Greek historiography.

**Grk 5350. Greek Literature: Philosophy.** (3 cr)

Read one or more works of Plato or Aristotle in the original Greek and find out what they really mean. Selections vary with each offering.

**Grk 5360. Literature: Religious Texts.** (3 cr [max 9 cr])

Reading and discussion of religious texts from Greek antiquity, such as the Homeric Hymns, cultic verse, aretology, sacred tales, oracle texts.

**Grk 5370. Greek Literature: Epic.** (3 cr [max 9 cr])

Reading of classical Greek epic on an advanced level.

**Grk 5380. Greek Literature: Lyric.** (3 cr [max 9 cr])

Selections from the Greek lyric poets.

**Grk 5390. Greek Literature: Romance.** (3 cr [max 9 cr])

Selections from the Hellenistic Romances of, e.g., Chariton, Longus.

**Grk 5440. Greek Literature: Later Authors.** (3 cr [max 9 cr])

Selected topics in later Greek literature, especially Byzantine prose.

**Grk 5450. Greek Literature: Classical Authors.** (3 cr [max 9 cr])

Selected topics in classical Greek literature; topics specified in *Class Schedule*.

**Grk 5621. Greek Paleography.** (3 cr)

Analysis of various hands used in Greek manuscripts with attention to date and provenance; history of the transmission of Greek literature.

**Grk 5715. Introduction to the Historical-Comparative Grammar of Greek and Latin.** (3 cr. Prereq-# or 2 yrs college Latin)

Historical and comparative grammar of Greek and Latin from their Proto-Indo-European origins to the classical norms.

**Grk 5716. History of Greek.** (3 cr. Prereq-Grk/Lat 5715 or equiv, 2 yrs Greek)

Reading and formal analysis of documents illustrating the evolution of the Greek language from Mycenaean to modern times.

**Grk 5993. Directed Studies.** (1-4 cr [max 18 cr].

Prereq-#, Δ, □)

Guided individual reading or study.

**Grk 5994. Directed Research.** (1-12 cr [max 18 cr].

Prereq-#, Δ, □)

Supervised original research on topic chosen by student.

**Grk 5996. Directed Instruction.** (1-12 cr [max 20 cr].

Prereq-#, Δ, □)

Supervised teaching internship.

**Grk 8120. Greek Text Course.** (3 cr [max 15 cr].

Prereq-3111 or Δ; not for students in dept of Classical and Nr East Sts)

Students attend 3xxx Greek courses. Supplementary work at discretion of instructor.

**Grk 8262. Survey of Greek Literature I.** (3 cr)

Extensive selections from all genres of Greek literature of archaic and early classical periods.

**Grk 8263. Survey of Greek Literature II.** (3 cr)

Extensive selections from Greek authors of the classical and Hellenistic eras.

**Grk 8910. Seminar.** (3 cr [max 30 cr])

Various topics in Greek literature examined in depth with emphasis on current scholarship and original student research.

## Health Informatics (HInf)

### Department of Laboratory Medicine and Pathology

### Medical School

**HInf 5430. Health Informatics I.** (3 cr; A-F only)

History/challenges of health informatics. Structure of healthcare delivery system. Computerized patient records. Clinical information systems. Basics of information, computation, communication. Data management in health settings. Clinical information exchange. Managing information technology as strategic resources for healthcare organizations.

**HInf 5431. Health Informatics II.** (3 cr)

Clinical decision analysis, support systems. Clinical monitoring. Signal processing. Image analysis. modeling/simulation. Databases supporting clinical/research efforts. Informatics support for basic research. Evaluation methodologies. Computational biology.

**HInf 5436. Seminar.** (1 cr; S-N only)

Presentation and discussion of research problems, current literature and topics of interest in Health Informatics.

**HInf 5494. Topics in Health Informatics.** (1-6 cr)

Individual or group studies in health informatics.

**HInf 5496. Internship in Health Informatics.** (1 cr [max 3 cr]; S-N only. Prereq-5430, 5431, #)

Practical industrial experience not directly related to student's normal academic experience.

**HInf 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**HInf 8405. Advanced Topics in Health Computer Sciences I.** (3 cr. Prereq-#)

Computer systems design for health sciences, small computer concepts/use, computers for clinical services, computer-aided medical decision making, biomedical image processing, pattern recognition. All topics use techniques, and examples or case studies, from health sciences.

**HInf 8406. Advanced Topics in Health Computer Sciences II.** (3 cr. Prereq-#)

Computer systems design for health sciences, small computer concepts/use, computers for clinical services, computer-aided medical decision making, biomedical image processing, pattern recognition. All topics use techniques, and examples or case studies, from health sciences.

**HInf 8434. Medical Decision Support Techniques.** (3 cr; A-F only. Prereq-5432 or #)

Examines systems based on statistical and logical approaches to decision making that include statistical prediction, rule-based systems, case-based reasoning, quantitative reasoning, and neural networks, and issues related to their use.

**HInf 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**HInf 8446. Professional Studies in Health Informatics.** (1-2 cr; A-F only. Prereq-5431, PubH 5452 or #, grad hlth inf major)

Health informatics as a profession, including discipline, responsibilities, resources, and job opportunities. Directed experiences in consulting, teaching, writing, conducting research, and managing facilities.

**HInf 8492. Advanced Readings in Health Informatics.** (1-6 cr; A-F only. Prereq-#)

Directed readings in topics of current or theoretical interest in medical informatics.

**HInf 8494. Research in Health Informatics.** (1-6 cr; A-F only. Prereq-#)

Directed research under faculty guidance.

**HInf 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Hinf 8770. Plan B Project.** (4 cr; A-F only. Prereq–Plan B MS student, #; no cr toward PhD)  
Research project. Topic arranged between student and instructor. Written report required.

**Hinf 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq–Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Hinf 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer; 24 cr required)

## Hebrew (Hebr)

*Department of Classical and Near Eastern Studies*  
*College of Liberal Arts*

**Hebr 5200. Advanced Classical Hebrew: Biblical Literature.** (3 cr [max 18 cr]. \$3200. Prereq–3012 or 3102 or #)

In-depth reading, analysis, and discussion of classical biblical Hebrew texts. Grammar, syntax. Introduction to text-criticism, history of scholarship, and scholarly tools. Format varies between survey of themes (e.g., law, wisdom, poetry) and extended concentration upon specific biblical books.

**Hebr 5992. Directed Readings.** (1-4 cr [max 12 cr]. Prereq–3012 or #)  
Guided individual reading or study.

## Hindi (Hndi)

*Department of Asian Languages and Literatures*  
*College of Liberal Arts*

**Hndi 5040. Readings in Hindi Text.** (2-4 cr [max 12 cr]; A-F only. Prereq–4162 or equiv or #)  
Students read authentic materials of various types to improve reading/speaking ability. Topics specified in *Class Schedule*.

**Hndi 5710. Topics in Hindi Language, Literature, and Culture.** (4-5 cr)  
Topics in Hindi literature or the linguistic structure of Hindi.

**Hndi 5990. Directed Research.** (3-5 cr. Prereq–#, Δ, □)

**Hndi 5993. Directed Readings.** (1-4 cr [max 12 cr]. Prereq–#, Δ, □)  
Guided individual reading or study of modern Hindi texts.

**Hndi 8790. Research.** (1-5 cr. Prereq–#)

## History (Hist)

*Department of History*  
*College of Liberal Arts*

**Hist 5011. Quantitative Methods for Historical Research.** (4 cr. Prereq–#)  
Basics of quantitative historical data collection, measurement, and analysis.

**Hist 5035. The Germ Theory and Modern Medicine.** (3 cr. Prereq–History of medicine or of science course recommended for undergrads)  
A study of the development of the modern germ theory of disease and of its applications in medicine and public health. Emphasis will be placed on developments between 1860 and 1950

**Hist 5045. The Modern Medical Profession.** (3 cr. Prereq–History of medicine or of science course recommended for undergrads)  
A comparative history of the medical professions in the United States and in select northern European nations. Analyze the process of professionalization and the role the profession has played in western industrial societies since 1800.

**Hist 5051. Before Herodotus: History and Historiography of Mesopotamia and the Ancient Near East.** (3 cr; A-F only. Prereq–Prev coursework in ancient Near Eastern history recommended)  
Historical method/sources for ancient Near Eastern history. Historical traditions. Historiographic texts of Mesopotamia and neighboring regions of the ancient Near East, secondary emphasis on their relationship to works of classical historians such as Herodotus. Use of these sources in modern historiography of ancient Near East.

**Hist 5111. Proseminar in the History of Medieval Europe.** (3 cr; A-F only. Prereq–Advanced undergrads of exceptional ability or grads, #)  
Examination of basic scholarly bibliography for medieval Western European history. Aim is to help students to prepare for M.A. and Ph.D. examinations.

**Hist 5115. Medieval Latin Historians.** (3 cr. Prereq–Reading knowledge of Latin)  
Writing of history in Western Europe during the Middle Ages. Focus on idea of history, philosophy of various historians, techniques of research by medieval historians and chroniclers, history as literature, and value of medieval histories to modern research scholars. Latin texts only.

**Hist 5251. Socialist/Post-socialist Transformations.** (3 cr; A-F only)  
Transformations underway in post-socialist societies of Eastern Europe, former Soviet Union. Ramifications of abandonment of state socialism, introduction of market relations. Effect of former system, new market system on cultural institutions/identities.

**Hist 5264. Imperial Russia: Formation and Expansion of the Russian Empire in the 18th and 19th Centuries.** (3 cr)  
Interaction with Europe and Asia; attempts at modernization and reform; emancipation of the serfs and rise of revolutionary movements.

**Hist 5265. 20th-Century Russia: The Collapse of Imperial Russia, the Revolutions, and the Soviet Regime.** (3 cr)  
Analysis of the factors that led to the collapse of the tsarist regime; discussion of the 1917 revolution, the evolution of the Soviet regime and the collapse of Soviet communism. Emphasis on the role of nationalities and the rise of the Commonwealth of independent states.

**Hist 5274. Southeastern Europe: Ottoman Empire and Successor States.** (3 cr [max 3 cr])  
The legacy of empires; 18th-century background; rise of Balkan nationalism; the Eastern Questions in the 18th and 19th centuries; the Balkans in the 20th century; population movements or exchanges; ethnic conflict in the Communist and Post-Communist periods.

**Hist 5276. Intellectual and Cultural History of Modern Greece.** (3 cr)  
Literary and cultural contributions of modern Greece. The modern Greek experience seen through Greek historical and cultural monuments. An attempt at self-definition.

**Hist 5285. Problems in Historiography and Representation of the Holocaust.** (3 cr. Prereq–JwSt 3521 or RelS 3521 or #)  
Issues connected with the Holocaust. Inclusiveness of other groups, Holocaust vs. “Shoah,” historiographical conflicts about perpetrators, problems of representation in literature/art, problems of narrative theology after Auschwitz.

**Hist 5294. Social History of Russia and Eastern Europe Through the 19th Century.** (3 cr)  
Lives of peasants and workers, nobles and merchants. Topics include family, marriage, sexuality; culture and tradition; transformation from an agricultural to a modern society.

**Hist 5295. Social History of Russia and Eastern Europe From the Late 19th Century to the Present.** (3 cr)  
Social movements (revolutionary, nationalist, women’s); communist and post-communist societies.

**Hist 5301. U.S. Women’s Legal History.** (3 cr)  
Women’s legal status in U.S. history, 1648 to present. Changes in women’s legal status in marriage, divorce, and child custody; reproductive/sexual autonomy; and economic/educational equality. Differences among women based on race, class, and ethnicity.

**Hist 5379. Problems in Early American History.** (3 cr)  
Intensive consideration of topics in early American history. Topics may include readings in race, class, and gender; comparative colonialism; slavery; demography; economic history; religion; and regions in the colonial world.

**Hist 5381. Minnesota History Workshop.** (3-4 cr [max 4 cr]. Prereq–1301, 1302)  
A case study and seminar approach to historical research and interpretation. It offers teachers and other scholars a chance to survey a particular topic in Minnesota history and to write their own historical narrative based on primary source research.

**Hist 5421. Gender in Latin American History.** (3 cr)  
Women’s history/masculinity. Gender/colonialism, marriage, sexuality, nationalism, labor, political movements, feminism.

**Hist 5436. Social History of African Women: 1850 to the Present.** (3 cr. Prereq–# for undergrads)  
Explore the historical forces which have shaped African women’s everyday lives and the ways in which these women have been active agents in the making of their own histories.

**Hist 5438. Seminar: The African American Experience in South Africa.** (3 cr. \$Afro 5191)  
Ideological, political, religious, and cultural ties that have informed African American and black South African relations from late 18th century to present.

**Hist 5446. Problems in West African History.** (3 cr. Prereq–# for undergrads)  
This problem-centered course explores several of the major historiographical, methodological, and theoretical debates in West African history. Core topics include state formation, trade, slavery, Islam, gender, and colonialism.

**Hist 5464. China in the Song, Yuan, and Ming Dynasties.** (3 cr. \$3464, \$EAS 3464)  
China during the Song (976-1279), Yuan (1279-1368) and Ming (1368-1644) dynasties, political institutions, and social structures. Attention to primary sources and how historians ask and answer questions about the past.

**Hist 5465. China in the Ming and Qing Dynasties.** (3 cr. \$3465, \$EAS 3465. Prereq–#)  
Political/social history of China from 1600 until end of Qing dynasty in 1911. Ethnicity, daily life, legal structures, city life, peasantry.

**Hist 5467. State and Revolution in Modern China.** (3 cr. \$3467, \$EAS 3467)  
Modern China’s political evolution including the Taiping Rebellion, Republican Revolution, rise of Nationalist and Communist parties, Maoist era; reform under Deng Xiaoping, and the emergence of democracy in Taiwan.

**Hist 5468. Social Change in Modern China.** (3 cr. \$3468)  
Opium War and opening of Treaty Ports in 19th century; missionary activity and cultural influence; changes in education system; women’s movement; early industrialization; socialism and collectivization after 1949; industrialization of Taiwan; PRC’s entry into the world trading system.

**Hist 5472. Early Modern Japan.** (3 cr)  
Tradition/change in society/culture under Tokugawa shoguns (1600-1867). Growth of cities. Decline of samurai class. Response to Western intrusion.

**Hist 5473. Japan's Modernities: Historiographies.**

(3 cr; A-F only. Prereq-[Advanced undergrad, #] or grad student)

Historiography on modern Japan in English language scholarship. Major trends since 1950s, latest scholarship. Issues concerning Japan's modernity. Definitions of modernity, modernization, and modernism. Relationship between knowledge-making and nation building. Japan's place in world.

**Hist 5474. Sex and the Politics of Desire: Japan and Beyond.**

(3 cr; A-F only. Prereq-Grad student or #) History of gender/sexuality in modern Japan and Korea. Geography of Japan. Theoretical/methodological literature not specific to Japan. Sexology, eugenics, feminism, nationalism, colonialism, cyber sexuality.

**Hist 5479. Wall and Market: History of Chinese Cities.**

(3 cr; A-F only. \$Hist 3479) Introduction to traditional Chinese cities and their modern transformation. Ideal city plan in Confucian classics compared with physical layout of some major cities. Models about Chinese cities, influence of the models on our understanding of Chinese history/society.

**Hist 5501. Medieval Europe and the World.**

(3 cr; A-F only. Prereq-#) Place of medieval Europe in the world. Relations of Europe with Asia, Africa, and the Americas. European knowledge of the world's other great cultures. European travelers/explorers. Assessment of other cultures' knowledge of Europe in the period.

**Hist 5505. Survey of the Middle East.**

(3 cr. Prereq-Grad or #) Peoples, lands, cultures of the Middle East, from earliest civilizations to present.

**Hist 5520. Topics in Chinese History.**

(3 cr [max 12 cr]) Selected topics not covered in regular courses. Taught as staffing permits.

**Hist 5541. Islam in the Catholic Age.**

(3 cr. Prereq-Grad or #) Rise of Islam in its Arabian setting. Roles of prophet, orthodox/Umayyad caliphs. Development of Islamic state/empire, organizations, institutions, status of Muslims/non-Muslims.

**Hist 5547. The Ottoman Empire.**

(3 cr. Prereq-Grad student or #) Founding of Ottoman society/state to empire, 1300 to end of empire in 1920. Lands, institutions, peoples, legacy. Impact on Europe.

**Hist 5611. Proseminar in Medieval History.**

(3 cr; A-F only. Prereq-Grad student or #) Examines basic scholarly bibliography for medieval Western Europe history during Middle Ages. Foundation for students to teach courses in medieval history, prepare for general doctoral exam.

**Hist 5612. Proseminar in Medieval History.**

(3 cr; A-F only. Prereq-[5611, grad student] or #) Examines basic scholarly bibliography for medieval Western Europe History during Middle Ages. Foundation for students to teach courses in medieval history, prepare for general doctoral exam.

**Hist 5614. The Medieval Church.**

(3 cr. Prereq-Grad student or #) Introduction to history of western church in Middle Ages. Emphasizes church teachings and institutional structures, beliefs/practices of lay people, medieval Christian encounter with non-Christian world.

**Hist 5616. Proseminar in Medieval Spain.**

(3 cr; A-F only. Prereq-#) Graduate research on the development of the medieval kingdoms of Spain from Roman times to ca. 1500. Emphasis on major social, economic, and cultural developments. Christian, Jewish, and Muslim interaction. Spain and the beginnings of European expansion.

**Hist 5617. Spain in the Early Modern Period: 1492-1814.**

(3 cr) Historiography, documents, and archives of early modern Spain analyzed. Includes reading in modern English and Spanish and practical experience with Spanish manuscript documents from the period.

**Hist 5621. Proseminar: The French Revolution.**

(3 cr; A-F only. Prereq-Grad student or [advanced undergrad, #]) Historical literature about French Revolution of 1789. Old Regime political culture, Enlightenment, origins of the revolution, revolutionary transformations in society, politics/culture both in France and abroad, the Terror, Napoleon, revolutionary legacy.

**Hist 5631. Proseminar: Comparative Early Modern History.**

(3 cr; A-F only. Prereq-Hist grad or #) Critical reading of historical literature dealing with integration of the globe during the early modern period, ca. 1350-1750; book reports, class discussion.

**Hist 5632. World History Proseminar.**

(3 cr; A-F only. Prereq-#) Theoretical approaches to world/global history. Review of major theories, controversies, chronologies, pedagogical approaches.

**Hist 5633. Socio-Economic History of China.**

(3 cr; A-F only. Prereq-Grad student or [adv undergrad, #]) Nature of Chinese socio-political formations and economic development in Qing and Republican eras, 1644-1937. Establishment/methods of state rule, merchants, agrarian social structure, domestic industry, demographic regimes, capitalism, and imperialism. Comparisons using theoretical and case studies of economic development.

**Hist 5634. Proseminar in Medieval and Early Modern European Russia.**

(3 cr; A-F only. Prereq-Some coursework in history of medieval and early modern European Russia or #)

Selected readings covering the major studies, key primary sources, and basic interpretations of the peoples of medieval and early modern European Russia as well as an analysis of the new approaches and interpretations in the field.

**Hist 5649. Ideas in Context: Making Early Modern Knowledge, 1500-1800.**

(3 cr; A-F only. Prereq-Grad student or #) Role of institutions/locale in development of early-modern European thought/culture. University, academy, learned society, princely court, museum, printing house, workshop, trading company, armies/navies, state bureaucracies, salons, other independent associations of nascent civil society.

**Hist 5650. Proseminar: Early Modern Europe.**

(3 cr; A-F only. Prereq-Hist grad or #) Critical reading of historical literature for early modern Europe, ca. 1450-1700., dealing with France, Germany, Italy, the Low Countries, and Spain. Each student chooses a country to focus on; book reports, class discussion.

**Hist 5651. Proseminar in Tudor England: 1485-1603.**

(3 cr; A-F only. Prereq-#) A critical study of principal writings about English history during the Tudor and Stuart periods.

**Hist 5652. Proseminar in Stuart England: 1603-1689.**

(3 cr; A-F only. Prereq-#) Critical study of principal writings about English history.

**Hist 5671. Proseminar: Modern Britain.**

(3 cr; A-F only. Prereq-#) Critical study of major writings in British history, 1760-1945, and preparation for research in field.

**Hist 5715. Readings in European Women's History: 1450-1750.**

(3 cr; A-F only) Introduction to current historical research on European women's history, 1450-1750. Topics include gender roles and form of family structure, women's participation in religious movements, legal status of women.

**Hist 5720. Society and Politics in Modern Europe.**

(3 cr [max 6 cr]; A-F only. Prereq-Grad or #) Introduction to literature in English on problems of modern European social, cultural, political history. Thematic/geographic focus varies year to year. Topics include historical approaches to class/gender relations, state formation as social/political process, family history, evolution of public life, popular culture.

**Hist 5721. Contemporary Europe From the Late 19th Century to the Beginning of the Cold War: 1890-1950.**

(3 cr. \$3721. Prereq-Previous coursework in 19th- and/or 20th-century Europe, #)

The historical literature and debates surrounding major issues in the social, political, cultural, and economic development of Europe from the turn of the century through the impact of WWII. Topics include the development of imperialism, national rivalries, social and political conflict, the rise of fascism and communism, and the origins of war.

**Hist 5735. European Women's History: 1750 to the Present.**

(3-4 cr. Prereq-#) Selected themes in modern European women's history. Forms of patriarchy. Women in the Enlightenment. Women and revolution. Gender, class, and family life. Women in the labor force. Sexuality and reproduction. Female education. Women's political movements. Women and imperialism. Gender and fascism.

**Hist 5740. Topics in Modern German History.**

(3-4 cr [max 12 cr]; A-F only. Prereq-#) Readings and discussions on some central questions concerning the history of Germany during the modern period with a particular emphasis on the relationship between social change and political development. Offerings vary in thematic and chronological focus.

**Hist 5756. Modern Greece; Mid-18th Century to Present: Greek Nationalism and Establishment of the Greek State.**

(3 cr) Evolution of modern Greece from mid-18th century to the present. Political, cultural, and socioeconomic factors that contributed to Greek nationalism. Establishment of independent Greece and its role in the European community of nations.

**Hist 5761. Proseminar - Imperial Russia.**

(3 cr. Prereq-Knowledge of Russian or German or French) Western and Russian historiography on crucial issues of imperial Russia. Political institutions; culture and society; modernization and reforms; new interpretations.

**Hist 5762. Proseminar in 20th Century Russia.**

(3 cr. Prereq-5761, knowledge of Russian or German or French) Western and Russian historiography on crucial issues of 20th-century Russia. The nature of revolutions, debate over the evolution of the Soviet regime, the collapse of empires, new interpretations.

**Hist 5777. Proseminar in Habsburg Central Europe.**

(3 cr. Prereq-#) Central Europe under Habsburg rule from the reforms of Maria Theresa to imperial collapse. Continuity and change in society; economic and political modernization; the rise of national consciousness and anti-Semitism; politics and culture in the Fin de Siecle; the Empire and World War I.

**Hist 5794. Proseminar in European Economic History.**

(3 cr. Prereq-#) Europe's rise in the world economy; England's industrial revolution and uneven development in Europe; imperialism and World War I; the Great Depression; the post-1945 economic miracle; continuity and change in Eastern Europe.

**Hist 5797. Methods of Population History.**

(3 cr) Standard methods of population analysis with a special focus on methods widely used for historical population research.

**Hist 5801. Seminar in Early American History.**

(3 cr; A-F only) Introduction to the literature of early American history. Readings selected from some of the best scholarship in the field, the questions that now hold the attention of colonial historians, and the theories, methods, and sources they use in pursuit of those questions.

**Hist 5811. Nineteenth-Century U.S. History.** (3 cr; A-F only. Prereq–Grad student or [undergrad honors history major, #])

Proseminar. Central themes/debates in historiography of 19th-century United States. Market revolution, antebellum party politics. Slavery, the Civil War, and Reconstruction. Immigration and nationalism. Transformations in ideologies/experiences of race/gender. Industrialization, labor, and urbanization. Western expansion. Emergence of populism/progressivism.

**Hist 5821. American History in the Twentieth Century.** (3 cr; A-F only. Prereq–Grad student, #) Intensive readings seminar.

**Hist 5841. Proseminar in American Economic History.** (3 cr; A-F only. Prereq–#)

Historical literature on American economic and business history from American Revolution to the modern economy.

**Hist 5844. U.S. Labor History.** (3 cr)

Readings in classic and recent approaches to the history of the working class in the United States. Central topics include slavery and free labor, women's paid and unpaid labor, management strategy, labor protest, and trade union organization.

**Hist 5845. History of American Capitalism.** (3 cr; A-F only. Prereq–Grad student or #)

Historiography/history of American capitalism. Crucial events (e.g., market "revolution," development of industrial cities) focus weekly discussions of new literature. Students analyze theoretical models of capitalism and new work in social, political, and economic history.

**Hist 5857. Proseminar: Readings in the History of American Women.** (3 cr. Prereq–#)

An intensive graduate-level readings course. Survey selected significant topics in historical literature, conceptual frameworks, and methodological problems in the history of American women from 1600 to the present.

**Hist 5861. History of American Immigration.** (3 cr; A-F only. Prereq–#)

Readings in historical literature on immigration to the United States. Emphasis on recent works distinguished by new research methodologies and interpretations.

**Hist 5862. History of American Immigration.** (3 cr; A-F only. Prereq–#)

Readings in historical literature on immigration to the United States. Emphasis on recent works distinguished by new research methodologies and interpretations. Each student undertakes an independent reading and/or research project.

**Hist 5864. Proseminar: African-American History.** (3 cr. Prereq–#)

Readings in African-American history designed for both incoming and advanced graduate students. Structured around various themes and issues including slavery, Reconstruction, the Great Depression, and the civil rights movement.

**Hist 5865. Proseminar: African-American History.** (3 cr. Prereq–#)

The second half of the graduate sequence in African-American history is oriented primarily toward thinking about and performing independent research.

**Hist 5871. Readings in U.S. Intellectual History: 19th-20th Centuries.** (3 cr. Prereq–#)

Definitions of American national identity from 1789 to the present as expressed in politics, religion, literature, painting, music, architecture, and history.

**Hist 5881. American Foreign Relations to 1895.** (3 cr. Prereq–#)

Intensive readings in the historiography of American foreign relations with emphasis on American imperialism, domestic courses of foreign policy, and international political, economic, and cultural relations.

**Hist 5882. American Foreign Relations Since 1895.** (4 cr. Prereq–#)

Intensive readings in the historiography of American foreign relations with emphasis on American imperialism, domestic courses of foreign policy, and international political, economic, and cultural relations.

**Hist 5890. Problems in American Indian History.** (3 cr. Prereq–#)

Intensive consideration of topics in American Indian history. Topics may include social history, history of particular regions, political systems, education, and American Indian policy.

**Hist 5900. Topics in European/Medieval History.**

(1-4 cr [max 16 cr]. Prereq–Grad or [advanced undergrad student with #])

Selected topics in European or medieval history not covered in regular courses; taught as staffing permits.

**Hist 5901. Latin America Proseminar: Colonial.** (3 cr. Prereq–#)

Introduces beginning graduate and advanced undergraduate students to major historical writings on various Latin American themes.

**Hist 5902. Latin America Proseminar: Modern.** (3 cr. Prereq–#)

Introduces beginning graduate and advanced undergraduate students to major historical writings on various Latin American themes.

**Hist 5910. Topics in U.S. History.** (1-4 cr [max 16 cr].

Prereq–Grad or advanced undergrad student with #) Selected topics in U.S. history not covered in regular courses. Taught as staffing permits.

**Hist 5920. Topics in African Social History.** (3 cr [max 16 cr]. Prereq–Grad student or adv undergrad or #)

Focuses on the experiences of Africans in their workplaces, households, and communities. Detailed treatment of selected historical themes. Topics vary by semester.

**Hist 5930. Topics in Ancient History.** (1-4 cr [max 16 cr]; A-F only. Prereq–Grad or #)

Selected topics in ancient history not covered in regular courses. To be taught as staffing permits and as enrollment warrants.

**Hist 5931. Topics in Comparative Third World History.** (3 cr [max 16 cr]; A-F only. Prereq–Grad student or #)

Topics specified in *Class Schedule*.

**Hist 5932. African Historiography and Methodology.** (3 cr; A-F only)

Recent analysis of several major themes in the historiography of pre-colonial and colonial Africa and the methods used by African historians to reconstruct the African past.

**Hist 5933. Seminar in Ancient History.** (3 cr; A-F only. Prereq–Previous coursework in Greek or Roman history, #) Seminar on a selected topic in ancient history.

**Hist 5934. Comparative History and Social Theory.** (3 cr; A-F only. Prereq–[Grad or upper-div undergrad] student, #)

Focuses on works of history/sociology that are broadly comparative/theoretical and speak to issues of state formation, social movements, social structure, and economic development.

**Hist 5940. Topics in Modern Chinese History.** (1-4 cr [max 16 cr]. Prereq–Grad student, #)

Possible topics include cultural, economic, intellectual, political, and social history.

**Hist 5941. Readings in Chinese Documents.** (3 cr.

Prereq–Reading knowledge of Chinese) Readings in Chinese on a topic to be selected by the instructor. Depending on the topic and the time period, readings may involve a mixture of modern and classical Chinese or may be entirely in modern Chinese. Consult instructor for more information.

**Hist 5942. Topics in the History of Medicine.** (3-4 cr [max 16 cr]. Prereq–Prior history of medicine or history of science course recommended for undergrads)

An exploration of topics central to the history of medicine. Emphasis on mid-18th century to the present. Topics vary yearly.

**Hist 5950. Topics in Latin American History.** (1-4 cr [max 16 cr]. Prereq–Grad or advanced undergrad with #) Selected topics in Latin American history not covered in regular courses. Taught as staffing permits.

**Hist 5960. Topics in History.** (1-4 cr [max 16 cr]. Prereq–Grad or [advanced undergrad with #])

Selected topics in history not covered in regular courses. Taught as staffing permits.

**Hist 5962. Expansion of Europe.** (3 cr; A-F only. Prereq–Grad student, #)

Research proseminar on actions of Europeans in wider world, 1350-1790. Based on documents in James Ford Bell Library.

**Hist 5964. Comparative Economic History.** (3 cr. Prereq–#)

Theoretical approaches guide cross-cultural examinations of major issues in the economic history of East Asia, Europe, and the New World. Agrarian structures in economic development, markets, the state and economic development, and the industrial revolution.

**Hist 5970. Advanced Research in Quantitative History.** (4 cr [max 16 cr])

Students will carry out publishable-quality research on a quantitative historical topic.

**Hist 5971. Proseminar: Editing and Publishing.** (3 cr; A-F only)

Evolution of modern scholarly publication as system of knowledge. Survey of history of printing/manufacture of books. Recent changes in information technology. Contemporary academic publishing. Basics of editing/editorial policy. Journals/presses.

**Hist 5980. Topics in Comparative Women's History.** (3 cr [max 16 cr]. Prereq–Grad student or [advanced undergrad, #])

Cross-cultural/thematic explorations in history of women. Topics vary. May include gender and colonialism; women and class formation; women and religion; sexuality; medical construction of gender; women's narratives as historical sources; gender and politics.

**Hist 5990. Readings in Comparative History.** (3 cr [max 15 cr]. Prereq–#)

Students read/discuss historical works that focus on common theme or employ similar methods in different geographic areas. Issues of cross-area comparison. Topics vary (e.g., peasant societies, race/ethnicity, states/nationalism).

**Hist 5993. Directed Study.** (1-16 cr [max 16 cr]. Prereq–[Grad student or sr], w/#, Δ, □)

Guided individual reading or study.

**Hist 5994. Directed Research.** (1-16 cr [max 16 cr]. Prereq–[Grad student or sr], w/#, Δ, □)

Work on a tutorial basis.

**Hist 8015. Scope and Methods of Historical Studies.** (3 cr; A-F only. Prereq–#)

Development of historical studies over time (especially in 19th and 20th centuries). Methodologies currently shaping historical research. Theoretical developments within the discipline during 19th and 20th centuries.

**Hist 8021. Seminar: Advanced Historical Writing.** (3 cr; A-F only. Prereq–Grad student, #)

Formal writing group. Writing practices for historians. Readings/discussions about historical analysis. Practical application of writing historical narratives. Students complete a major writing project based on their program needs and progress.

**Hist 8110. Medieval History: Research Seminar.** (3 cr; A-F only. Prereq–#, good reading knowledge of Latin, French, one other European language)

Research in medieval European history, using primary source material.

**Hist 8239. Readings in Gender, Race, Class, and/or Ethnicity in the United States.** (3 cr; A-F only. Prereq–#)

Dynamics of gender, racial, class, and ethnic relations in U.S. history; intersections of these forces.

**Hist 8240. Topics in Research in Gender, Race, Class, or Ethnicity in the United States.** (3 cr [max 6 cr]; A-F only. Prereq-#)  
Dynamics of gender, racial, class, and ethnic relations in U.S. history. Intersections of these forces. Topics vary by instructor.

**Hist 8245. Race, Nation, and Genocides.** (3 cr; A-F only)  
Theoretical literature on genocides and human rights. Historical case studies of genocides. Readings/discussions on meaning of "genocide" and its codification in international law. Theoretical literature on race/nation. Historical cases, primarily in 20th century (e.g., Armenian genocide, the Holocaust, Rwanda, former Yugoslavia). Students choose specific case to research.

**Hist 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**Hist 8390. Research in American Indian History.** (3 cr; A-F only. Prereq-5890 or Amln 5890 or #)  
Research and writing skills in American Indian history. With instructor and other participants, students identify their research questions, locate sources with which to answer these questions, conduct original research, and produce a substantial research paper.

**Hist 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**Hist 8464. Research in Yuan, Ming, and Qing History.** (3 cr; A-F only. Prereq-Good working knowledge of classical Chinese, background in history of late imperial China)  
Basic skills and resources for doing research in history of late imperial China. Bibliographic exercises; reading and translating primary documents.

**Hist 8465. Research in Yuan, Ming, and Qing History.** (3 cr. Prereq-Good working knowledge of classical Chinese, background in history of late imperial China)  
Basic skills and resources for doing research in history of late imperial China. Students select, translate, and annotate texts appropriate to their research interests and write a research paper centering on these texts.

**Hist 8630. Seminar in World History.** (3 cr; A-F only. Prereq-#)  
Critical examination of historical literature dealing with theoretical approaches to world history and teaching of world history.

**Hist 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Hist 8709. Seminar: History of Sexuality.** (3 cr; A-F only)  
Theories of sexuality (by, e.g., Foucault, Butler, deLauretis), their application in history. Topics may include: feminist critique of Foucault and the classics, psychoanalytic approaches to religious transformations such as the Reformation, varying forms of gender transgression, sexuality in colonial encounters, operation of sexual metaphors in political conflict, and AIDS and the writing of history.

**Hist 8715. Research on European Women's History, 1450-1750.** (3 cr. Prereq-5715)  
Research techniques for completing a major research paper based on primary sources.

**Hist 8720. Research Seminar on Central European History.** (1-4 cr [max 16 cr]; A-F only)  
Broad research theme/problem: in most cases preparation for dissertation. Students identify primary/secondary sources, conduct research, write paper, and read/comment upon each other's drafts. Geographic focus varies with instructor, may include Germany or lands of former Habsburg Austrian empire.

**Hist 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Hist 8857. Seminar: Research in the History of American Women.** (3 cr; A-F only. Prereq-5857, #)  
Students define a historical problem or area of research on a topic in American women's history they would like to pursue in depth, identify appropriate

sources and accomplish research in primary and secondary sources, write a 25 to 35-page scholarly article, and read and comment upon each other's drafts.

**Hist 8858. Research in Early American History.** (3 cr; A-F only. Prereq-5801 or #)  
Research and writing skills. With instructor and other participants, students identify their research questions, locate the sources with which to answer these questions, conduct original research, and produce a substantial research paper.

**Hist 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

**Hist 8900. Topics in European/Medieval History.** (1-4 cr [max 16 cr]; A-F only. Prereq-Offered as staffing permits)  
Topics not covered in regular courses.

**Hist 8910. Topics in U.S. History.** (1-4 cr [max 16 cr]; A-F only. Prereq-Offered as staffing permits)  
Topics not covered in regular courses.

**Hist 8920. Topics in African History.** (1-4 cr [max 16 cr]; A-F only. Prereq-Offered as staffing permits)  
Topics not covered in regular courses.

**Hist 8930. Topics in Ancient History.** (1-4 cr [max 16 cr]; A-F only. Prereq-Offered as staffing permits)  
Topics not covered in regular courses.

**Hist 8940. Topics in Asian History.** (1-4 cr [max 16 cr]; A-F only. Prereq-Offered as staffing permits)  
Topics not covered in regular courses.

**Hist 8944. Research Seminar: New Directions in African Social History I.** (3 cr; A-F only. Prereq-#)  
First of two-part course. Radical transformation in field of African social history during past two decades. Students select major research topic and begin preliminary investigation.

**Hist 8945. Research Seminar: New Directions in African Social History II.** (3 cr; S-N only. Prereq-8944, #)  
Second of two-part course. Students conceptualize and write major research paper.

**Hist 8950. Topics in Latin American History.** (1-4 cr [max 16 cr]; A-F only. Prereq-Offered as staffing permits)  
Topics not covered in regular courses.

**Hist 8960. Topics in History.** (1-4 cr [max 16 cr]; A-F only. Prereq-Offered as staffing permits)  
Topics not covered in regular courses.

**Hist 8961. Research Seminar: Intellectual History.** (3 cr; A-F only)  
Approaches/methods. Readings on or exemplifying intellectual history. Intellectual history as something broader than history of philosophical thought: a set of approaches of broad cross-disciplinary applicability. Each student prepares a research paper on a topic of intellectual history and present it to class for critique.

**Hist 8990. Topics in Comparative History-Research.** (3 cr [max 15 cr]. Prereq-#)  
Topics vary. Students read/discuss historical works from different geographic areas, develop proposals for comparative research, or pursue comparative research projects.

**Hist 8993. Directed Study.** (1-16 cr [max 16 cr]; A-F only. Prereq-Grad student, #)  
Students work on tutorial basis. Guided individual reading or study.

**Hist 8994. Directed Research.** (1-16 cr; A-F only. Prereq-#)

## History of Medicine (HMed)

### Medical School

**HMed 5002. Public Health Issues in Historical Perspective.** (3 cr)  
Introduction to the evolution of major recurring problems and issues in public health including environment and health, food customs and nutrition, control of alcohol and drugs, venereal diseases and public policy, human resources regulation, and relationship of science to promotion of health.

**HMed 5035. The Germ Theory and Modern Medicine.** (3 cr)  
Analysis of the formulation of the germ theory of disease and of its consequences for medical procedures (therapeutics, surgery, management of hospitals), public health programs, and the structure and prestige of the medical profession.

**HMed 5045. Modern Medical Profession.** (3 cr)  
Historical analysis of American medical profession in 19th/20th centuries. Role of institutions, influence of social/moral values. Consequences of specialization, scientific innovation.

**HMed 5055. Women, Health, and History.** (3 cr. Prereq-Grad student or [jr or sr] with prev coursework in hist or #)  
Women's historical roles as healers, patients, research subjects, health activists. Biological determinism, reproduction, mental health, nursing, women physicians, public health reformers, alternative practitioners. Gender disparities in diagnosis, treatment, research, careers. Assignments allow students to explore individual interests.

**HMed 5200. Early History of Medicine to 1700.** (3 cr; A-F only)  
An introductory survey of the history of medicine in Europe and America.

**HMed 5201. History of Medicine from 1700 to 1900.** (3 cr. Prereq-HMed 5-200)  
An introductory survey of the history of medicine in Europe and America.

**HMed 5210. Seminar: Theories and Methods in Medical History.** (3 cr; A-F only)  
Historiography of the history of medicine.

**HMed 5211. Seminar: Theories and Methods in Medical History.** (3 cr; A-F only. Prereq-5210)  
Use of archives, primary sources. Supervised research project.

**HMed 5940. Topics in the History of Medicine.** (3 cr)  
Seminar on the historical relations between medicine and the State from the 18th to 20th centuries.

**HMed 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**HMed 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**HMed 8631. Directed Study.** (3-6 cr; A-F only)

**HMed 8632. Directed Study.** (3-6 cr; A-F only)

**HMed 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**HMed 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**HMed 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

## History of Science and Technology (HSci)

### Department of History of Science and Technology Institute of Technology

#### HSci 5211. Biology and Culture in the 19th and 20th Centuries. (3 cr. §3211)

Changing conceptions of life and aims and methods of biology; changing relationships between biology and the physical and social sciences; broader intellectual and cultural dimensions of developments in biology.

#### HSci 5242. The Darwinian Revolution. (3 cr. §3242)

Development of evolutionary thought in 19th/20th centuries. Emphasizes Darwin's theory of evolution by natural selection. Scientific, economic, political, religious, philosophical dimensions of Darwinism. Comparative reception of Darwinism in different countries/cultures.

#### HSci 5244. History of Ecology and Environmentalism. (3 cr. §3244)

Development of ecological thought from 18th century natural theology to contemporary ecology and conservation biology; changing views of "balance" and the "economy" of nature; conceptual and methodological developments in ecosystems ecology; connections between ecology and conservation, population and environmental politics.

#### HSci 5331. Technology and American Culture. (3 cr. §3331)

Development of American technology in its cultural/intellectual context from 1790 to present. Transfer of technology to America. Establishment of an infrastructure promoting economic growth. Social response to technological developments.

#### HSci 5332. Science and American Culture. (3 cr. §3332)

Development of American science since 1600, including transfer of science to America. Development of indigenous traditions for pursuit of science. Establishment of infrastructure for education/research. Response of public to scientific development.

#### HSci 5401. Ethics in Science and Technology. (3 cr. §3401)

Historical issues involving ethics in science. Ethical problems posed by modern science/technology, including nuclear energy, chemical industry, and information technologies.

#### HSci 5411. Art and Science in Early Modern Europe. (3 cr. §4411)

Interaction of art and science, from Renaissance to 19th century. Development of linear perspective, color theory, artistic practice, and scientific illustration/representation.

#### HSci 5993. Directed Studies. (1-15 cr [max 15 cr]. Prereq-#)

Guided individual reading or study.

#### HSci 5994. Directed Research. (1-15 cr [max 15 cr]. Prereq-#)

**HSci 8111. Historiography of Science and Technology.** (3 cr; S-N only. Prereq-Grad HSci major or #)  
Review of methods and historiography. Tools needed to perform creative work in the field. Models of historical practice, different schools of history, work of representative historians of science and technology.

**HSci 8124. Foundations for Research in Ancient Science.** (3 cr; A-F only. Prereq-Grad HSci major or minor or #)  
Development of natural/mathematical science in ancient Near East and Classical Greece.

**HSci 8125. Foundations for Research in Scientific Revolution.** (3 cr; A-F only. Prereq-Grad HSci major or minor or #)  
Development of sciences/natural philosophy, 1500-1725.

**HSci 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

#### HSci 8421. Social and Cultural Studies of Science. (3 cr)

Review of recent work; theoretical and methodological differences among practitioners; selected responses from historians and philosophers of science.

#### HSci 8441. Women in Science: Historical Perspectives. (3 cr. Prereq-#)

Key literature dealing with patterns of participation in science and medicine since the 18th century. The ways in which modern science is perceived to be gendered, particularly in its practice and in ways that seem to influence theory and applications.

#### HSci 8444. FTE: Doctoral. (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**HSci 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**HSci 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**HSci 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

#### HSci 8900. Seminar: History of Early Physical Science. (3 cr. Prereq-#)

For advanced graduate students; topics in development of natural and mathematical science before 1800.

#### HSci 8910. Seminar: History of Modern Physical Sciences. (3 cr. Prereq-#)

For advanced graduate students; topics in development of physical sciences since 1800.

#### HSci 8920. Seminar: History of Biological Sciences. (3 cr. Prereq-#)

For advanced graduate students; topics in development of natural, biological, and medical sciences from Aristotle to the present.

#### HSci 8930. Seminar: History of Technology. (3 cr. Prereq-#)

For advanced graduate students; topics in development of technology from ancient times to the present.

#### HSci 8940. Seminar: History of Science and Technology in the Americas. (3 cr. Prereq-#)

For advanced graduate students; topics in development of science and technology, emphasizing the United States and Canada.

#### HSci 8950. Seminar: Science and Technology in Cultural Settings. (3 cr. Prereq-#)

For advanced graduate students; topics in development of science and technology in or across specific geographic regions or particular cultures.

#### HSci 8993. Directed Studies. (1-5 cr [max 15 cr]. Prereq-#)

#### HSci 8994. Directed Research. (1-5 cr [max 15 cr]. Prereq-#)

## Horticultural Science (Hort)

### Department of Horticultural Science College of Agricultural, Food and Environmental Sciences

#### Hort 5007. Advanced Plant Propagation. (3 cr. Prereq-1001)

Control of growth/development in sexual/asexual reproduction of plants. Effects of environment, plant growth substances. Protocols on dormancy, origin, and development of adventitious structures. Specialized propagation techniques. Lecture, lab.

#### Hort 5009. Pest Management in Horticulture. (3 cr; A-F only. Prereq-BioC 2011 or #)

History of and practical information about pesticides used by horticulture industry. Pesticide modes of action. Use, application methods, environmental effects. Final three weeks devoted to labs on practical mixing and delivery systems.

#### Hort 5018. Landscape Operations. (3 cr. Prereq-1001 or #)

Demonstration/hands-on experiences with landscape operations. Planting, mulching, staking, pruning, fertilizing, large tree care, seeding, sodding, aerifying, calibrating, irrigating, surveying. Written report on special project or experiment. Discussion/laboratory. Team taught by faculty, staff, and industry professionals.

**Hort 5022. Topics in Plant Science for Teachers.** (1-4 cr. Prereq-Biol 2012 or equiv or ed course; no cr for Hort major or grad student)

#### Hort 5023. Public Garden Management. (2 cr. Prereq-#)

Overview of knowledge/skills necessary to manage a public garden. History of public gardens. Development of mission and vision. Planning and design. Operations. Education and research. Fund raising, business management, personnel, marketing, conservation.

#### Hort 5024. Landscape Development. (1 cr; A-F only. Prereq-5021 or #)

Hands-on experience in landscape development. Plan takeoffs, site evaluation/preparation, planting, installation/construction, equipment operation, hard-good/plant handling.

#### Hort 5031. Sustainable Fruit Production Systems. (2 cr; A-F only. Prereq-1001, 3005)

Principles of fruit production. Emphasizes temperature fruit crops. Integrated management of fruit cropping systems, including site selection, cultural management practices, taxonomic classification, physiological/environmental control of plant development. Integration of writing into understanding various fruit cropping systems.

#### Hort 5032. Sustainable Commercial Vegetable Production Systems. (3 cr; A-F only. Prereq-[3005, Ent 3005, PIPa 2001, Soils 2125] or #)

Principles of commercial vegetable production. Integrated management of vegetable cropping systems. Site selection/environment, seed/stand establishment, cultural management practices, commodity use, handling from harvest to market. Perspectives on types of vegetable cultivars. Origin, historical significance/improvement through breeding, nutrition/medicinal aspects, physiological/environmental control of development.

#### Hort 5041W. Nursery Production and Management I. (3 cr; A-F only. Prereq-[1001, 1012] or #)

Production, maintenance, and marketing of woody ornamental plants. Establishment/management of nursery or garden centers. Lab, field trips.

#### Hort 5051. Bedding Plant and Specialty Annual/Perennial Crop Production. (4 cr; A-F only. Prereq-1001, 1011, 3002)

Propagation, production, and use of floral crops. Emphasizes bedding plants, perennials, and cut flowers. Growing, marketing, and using herbaceous plants. Cultural practices. Manipulation of environment for growth/quality. Lab, field trips.

#### Hort 5052. Cut Flower Production. (3 cr; A-F only. Prereq-1001, 1011, 3002)

Media management, insect/disease control, management of annual versus perennial plant production systems. Soil modification, seed germination, transplanting, scheduling, weed control, fertilization/irrigation. Environment management, hydroponic solution management, pest management in closed environment. Post-harvest management/care, drying/dying procedures. Consumer surveys at Minneapolis and St. Paul farmers' markets.

**Hort 5061. Turfgrass Science.** (3 cr. Prereq-4061)  
For advanced students in turf with career objectives in professional turf management. Emphasis on ecology, physiology, and theory of turf population dynamics and specialized management situations such as golf course, commercial sod production, and fine turf athletic settings.

**Hort 5071. Restoration and Reclamation Ecology.** (3 cr. Prereq—Biol 2022 or Biol 3002, Biol 1001 or Biol 3407 or equiv or #)

Ecological and physiological concepts as a basis for revegetation of grasslands, wetlands, forests, and other landscapes. Plant selection, stand establishment, evaluating revegetation success. State and federal programs that administer restoration and reclamation programs. Field trips within Minnesota.

**Hort 5090. Directed Studies.** (1-6 cr [max 18 cr]. Prereq—8 cr upper div Hort courses, #)

In-depth exploration of concepts, technology, materials, or programs in specific area to expand professional competency/self-confidence. Planning, organizing, implementing, and evaluating knowledge obtained from formal education and from experience.

**Hort 8005. Supervised Classroom or Extension Teaching Experience in Horticulture.** (2 cr. Prereq—#)

Classroom or extension teaching experience in one of the following departments: Agronomy and Plant Genetics; Biosystems and Agricultural Engineering; Horticultural Science; Plant Pathology; or Soil, Water, and Climate. Participation in discussions about effective teaching to strengthen skills and develop personal teaching philosophy.

**Hort 8007. Extension Horticulture Practicum.** (1-5 cr. Prereq—9 grad cr in ag or bio sciences, #)

Selected activities that may include development of an extension fact sheet, assistance in Dial-U Clinic, or preparation of a workshop or short course.

**Hort 8023. Evolution of Crop Plants.** (2 cr; A-F only. Prereq—9 grad cr in ag or bio sciences)

Origin, distribution, and evolution of cultivated plants; implication of the effects of evolutionary processes on crop breeding for needs of people today.

**Hort 8040. Horticultural Seminar.** (1 cr [max 3 cr].

Prereq—Grad major in agro or applied plant sciences or hort or plant brdg or plant path or soil or #) Reports and discussions of problems and investigational work.

**Hort 8044. Manipulation of Plant Growth and Reproduction.** (2 cr. Prereq—PBio 5412)

Impact of environmental and genetic factors on crop growth, development, and reproduction. Emphasis on whole plant physiology and plant response to the environment as determined by genotype and its manipulation for the purpose of producing a crop. Lectures, discussion of current literature, and projects.

**Hort 8045. Plant Responses to Environmental Stresses.** (3 cr. Prereq—BioC 3021 or BioC 4331, PBio 5412)

Examined from molecular to organismal levels.

**Hort 8090. Graduate Horticultural Research.** (1-12 cr [max 18 cr]. Prereq—#)

Conduct literature, lab, and/or field research with horticultural plants and cropping systems.

**Hort 8201. Plant Breeding Principles I.** (3 cr; A-F only. Prereq—Stat 5301 or equiv)

Principles and current methods involved in breeding agronomic and horticultural crops. Use of genotype/environment data to increase genetic gain, population improvement, parent building, alternative selection strategies, breeding for special traits, and new approaches. Part of a two-semester sequence including Agro 8202.

**Hort 8270. Graduate Seminar.** (1 cr; A-F only.

Prereq—Grad major in [hort or applied plant sciences or ent or agro or plant brdg or plant path or soil] or #) Reports/discussions on problems, investigation work.

**Hort 8280. Current Topics in Applied Plant Sciences.** (1 cr; S-N only. Prereq—Grad major in [hort or applied plant sciences or ent or agro or plant brdg or plant path or soil] or #)

Topics presented by faculty or visiting scientists.

**Hort 8305. Physiological Ecology of Plants in Natural and Managed Ecosystems.** (4 cr; A-F only. Prereq—Biol 1009, Biol 1201/1202, BioC 3000)

Introduction to plants and their reactions and responses in managed and natural ecosystems,

including carbon and nitrogen allocation, root biology, microbial interaction, secondary metabolism, and plant response to biotic and abiotic stress.

**Hort 8900. Advanced Discussions.** (1-3 cr; S-N only. Prereq—#)

Special workshops or courses in applied plant sciences.

## Human Factors (HumF)

*School of Kinesiology*

*College of Education and Human Development*

**HumF 5001. Foundations of Human Factors/Ergonomics.** (3 cr; A-F only. Prereq—Enrollment in good standing, grad HumF minor)

Variability in human performance as influenced by interaction with designs of machines and tools, computers and software, complex technological systems, jobs and working conditions, organizations, and sociotechnical institutions. Conceptual, empirical, practical aspects of human factors/ergonomics.

**HumF 5124. Human Factors Physiology.** (3 cr; A-F only. Prereq—#)

Concepts, problems, and issues associated with ergonomic applications to improving design/operation of human work spaces.

**HumF 5505. Human-Centered Design: Principles and Applications.** (3 cr. \$3505, \$Kin 3505, \$Kin 5505)

Application of design to meet human needs. Design of fabricated products, tools/machines, software/hardware interfaces, art/culture, living environments, and complex sociotechnical systems.

**HumF 5722. Human Factors Psychology.** (3 cr; A-F only. Prereq—Grad student or #)

Psychological principles that underlie human interactions with technological systems. Techniques/methodologies to assess faulty/incorrect system design. Emphasizes human-centered approaches. Rigorous evaluation of human-machine interaction.

**HumF 8001. Special Topics: Human Factors/Ergonomics.** (2-3 cr. Prereq—Enrollment in good standing, grad HumF minor)

Survey course in human factors/ergonomics, an interdisciplinary science concerned with interaction of performance and behavior with design factors in performance environment. Concepts, methods, empirical findings, different systems applications, and current research. Topics vary.

**HumF 8002. Proseminar in Human Factors/Ergonomics.** (1 cr [max 2 cr]; A-F only.

Prereq—Enrollment in good standing, grad HumF minor) Issues and concerns tailored to interests of faculty and students regarding human factors/ergonomics, an interdisciplinary science concerned with interaction of performance and behavior with design factors in performance environment.

## Human Resource Development (HRD)

*Department of Work, Community, and Family Education*

*College of Education and Human Development*

**HRD 5001. Survey: Human Resource Development and Adult Education.** (3 cr)

Overview of fields of human resource development and adult education. Includes societal context, theories, processes, definitions, philosophies, goals, sponsoring agencies, professional roles, participants, and resources. Focus on the unique characteristics and ways the fields overlap and enhance one another.

**HRD 5101. Foundations of Human Resource Development.** (1 cr)

Introduction to human resource development as a field of study and practice.

**HRD 5102. Economic Foundation of Human Resource Development.** (1 cr. Prereq—5101)

Introduction to economics as a core discipline supporting the theory and practice of human resource development.

**HRD 5103. Psychological Foundation of Human Resource Development.** (1 cr. Prereq—5101)

Introduction to psychology as a core discipline supporting the theory and practice of human resource development.

**HRD 5104. Systems Foundation of Human Resource Development.** (1 cr. Prereq—5101)

Introduction to system theory as a core discipline supporting the theory and practice of human resource development.

**HRD 5105. Strategic Planning through Human Resources.** (3 cr; A-F only. Prereq—5001 or 5101, 5102, 5103, 5104)

The theory and practice of strategically developing, utilizing, and aligning human resources as a major contributor to organizational and quality improvement success.

**HRD 5106. Evaluation in Human Resource Development.** (3 cr; A-F only)

Evaluation of human resource development efforts from the perspective of impact on organizations, work processes, and individuals, plus follow-up decisions.

**HRD 5111. Facilitation and Meeting Skills.** (1 cr)

Introduction to the disciplines of planning and running effective meetings. Tools and methods for meeting management and evaluation are presented within the context of organization development.

**HRD 5196. Internship: Human Resource Development.** (1-10 cr [max 10 cr]; S-N only. Prereq—5001, 5201 or 5301)

Students apply and contract for human resource development positions. Contracts describe specific HRD responsibilities to be fulfilled during internship and theory-to-practice learning outcomes.

**HRD 5201. Personnel Training and Development.** (3 cr; A-F only)

Introduction to personnel training/development in organizations: analysis, design, development, implementation, evaluation.

**HRD 5202. Training on the Internet.** (3 cr)

Major concepts, skills, and techniques for giving and receiving training on the Internet.

**HRD 5301. Organization Development.** (3 cr; A-F only) Introduction to major concepts, skills, and techniques for organization development/change.

**HRD 5302. Managing Work Teams in Business and Industry.** (3 cr; A-F only. Prereq—2 core courses in HRD)

Frameworks and strategies for developing effective work teams. Skill development in facilitating resolution of conflicts in organizations. Provides foundational information as well as practical applications for participants (upper-level and graduate students) to become small team leaders.

**HRD 5408. International Human Resource Development.** (3 cr)

Problems, practices, programs, theories, and methodologies in human resource development as practiced internationally.

**HRD 5409. Planning and Decision-Making Skills.** (1 cr)

Introduction to the disciplines of planning and decision making typically used in process improvement interventions. Tools and methods for facilitating group decisions and problem solving.

**HRD 5496. International Field Study in Human Resource Development.** (3 cr. Prereq—5001)

Field study of the organization development, personnel training and development, career development, and quality improvement theories and practices in a selected nation.

**HRD 5601. Student and Trainee Assessment:**

**Advanced.** (2 cr; A-F only)  
Developing learning progress reporting systems and tests of knowledge, affect, and processes for programs focused on instruction of skills associated with business/industry. Evaluating instructional effectiveness. Applying tests and other evaluation instruments to assess/report learning in business/industry and career/technical education fields. Students develop each type of test and an overall evaluation plan for a course.

**HRD 5611. Futurism in Human Resource**

**Development and Adult Education.** (3 cr)  
Exploration of the implications of future developments in several arenas on theory and practice in human resource development and adult education.

**HRD 5612. Managing and Consulting in Human Resource Development and Adult Education.** (3 cr. Prereq-5001)

The theory of managing and consulting in human resource development and adult education. Includes a personal assessment of role requirements and experimentation with management and consultation processes and techniques.

**HRD 5624. Sales Training.** (3 cr; A-F only)

Strategies and techniques for developing effective sales people.

**HRD 5625. Technical Skills Training.** (3 cr)

Analyzing technical skills training practices in business and industry. Systems and process analysis and trouble-shooting of work behavior; design methods and developing training materials.

**HRD 5626. Customer Service Training.** (3 cr; A-F only)

Overview of customer service strategies used by successful organizations and training practices used to develop customer-oriented personnel.

**HRD 5627. Management and Supervisory Training and Development.** (3 cr)

Problems, practices, programs, and methodologies relating to the training and development of managers and supervisors, including needed competencies, needs assessment, delivery modes, and evaluation.

**HRD 5628. Multimedia Presentations in Business.** (3 cr. Prereq-BIE 5011 or equiv)

Designing, creating, and presenting information using multimedia resources in business settings.

**HRD 5629. Course Development in Business and Industry: Advanced.** (2 cr; A-F only)

Designing instructional programs/courses that help learners develop desired competence. Designing instruction for performance based training and vocational/technical education. Developing course syllabus components that clarify course expectations. Developing academic/community-based elements that complement course goals. Reflect on and compare performance-based instruction with other curriculum models for the field.

**HRD 5661. Instructional Methods in Business and Industry Education: Advanced.** (2 cr)

Theory/practice in instructional methods for career/technical education (CTE) instructors and human resources/development (HRD) professionals. How to select various teaching methods and plan for their delivery. Preparing an instructional methods plan to clarify course content, teaching methods selected, rationale for their selection, and how a student organization might facilitate student learning.

**HRD 5662. Computer Training in School and Industry Settings.** (2 cr. Prereq-BIE 5011 or equiv)

Alternative practices for teaching business applications software use—such as word processors, spreadsheets, graphics software, desktop publishing software, databases, and communications software—in both public school and industry settings.

**HRD 5770. Special Topics in Human Resource Development.** (1-4 cr [max 12 cr])

Explanation of issues, methods, and knowledge in HRD areas. Topics vary.

**HRD 5802. Education and Human Resource**

**Development Through Tourism.** (3 cr; A-F only)  
Policies/practices of education and human resource development in tourism industry.

**HRD 5821. Diversity Issues and Practices in Work, Community, and Family Settings.** (3 cr)

Nature of diverse populations and their unique learning and training needs, exemplary programs, and collaborative efforts among persons representing work, community, and family settings.

**HRD 5822. Diversity and Organizational Transformation in Education, Work, and Community.** (2 cr)

Develop models for understanding the impact of diversity on individual, organizational, and community outcomes. Discuss organizational change in relation to diversity.

**HRD 8001. Advanced Theory in Human Resource Development and Adult Education.** (3 cr; A-F only. Prereq-5001 or AdEd 5001)

Theoretical understanding of individuals and organizations as adaptive entities; roles of human resource development and adult education in mediating complex demands.

**HRD 8201. Advanced Personnel Training and Development.** (3 cr; A-F only. Prereq-5201)

Personnel training/development research. Critical review of selected, innovative practices.

**HRD 8301. Advanced Organization Development.** (3 cr; A-F only. Prereq-5301)

Organization development research. Critical review of selected, innovative practices.

## Human Resources and Industrial Relations (HRIR)

*Industrial Relations Center**Curtis L. Carlson School of Management***HRIR 5000. Topics in Human Resources and Industrial Relations.** (1-8 cr)

Selected topics of current relevance to human resource management and industrial relations.

**HRIR 5021. Systems of Conflict and Dispute Resolution.** (4 cr)

Introduction to theoretical and practical treatment of conflict settlement in interpersonal, work-related, community, business, and international settings. Lectures, discussions, observations of actual dispute resolution sessions, and lab exercises with students participating in dispute resolution simulations applied to real world conflicts.

**HRIR 5022. Managing Diversity.** (2 cr. Prereq-[[At least 50 sem cr or 75 qtr cr], 2.00 GPA] or grad student or Δ)

Ways to effectively manage increasingly diverse workforce. Human resource practices examined with respect to diversity. How to incorporate diversity into decision making to enhance organizational performance.

**HRIR 5023. Personnel and Industrial Relations Law.** (2 cr. Prereq-[[At least 50 sem cr or 75 qtr cr], 2.00 GPA] or grad Student or Δ)

Growing body of laws and their application to workplace: human rights, equal employment, compensation/benefit, employee protection, labor relations. Special issues (e.g., wrongful discharge, sexual harassment, defamation) discussed in context of statute, case law, and their application to work setting.

**HRIR 5024. Employee Performance: Appraisal and Management.** (2 cr. Prereq-[[At least 50 sem cr or 75 qtr cr], 2.00 GPA] or grad Student or Δ)

How employee performance is organized, appraised, and managed to achieve organizational/individual performance goals. Job design standards, employee appraisal systems, worker satisfaction.

**HRIR 5025. Comparative and International Human Resources and Industrial Relations.** (2 cr. Prereq-Grad majors must register A-F)

Emergence, evolution, structures, functions, current challenges of labor movements in industrialized societies. Critical differences in key human resource management practices. Industrial relations systems, collective bargaining in comparative perspective. International Labor Organization.

**HRIR 5054. Public Policy and Employee Benefits.** (2 cr. Prereq-Undergrad micro economics; HRIR grad majors must register A-F)

Survey of federally/state-mandated employee benefits: worker compensation, unemployment insurance, temporary disability insurance, social security. Effects of providing benefits on workers' incentives in regard to performance, acquisition, and maintenance of human capital, mobility, and risk sharing.

**HRIR 5061. Public Policies on Work and Pay.** (3 cr)

Analysis of public policies regarding employment, unions, and labor markets. Public programs affecting wages, unemployment, training, worker mobility, security, and quality of work life. Policy implications of the changing nature of work.

**HRIR 5991. Independent Study in Human Resources and Industrial Relations.** (1-8 cr [max 8 cr]. Prereq-Δ or #)

Individual readings or research topics.

**HRIR 8000. Graduate Topics in Human Resources and Industrial Relations.** (1-8 cr [max 8 cr]. Prereq-HRIR MA student or Sch Mgmt approval; grad majors must register A-F)**HRIR 8011. Quantitative Methods in Human Resources and Industrial Relations.** (4 cr. Prereq-Grad HRIR major or Δ; grad majors must register A-F)

Applications of descriptive and inferential statistics, including probability, hypothesis testing, confidence intervals, analysis of variance, and regression. Computers used in class and homework exercises.

**HRIR 8012. Applied Quantitative Methods in Human Resources and Industrial Relations.** (2 cr. Prereq-[8011, grad HRIR major] or Δ; grad majors must register A-F)

Evaluation of applied statistical research in human resources and industrial relations. Appropriate statistical inferences/applications. Sampling issues, multiple regression, advanced topics.

**HRIR 8013. Research Methods in Social and Labor Policy.** (3 cr. Prereq-8011, grad HRIR major or Δ; grad majors must register A-F)

Application of social science research methods to public policy issues.

**HRIR 8014. Human Resource Information Systems.** (2 cr. Prereq-Grad HRIR major or Δ; grad majors must register A-F)

Hardware and database fundamentals, software applications, security issues, vendor evaluation, system and software development and design issues, and strategies for gaining user acceptance.

**HRIR 8021. Introduction to Human Resources and Industrial Relations.** (3 cr. \$3021. Prereq-Econ 1101, Econ 1102, Psy 1001, Δ; grad HRIR majors must register A-F)

Human resource management in contexts of labor markets and organizations. Valuing, employing, developing, motivating, and maintaining human resources in an industrial society. Staffing, training, and development; organizational behavior and theory; compensation and benefits; labor market analysis; and labor relations and collective bargaining.

**HRIR 8022. Field Project.** (4 cr. Prereq-[8011, 8031, 8041, 8051, 8061, 8071, grad HRIR major] or Δ; grad majors must register A-F, must have instructors consent to drop course)

Teams formulate and execute study of actual business problem faced by business, non-profit, or governmental organization, generally in Twin Cities.

**HRIR 8023. International Human Resource Management.** (2 cr. Prereq—MBA 6215 or grad HRIR major or Δ; grad majors must register A-F) Growing U.S. interdependence with rest of the world and its implications for human resource management policies and practices at home and abroad.

**HRIR 8031. Staffing, Training, and Development.** (4 cr. Prereq—Psy 1001, grad HRIR major or Δ; grad majors must register A-F) Introduction to staffing processes (recruitment, selection, promotion, demotion, transfer, dismissal, layoff, retirement); training development theory and techniques as mechanisms for influencing individual and organizational outcomes, such as performance, satisfaction, and climate.

**HRIR 8032. Staffing and Selection: Strategic and Operational Concerns.** (2 cr. Prereq—[8031, HRIR grad student] or Δ; HRIR grad students must register A-F) Theory/practice related to staffing decisions (recruitment, selection, promotion, transfer, dismissal, layoff, retirement) in organizations. Legal environment in which staffing decisions are made. Staffing from strategic/organizational perspectives.

**HRIR 8033. Employee Training: Creating a Learning Organization.** (2 cr. Prereq—[8031, HRIR grad student] or Δ; HRIR grad students must register A-F) Theory, research, practice related to design/implement employee training programs. Instructional design, training techniques, transfer of training, program evaluation/costing. Role of employees, firm policies/practices in training.

**HRIR 8034. Employee Development: Creating a Competitive Advantage.** (2 cr. Prereq—8031 or #, grad HRIR major or Δ; grad majors must register A-F) Career development and planning, employee and management development techniques, and organizational and employee concerns related to mobility, job stress, balancing work and family, obsolescence and plateauing, and cross-cultural assignments.

**HRIR 8041. Design and Management of Organizations.** (4 cr. Prereq—Econ 1101, Econ 1102, Psy 1001 or #, grad HRIR major or Δ; grad majors must register A-F) Introduction to micro through macro organizational issues at individual, dyadic, group, organizational, and environmental levels; their implications for organizational design, control, coordination, and development.

**HRIR 8042. Organizational Structure and Performance.** (2 cr. Prereq—[8041 or #], [grad HRIR major or Δ]; grad majors must register A-F) How different organizational practices (e.g., employee empowerment, job enrichment, profit sharing, employee stock ownership, individual incentives, information sharing, integration mechanisms) affect organizations in their competitiveness, profitability, workplace safety, employment stability, and wages. Coherence of system of organizational practices.

**HRIR 8043. Comparative Organizations and HRM Systems.** (2 cr. Prereq—[8041 or #], [grad HRIR major or Δ]; grad majors must register A-F) Variations in organizational practices related to variations in ownership (profit, nonprofit, government, cooperatives), economic systems, culture, technology, market structure, etc. Organizational practices: employee empowerment, job enrichment, profit sharing, employee stock ownership, individual incentives, information sharing, integration mechanisms, and international comparisons.

**HRIR 8044. Motivation and Work Behavior in Contemporary Organizations.** (2 cr. Prereq—8041 or #, grad HRIR major or Δ; grad majors must register A-F) In-depth study of major topics in microlevel organizational behavior. Accountability, organization citizenship behaviors, forms of organizational attachment, motivation, and issues of equity and justice.

**HRIR 8051. Compensation and Benefits.** (4 cr. Prereq—Econ 1101, Econ 1102, Psy 1001 or #, grad HRIR major or Δ; grad majors must register A-F) Economic and behavioral theory and research on pay program applications. Effect of laws and regulations on pay. Work design, job analysis, and job evaluation. Performance measurement and evaluation. Incentive programs. Managerial and executive compensation. Comparative perspectives. Costing and forecasting.

**HRIR 8052. Compensation Theory and Applications.** (2 cr. Prereq—8051 or #, grad HRIR major or Δ; grad majors must register A-F) Relationship between economic and psychological theories and the design and operation of compensation programs. Demographic influences on compensation program outcomes. Statistical analysis applied to pay program design and administration. Global pay variations. Current pay issues and controversies.

**HRIR 8053. Employer-Sponsored Employee Benefit Programs.** (2 cr. Prereq—8011, 8051 or #, grad HRIR major or Δ; grad majors must register A-F) Design and administration of nonmandatory compensation benefit programs: medical expense insurance, pensions, profit sharing plans, disability, and other employee benefits. Effects of providing benefits on workers' incentives with regard to performance, acquisition and maintenance of human capital, mobility, and risk sharing.

**HRIR 8061. Introduction to Labor Market Analysis.** (4 cr. Prereq—Econ 1101, Econ 1102 or #, grad HRIR major or Δ; grad majors must register A-F) Labor supply and demand analysis, its international dimensions; determination of wages, employment and unemployment; accumulation of human capital and investment in education and training; government regulation in areas of discrimination and workplace safety; role of unions in wage determination.

**HRIR 8062. Human Resource Strategy and Planning.** (2 cr. Prereq—8061 or #, grad HRIR major or Δ; grad majors must register A-F) Case studies used to diagnose strategy.

**HRIR 8063. Human Resources and Organizational Performance.** (2 cr. Prereq—8061 or #, grad HRIR major or Δ; grad majors must register A-F) Impact of human resource policies and practices on organizational productivity and effectiveness. Role of government, unions, and private sector institutions on organizational effectiveness.

**HRIR 8064. Topics in Micro Labor Market Analysis.** (2-4 cr. Prereq—8061 or #, HRIR PhD student or Δ; grad majors must register A-F) May include micro aspects of unemployment, implicit contracts and efficiency wages, investment in human capital, occupational choice, job search, job matching and turnover, migration, labor force participation, and government program evaluation.

**HRIR 8065. Topics in Macro Labor Market Analysis.** (2-4 cr. Prereq—8061 or #, HRIR PhD student or Δ; grad majors must register A-F) May include theories of unemployment based on sectoral shocks, theories of wage rigidity, efficiency wage theories, interindustry wage structure, role of labor market in resource allocation, and effects of government intervention in labor market.

**HRIR 8071. Labor Relations and Collective Bargaining.** (4 cr. Prereq—Econ 1101, Econ 1102 or #, grad HRIR major or Δ; grad majors must register A-F) Evolution of U.S. labor unions and public policy, bargaining environment and structure, goals and negotiations, contract administration and results. International comparisons, labor-management cooperation, and newly emerging issues.

**HRIR 8072. Labor Movements in a Changing World.** (2 cr. Prereq—8071 or #, grad HRIR major or Δ; grad majors must register A-F) Labor movement philosophies. Critical evaluation of labor movement growth and adjustment to environmental change. Domestic and international perspectives of labor movement innovations.

**HRIR 8073. Dispute Resolution: Labor Arbitration.** (2 cr. Prereq—8071 or #, grad HRIR major or Δ; grad majors must register A-F) Arbitration to resolve grievances and impasses arising out of the collective bargaining agreement's administration and negotiation. Arbitration law and legal issues, procedures and practices, case presentation, management rights, discipline and discharge, evidence, contract language interpretation, and remedies. Newly emerging approaches.

**HRIR 8074. Labor-Management Negotiations.** (2 cr. Prereq—8071 or #, grad HRIR major or Δ; grad majors must register A-F) Analysis of the nature of negotiations with applications to private and public sector collective bargaining. Nature of conflict and dilemma between competition and cooperation. Determinants of bargaining strategies, tactics, outcomes, and impasses. Newly emerging issues.

**HRIR 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**HRIR 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**HRIR 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**HRIR 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**HRIR 8811. Advanced Quantitative Research Methods in Human Resources and Industrial Relations.** (2-4 cr. Prereq—HRIR core or #, HRIR PhD student or Δ; grad majors must register A-F) General linear model and its assumptions and violations; simultaneous equations; pooling cross-section and time series; limited qualitative dependent variable models; sample selection models; hazard models. Emphasizes application to human resources and industrial relations.

**HRIR 8812. Seminar: Human Resources and Industrial Relations Research Methodology.** (2-4 cr [max 8 cr]. Prereq—HRIR PhD student or Δ; grad majors must register A-F) Application in research projects.

**HRIR 8821. Seminar: Human Resources and Industrial Relations Systems.** (1-4 cr. Prereq—HRIR core or #, HRIR PhD student or Δ; grad majors must register A-F) Thought and research in the field. Investigating, integrating, and synthesizing more traditional related disciplines, theories, and research into interdisciplinary body of knowledge concerned with human resource and industrial relations problems and employment relationships.

**HRIR 8830. Seminar: Staffing, Training, and Development.** (1-4 cr [max 8 cr]. Prereq—8031 or #, HRIR PhD student or Δ; grad majors must register A-F) Concepts, problems, and research.

**HRIR 8840. Seminar: Organization Theory and Behavior.** (1-4 cr [max 8 cr]. Prereq—8041 or #, HRIR PhD student or Δ; grad majors must register A-F) Application in human resources and industrial relations research/practice.

**HRIR 8850. Seminar: Compensation and Reward.** (1-4 cr [max 8 cr]. Prereq—8051 or #, HRIR PhD student or Δ; grad majors must register A-F) Relevant theoretical models; formulation of research into compensation and reward issues.

**HRIR 8860. Seminar: Analysis of Current Labor Market Theory and Empirical Research.** (1-4 cr [max 8 cr]. Prereq—8061 or #, HRIR PhD student or Δ; grad majors must register A-F) Functions and operations of labor markets, theory, and research.

**HRIR 8870. Seminar: Labor Relations and Collective Bargaining.** (1-4 cr [max 8 cr]. Prereq—8071 or #, HRIR PhD student or Δ; grad majors must register A-F) Analysis of contemporary theoretical and empirical research.

**HRIR 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

**HRIR 8991. Independent Study in Human Resources and Industrial Relations.** (1-8 cr [max 8 cr]; A-F only. Prereq—#)  
Individual readings and/or research projects.

## Industrial Engineering (IE)

*Department of Mechanical Engineering  
Institute of Technology*

**IE 5080. Topics in Industrial Engineering.** (4 cr. Prereq—Upper div or grad student)  
Topics vary each semester.

**IE 5441. Engineering Cost Accounting and Cost Control.** (4 cr; A-F only)  
Financial accounting, managerial accounting, engineering economics. Preparing financial statements, handling accounts payable/receivable, inventories, depreciation. Financing sources, capital cost/structure. Time value of money and of risk in managerial decision making. Design of cost accounting system and activity-based accounting.

**IE 5511. Human Factors and Work Analysis.** (4 cr; A-F only. Prereq—Upper div IT or grad student)  
Human factors engineering (ergonomics), methods engineering, and work measurement. Human-machine interface: displays, controls, instrument layout, and supervisory control. Anthropometry, work physiology and biomechanics. Work environmental factors: noise, illumination, toxicology. Methods engineering, including operations analysis, motion study, and time standards.

**IE 5512. Applied Ergonomics.** (4 cr; A-F only. Prereq—Upper div IT or grad student, 5511)  
Small groups of students work on practical ergonomic problems in local industrial firms. Projects cover a variety of ergonomic issues: workstation design, equipment and tool design, back injuries and material handling, cumulative trauma disorders, illumination and noise, and safety.

**IE 5513. Engineering Safety.** (4 cr; A-F only. Prereq—Upper div IT or grad student)  
Occupational, health, and product safety. Standards, laws, and regulations. Hazards and their engineering control, including general principles, tools and machines, mechanics and structures, electrical safety, materials handling, fire safety, and chemicals. Human behavior and safety, procedures and training, warnings and instructions.

**IE 5522. Quality Engineering and Reliability.** (4 cr. Prereq—[4521 or equiv], [upper div or grad student or CNR])  
Quality engineering/management, economics of quality, statistical process control design of experiments, reliability, maintainability, availability.

**IE 5531. Engineering Optimization I.** (4 cr. Prereq—Upper div or grad student or CNR)  
Linear programming, simplex method, duality theory, sensitivity analysis, interior point methods, integer programming, branch/round/dynamic programming. Emphasizes applications in production/logistics, including resource allocation, transportation, facility location, networks/flows, scheduling, production planning.

**IE 5541. Project Management.** (4 cr. Prereq—Upper div or grad student)  
Project screening/selection, multiple-criteria methods for project evaluation, project structuring/work breakdown, project teams, project scheduling, resource management, life-cycle costing, project control, project termination, research/development projects, computer support for project management.

**IE 5545. Decision Analysis.** (4 cr. Prereq—4521 or equiv)  
Normative theories of decision making. Emphasizes structuring of hard decision problems arising in business and public policy contexts. Decision trees, expected utility theory, screening prospects by dominance, assessment of subjective probability, multiple attribute utility, analytic hierarchy process, benchmarking with data envelopment analysis, basics of game theory.

**IE 5551. Production Planning and Inventory Control.** (4 cr. Prereq—CNR or upper div or grad student)  
Inventory control, supply chain management, demand forecasting, capacity planning, aggregate production and material requirement planning, operations scheduling, and shop floor control. Quantitative models used to support decisions. Implications of emerging information technologies and of electronic commerce for supply chain management and factory operation.

**IE 5552. Design and Analysis of Manufacturing Systems.** (4 cr. Prereq—Upper div or grad student)  
Flow lines, assembly systems, cellular manufacturing systems, and flexible manufacturing systems. Emphasis is on methodologies for modeling, analysis and optimization. Lead time analysis, capacity and workload allocation, scheduling and shop floor control, work-in-process management, facilities planning and layout, and information management.

**IE 5553. Simulation.** (4 cr. Prereq—CNR or upper div or grad student)  
Discrete event simulation. Using integrated simulation/animation environment to create, analyze, and evaluate realistic models for various manufacturing, assembly, and material handling systems. Experimental design for simulation. Random number generation. Selecting input distributions. Evaluating simulation output.

**IE 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**IE 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**IE 8531. Engineering Optimization II.** (4 cr)  
Non-linear/global optimization, computational tools/algorithms for solving constrained/unconstrained optimization problems, necessary/sufficient conditions of optimality. Jacobian/Lagrangian methods. Kuhn-Tucker condition. Direct search, gradient methods. Separable, quadratic, geometric, stochastic programming. Emerging search techniques/heuristics.

**IE 8532. Stochastic Processes and Queuing Systems.** (4 cr. Prereq—4521 or equiv)  
Introduction to stochastic modeling and processes. Random variables, discrete and continuous Markov chains, renewal processes, queuing systems. Brownian motion, and elements of reliability and stochastic simulation. Applications to design, planning, and control of manufacturing and production systems.

**IE 8533. Advanced Stochastic Processes and Queuing Systems.** (4 cr. Prereq—8532 or #)  
Renewal/generative processes, Markov/semi-Markov processes, martingales, queuing theory, queuing networks, computational methods, fluid models, Brownian motion.

**IE 8534. Advanced Topics in Operations Research.** (4 cr [max 8 cr]. Prereq—5531, 8532)  
Special topics determined by instructor. Examples include Markov decision processes, stochastic programming, integer/combinatorial optimization, and queuing networks.

**IE 8538. Advanced Topics in Information Systems.** (4 cr; A-F only. Prereq—8541, college-level computer programming course)  
Decision support methods. Case studies of specific systems. Methods for testing usability/performance. Trust/over-reliance, their impact on system performance. System-level issues, general planning, design, information analysis, problem paradigms. How to frame problems. Techniques to combine engineering and information technology.

**IE 8541. Decision Support Systems.** (4 cr; A-F only. Prereq—College-level computer programming course)  
Intelligent computer tools to aid designers, process planners, and analysts in making decisions better or faster.

**IE 8552. Advanced Topics in Production, Inventory, and Distribution Systems.** (4 cr [max 8 cr]. Prereq—5551)  
Cutting edge research issues in production, inventory, and distribution systems. Topics vary: stochastic models of manufacturing systems, stochastic inventory theory, multi-echelon inventory systems and supply chains, supplier-retailer and supplier-manufacturer coordination, supplier and warehouse networks, business logistics, transportation.

**IE 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**IE 8773. Graduate Seminar.** (1 cr; S-N only)  
Recent developments.

**IE 8774. Graduate Seminar.** (1 cr; S-N only. Prereq—8773)  
Recent developments.

**IE 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**IE 8794. Industrial Engineering Research.** (1-6 cr [max 10 cr]. Prereq—#)  
Directed research.

**IE 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

**IE 8951. Plan B.** (1 cr; S-N only)  
Structured environment in which students can complete M.S. Plan B project.

**IE 8953. Plan B.** (2 cr; A-F only. Prereq—8951)  
Structured environment in which students can complete M.S. Plan B project.

## Information and Decision Sciences (IDSc)

*Department of Information and Decision Sciences  
Curtis L. Carlson School of Management*

**IDSc 8511. Conceptual Topics and Research Methods in Information and Decision Sciences.** (4 cr. Prereq—Business admin PhD student or #)  
Relationships to underlying disciplines; major research streams; seminal articles, survey literature, and major researchers. Provides framework for organizing knowledge about information and decision sciences.

**IDSc 8521. System Development.** (2 cr. Prereq—Business admin PhD student or #; offered alt yrs)  
Why it is hard to develop efficient/effective information systems, what can be done to improve situation. Defining efficiency/effectiveness in development process and in systems. Producing/evaluating artifacts (constructs, models, methods, tools) that enable more efficient/effective information systems to be developed.

**IDSc 8711. Cognitive Science.** (4 cr. Prereq—Business admin PhD student or #; offered alt yrs)  
Empirically based concepts of knowledge and reason, mental representation and conceptual systems that guide problem solving and decision making. Computational metaphor of mind drawn from psychology, computer science, linguistics, anthropology, and philosophy. Implications for understanding of knowledge work.

**IDSc 8721. Behavioral Decision Theory.** (2 cr. Prereq—Business admin PhD student or #; offered alt yrs)  
Traditional/current research. Major models/methodologies. Issues of preference, judgment, and choice under conditions of certainty/uncertainty. Seminar format.

**IDSc 8722. Heuristic Decision Making.** (2 cr.  
Prereq–Business Admin PhD student or #; offered alt yrs)  
How decisions are made, how knowledge is stored/used, how knowledge of variability/feedback influence decisions. Decisions at strategic, operational, individual level. Exceptional performance, pathologies of decision making. Basis for “best practice.” How knowledge is managed in decisions, decision failure. Folly, normal accidents, decision problems in which individuals manipulate information to influence/deceive others.

**IDSc 8800. Research Seminar in Information and Decision Sciences.** (4 cr [max 20 cr]. Prereq–Business admin PhD student or #)  
Topics, which vary by semester, are selected from new areas of research, research methods, and significant issues.

**IDSc 8801. Research Seminar in Information and Decision Sciences.** (2 cr [max 20 cr]. Prereq–Business Admin PhD student or #)  
New areas of research, research methods, issues.

**IDSc 8802. Research Seminar in IDSc.** (3 cr [max 15 cr]; A-F only. Prereq–PhD student or #)  
Topics selected from new areas of research, research methods and significant issues in information and decision sciences.

**IDSc 8892. Readings in Information and Decision Sciences.** (1-8 cr [max 16 cr]. Prereq–Business admin PhD student or #)  
Readings useful to a student’s individual program and objectives that are not available through regular courses.

**IDSc 8894. Graduate Research in Information and Decision Sciences.** (1-8 cr [max 16 cr]. Prereq–Business admin PhD student or #)  
Individual research on an approved topic appropriate to student’s program and objectives.

## Infrastructure Systems Engineering (ISE)

*Center for Development of Technological Leadership*

*Institute of Technology*

**ISE 5101. Project Management.** (3 cr; A-F only. Prereq–ISE student)  
Broad areas in project management and leadership. Emphasizes practical understanding of business/engineering project management. Project planning, scheduling, controlling. Budgeting, staffing, task/cost control. Communicating with, motivating, leading, and managing conflict among team members. Lectures, discussions, experiential exercises.

**ISE 5104. Construction Estimating.** (2 cr; A-F only. Prereq–ISE grad student)  
Methods for quantity take-offs. Identification of resources for price/availability information.

**ISE 5105. Computer Applications II.** (1 cr; A-F only. Prereq–ISE grad student)  
Application features in Excel, Visual Basic, and Web Authoring. Data reduction, data presentation, interactive Web calculations. Student projects.

**ISE 5112. Infrastructure Systems Engineering Management.** (2 cr; A-F only. Prereq–ISE grad student)  
Managing a public works infrastructure. Case studies of decision making in an environment of conflicting interests.

**ISE 5113. Computer Applications in Infrastructure Systems Engineering.** (2 cr; A-F only. Prereq–ISE grad student)  
Advanced application of computer tools/methods in infrastructure engineering problems. Spreadsheet Visual Basic programming, HTML, JAVA script.

**ISE 5114. Pavement Management, Maintenance, and Rehabilitation.** (3 cr; A-F only. Prereq–ISE grad student)  
Concepts in network/project level pavement management for flexible/rigid pavements. Pavement distress identification/quantification. Functional/structural evaluation. Identification of appropriate maintenance activities. Selection/design of rehabilitation alternatives.

**ISE 5201. Pavement Management Maintenance and Rehabilitation.** (2 cr; A-F only. Prereq–ISE grad student)  
Concepts in network/project-level pavement management for flexible/rigid pavements. Pavement distress identification/quantification. Functional/structural evaluation. Identification of appropriate preventative/reactive maintenance activities. Selection/design of rehabilitation alternatives.

**ISE 5202. Traffic Engineering Management.** (2 cr; A-F only. Prereq–ISE student)  
Identification and effective use of traffic control devices. Automated method of characterizing/assessing traffic flow. Evaluation/improvement of geometric features.

**ISE 5301. Bridge Management Maintenance and Rehabilitation.** (2 cr; A-F only. Prereq–ISE grad student)  
Structural/functional evaluation of steel, concrete, and timber bridges. Distress identification. Modes of failure, including fatigue, corrosion, and foundation erosion (scour). Preventative/reactive maintenance techniques. Rehabilitation design/construction.

**ISE 5401. Water Distribution Systems.** (1 cr; A-F only. Prereq–ISE grad student)  
Components/design of water distribution systems. Methods of evaluation/management. Maintenance/rehabilitation techniques.

**ISE 5402. Storm Water Management.** (2 cr; A-F only. Prereq–ISE grad student)  
Components/design of storm water collection systems. Methods of evaluation/management. Maintenance/rehabilitation techniques.

**ISE 5403. Water Treatment Systems.** (2 cr; A-F only. Prereq–ISE student)  
Components/design of water treatment systems. Evaluation/management methods. Maintenance/rehabilitation techniques.

**ISE 5500. Public Interactions.** (1 cr [max 2 cr]; A-F only. Prereq–ISE student)  
Techniques for effective public communication. How to run a public hearing. Resources for publishing public notices. Sequence course, in three parts.

**ISE 5501. Geographic Information Systems.** (2 cr; A-F only. Prereq–ISE student)  
Introduction to geographic Information Systems (GIS) for infrastructure. GIS application domains, data models/sources, analysis methods, and output techniques. Lectures, readings, hands-on experience with GIS software.

**ISE 5503. Financial Management in Public Organizations.** (2 cr; A-F only. Prereq–ISE student)  
Design, installation, and use of accounting/control systems in public organizations. Public accounting standards/practices, financial administration, financial reporting, debt management, budgeting, and contract/procurement management systems. Lecture, discussion, case analysis.

**ISE 5504. Construction Law and Ethics.** (2 cr; A-F only. Prereq–ISE student)  
Ethical framework for responsible management of public works projects. Moral leadership, trust in public/private organizations, quality control.

**ISE 8105. Capstone Project.** (3 cr; A-F only. Prereq–ISE student)  
Integrates knowledge from courses in Master’s program with job experience. Students prepare proposal, conduct project, and report results in written and oral form. Project involves aspect of design, management, or operation of some feature of infrastructure.

**ISE 8333. FTE: Master’s.** (1 cr; NGA. Prereq–Master’s student, adviser approval, DGS approval)

## Insurance (Ins)

*Industrial Relations Center*

*Curtis L. Carlson School of Management*

**Ins 5000. Personal Financial Planning 2: Tax and Estate Planning Techniques.** (2 cr. Prereq–5201)  
In-depth treatment of estate planning and tax management techniques introduced in 5201. Charitable giving, probate process, use of health care directives, durable powers of attorney, revocable/irrevocable trusts, wills, asset distribution.

**Ins 5100. Corporate Risk Management.** (2 cr)  
Theory applied to corporate risk management and insurance practices. Identification, measurement, and treatment of an organization’s financial risks integrated with its property, liability, workers compensation, and human resource risks. Selection and application of risk control and risk financing tools: risk retention, reduction and transfer, including insurance.

**Ins 5101. Employee Benefits.** (2 cr. Prereq–5100 or HRIR 3021 or #)  
Design/administration of employee benefit plans and pension programs: health insurance, disability plans, salary reduction/deferred compensation programs— from social insurance to executive benefits. Multiple employer trusts. Alternative funding methods, including self-insurance. Ethical issues, legal liability, compliance with regulations.

**Ins 5200. Insurance Theory and Practice.** (2 cr)  
Risk theory is applied to practices in health, liability, life, property, and workers compensation insurance. Insurance marketing, pricing, underwriting, and claims administration, with adverse selection and moral hazard effects. Policy issues of tort versus no-fault compensation systems. Self-insurance and integrated risk financing methods.

**Ins 5201. Personal Financial Management.** (2 cr)  
Personal financial planning. Financial statements, cash flow/debt analysis, time value of money. Management of liability, disability, life, medical, and property risks. Investments, portfolio management. Tax reduction, employee benefits, retirement/estate planning. Ethical issues, regulation of financial planners.

**Ins 5202. Personal Financial Planning 2: Tax and Estate Planning Techniques.** (2 cr. Prereq–5201)  
In-depth treatment of estate planning and tax management techniques introduced in 5201. Charitable giving, probate process, use of health care directives, durable powers of attorney, revocable/irrevocable trusts, wills, asset distribution.

## Interdisciplinary Archaeological Studies (InAr)

*College of Liberal Arts*

**InAr 5100. Topics in Interdisciplinary Archaeological Studies.** (3 cr; A-F only. Prereq–InAr grad major or #)  
Topics specified in the *Class Schedule*.

**InAr 8004. Method and Theory in Archaeology.** (3 cr; A-F only. Prereq–Grad InAr major or #)  
Survey and evaluation of archaeological approaches to non-literary, material evidence for past human activities and societies.

**InAr 8100. Interdisciplinary Seminar.** (3 cr; A-F only. Prereq–Grad InAr major or #)  
Review and evaluation of approaches to interdisciplinary research; themes vary. Leadership and research shared by staff, visitors, and students.

**InAr 8200. Directed Readings.** (1-7 cr. Prereq–Grad InAr major or #)

**InAr 8300. Directed Research.** (1-7 cr. Prereq–Grad InAr major or #)

**InAr 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**InAr 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**InAr 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**InAr 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**InAr 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

## Interpersonal Relationships Research (IRel)

### College of Education and Human Development

**IRel 8001. Proseminar in Interpersonal Relationships Research.** (1 cr [max 2 cr]; S-N only. Prereq—Grad IRel minor)

Survey of major topics, including theoretical assumptions, methods, and samples of current research.

**IRel 8021. Seminar: Statistical and Methodological Issues in Research on Dyadic Relationships.** (2 cr; S-N only. Prereq—Grad IRel minor, #)  
Survey of topics in design and analysis of research on behavior in two-person interactions.

**IRel 8360. Seminar: Topics in Interpersonal Relationships Research.** (1-3 cr [max 6 cr]. Prereq—Grad IRel minor or #)

Intensive study of topics.

## Italian (Ital)

### Department of French and Italian

#### College of Liberal Arts

**Ital 5201. Reading Italian Texts: Poetics, Rhetoric, Theory.** (3 cr. \$3201. Prereq—Grad student or #)  
Rhetorical/poetic aspects of language and literature. Interpretive methods, theoretical concepts.

**Ital 5203. Italian Travelers: From the Enlightenment to the Present.** (3 cr. \$3203. Prereq—Grad student or #)  
Literary representations of travel, migration, immigration, exile, and tourism in Italy, from Enlightenment to present.

**Ital 5209. Trecento Literature: Ruling the Canon.** (4 cr. Prereq—3015, 3201 or #)  
Works of Boccaccio and Petrarch and their role in establishing the canon of Italian vernacular literature. Taught in English also as MeSt 5610.

**Ital 5289. The Narrow Door: Women Writers and Feminist Practices in Italian Literature and Culture.** (4 cr. Prereq—3015)  
Focuses on issues of gender, sexual difference, equality, and emancipation raised by Italian women writers and thinkers from the 19th century to the present.

**Ital 5305. Staging the Self: Theater and Drama in Modern Italy.** (4 cr. \$3305. Prereq—Grad student or #)  
Theatrical representations of the self in modern Italy. Focuses on issues of identity, gender, and class in theatrical works ranging from Alfieri's *Mirra*, Pirandello's *Enrico IV* to Dacia Maraini's *Clytemnestra*.

**Ital 5321. Italian Renaissance Epic.** (4 cr. Prereq—3015, 3201 or #)  
Study of the narrative poems of Boiardo, Ariosto, and Tasso in the context of the fashioning of early modern Europe.

**Ital 5337. Nation and Narration: Writings in the 19th Century.** (4 cr. Prereq—3015)

Introduces the construction of modern Italian national identity by examining the role that literature plays in this process. Works by Manzoni, Foscolo, Leopardi, Gioia, Verga, Sereno, and Deledda studied in the context of a range of sociopolitical and cultural issues.

**Ital 5401. Mondo di Dante.** (4 cr. Prereq—3015, 3201 or #)  
Intensive reading of Dante's *Inferno*, *Purgatorio*, and *Vita Nuova* with emphasis on Dante's linguistic and cultural contributions.

**Ital 5502. Making of Modern Italy: From the Enlightenment to the Present.** (3 cr. \$3502. Prereq—Grad student or #)

Italian literary, cultural, and symbolic practices, from Enlightenment to present.

**Ital 5609. World of Dante.** (4 cr [max 8 cr])  
Taught in English. Intensive reading of Dante's *Inferno*, *Purgatorio*, and *Vita Nuova* with emphasis on the personal, poetic, and political stakes of the journey of Dante's pilgrim through hell to the earthly paradise.

**Ital 5806. Negotiating the Terms: Italian Film and Literature.** (3 cr. \$3806. Prereq—Grad student or #)  
Cinematic representations of Italian literary texts. Basic tools of literary/film analysis. How both media impact Italian culture. Taught in English.

**Ital 5970. Directed Readings.** (1-4 cr [max 16 cr]. Prereq—#)  
Meets unique requirements decided on by faculty member and student. Individual contracts list contact hours, number of credits, written and other work required.

**Ital 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**Ital 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Ital 8992. Directed Readings.** (1-4 cr [max 16 cr]. Prereq—#)  
Requirements decided on by faculty member and student: contact hours, number of credits, written/other work.

## Japanese (Jpn)

### Department of Asian Languages and Literatures College of Liberal Arts

**Jpn 5040. Readings in Japanese Text.** (2-4 cr [max 12 cr]; A-F only. Prereq—4041 or equiv or #)  
Students read authentic materials of various types to increase reading/speaking ability. Topics specified in *Class Schedule*.

**Jpn 5071. Communicative Competence for Japan-Oriented Careers.** (4 cr. Prereq—4041 or 4042 or #)  
Effective communication using spoken and written Japanese in contexts likely to be encountered by a career-oriented professional in Japan.

**Jpn 5072. Communicative Competence for Japan-Oriented Careers.** (4 cr. Prereq—5071 or #)  
Effective communication using spoken and written Japanese in contexts likely to be encountered by a career-oriented professional in Japan.

**Jpn 5160. Topics in Japanese Literature.** (4 cr [max 16 cr])  
Literary, historical, or cultural study of selected Japanese literature.

**Jpn 5161. Women's Writing in Premodern Japan.** (4 cr; A-F only. Prereq—3162, 4061 or # when readings are in Japanese; 3162 or # when in translation)  
Works by women in premodern Japan including Genji monogatari, a lengthy narrative, *Makura no soshi*, a collection of vignettes, and poetry. Concerns include gendered writing system/authorship, narrative techniques, sexuality and the figure of the author, and strategies of fictionality.

**Jpn 5162. Tale Literature in Premodern Japan.** (4 cr; A-F only. Prereq—3162, course from classical Japanese language sequence or #)  
Tale literature, both Buddhist and secular, presents the world of the middle- to lower-class people. Rhetoric and religion, fiction and history, gender and sexuality, the role of the supernatural/fantastic, and re-tellings of earlier texts.

**Jpn 5163. Premodern Historical Narratives.** (4 cr; A-F only. Prereq—3162, course from classical Japanese language sequence or #)  
Narratives rooted in history. Issues include the problematization of reality, the formation of national identity, the idea of divine Imperial power, oral storytelling and its relationship to written texts, and the popularization of historical writings.

**Jpn 5164. Readings in Early Modern Japanese Literature.** (4 cr; A-F only. Prereq—3032 when readings are in Japanese or #)  
An examination of the stylistic and ideological aspects of the prose fiction, poetry, and non-fiction of the period 1863 to 1945. Offered in a rotating format alternating between readings in the original language and readings in English translation.

**Jpn 5165. Readings in Postwar and Contemporary Japanese Literature.** (4 cr; A-F only. Prereq—3032 when offered in Japanese or #)  
Literary and historical exploration of selected works published between 1945 and the present. Focus may be on a writer, a period, or a theme. Offered in a rotating format alternating between readings in the original language and readings in English translation.

**Jpn 5166. Literature by 20th-Century Japanese Women.** (4 cr. Prereq—3032 or #)  
Literary and historical exploration of selected works by Japanese women writers in a variety of genres. All literary texts read in Japanese; critical readings may be in English.

**Jpn 5171. Women's Writing in Premodern Japan in Translation.** (4 cr; A-F only. Prereq—3162 or #)  
Genji monogatari, a lengthy narrative, *Makura no soshi*, a collection of vignettes, and poetry. Gendered writing system/authorship, narrative techniques, sexuality and the figure of the author, and strategies of fictionality.

**Jpn 5176. Literature by 20th-Century Japanese Women in Translation.** (4 cr)  
Literary and historical exploration of selected works by Japanese women writers in a variety of genres. All literary texts read in English.

**Jpn 5251. History of the Japanese Language.** (4 cr. Prereq—3032, 5451 or #)  
Development of Japanese grammar from classical to the modern language.

**Jpn 5451. Structure of Japanese: Syntax/Semantics.** (4 cr. Prereq—3032, Ling 3001 or #)  
Analysis of structure and meaning of Japanese sentence patterns.

**Jpn 5452. Structure of Japanese: Phonology/Morphology.** (4 cr. Prereq—3032, Ling 3001 or #)  
Generative and nongenerative approaches to Japanese sound and word structure.

**Jpn 5453. Structure of Japanese: Discourse/Conversation Analysis.** (4 cr. Prereq—3032, Ling 3001 or #)  
Analysis of Japanese written texts and conversations. Emergence of grammar in discourse, discourse/conversational structural units, patterns genre, strategies, style, and sociolinguistics variables.

**Jpn 5650. Proseminar: Japanese Linguistics.** (4 cr [max 12 cr]. Prereq—5451 or 5452 or 5453 or #)  
Selected topics in Japanese linguistics and/or contrastive analysis of Japanese and English with attention to contributions from Eastern and Western linguistic traditions.

**Jpn 5993. Directed Studies in Japanese.** (1-15 cr [max 15 cr]. Prereq—#, Δ, □)  
Individual study with guidance of a faculty member.

**Jpn 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**Jpn 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**Jpn 8630. Seminar in Premodern Japanese Literature.** (4 cr [max 12 cr]; A-F only. Prereq—#)  
Selected topic in Japanese literature from 8th century to 1860s; theoretical tools used to analyze modern Japanese literature.

**Jpn 8631. Premodern Poetry.** (4 cr; A-F only. Prereq—3162, course from classical Japanese language sequence or #)

Presentation of poetry in four genres: imperial anthologies, narratives centered around poetry, personal collections, and noh plays. Implications of anthologizing/collecting, relationships between prose and poetry, and construction of an authorial figure.

**Jpn 8632. Marginalized Literatures of Premodern Japan.** (4 cr; A-F only. Prereq—3162, course from classical Japanese language sequence [preferably both courses] or #)

Texts located at fringes of premodern Japanese literary canon. Ranges from collection of songs sung by women entertainers/prostitutes to texts from Ryukyu islands. Power, canon, and center/margin relationship.

**Jpn 8633. Premodern Urban Literature.** (4 cr; A-F only. Prereq—Course from classical Japanese language sequence [preferably both courses] or #)

Literature and dramatic scripts between 1600-1868 about urban space and society in regions of Kyoto/Osaka and Edo (Tokyo). Notion of popular culture, relationship between textual production and consumption, and discourses of the urban.

**Jpn 8640. Seminar in Modern Japanese Literature.** (4 cr [max 12 cr]. Prereq—#)

Selected topic in Japanese literature from 1860s to the present, including analytical styles and strategies used in Japanese literary criticism.

**Jpn 8650. Seminar: Japanese Linguistics.** (4 cr [max 12 cr]. Prereq—5451, 5452, 5453 or #)  
Research on selected topic in Japanese linguistics; emphasizes collecting and analyzing primary data.

**Jpn 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Jpn 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Jpn 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

## Jewish Studies (JwSt)

*Department of Classical and Near Eastern Studies  
College of Liberal Arts*

**JwSt 5013. Biblical Law and Jewish Ethics.** (3 cr. §3013, §RelA 3013, §RelA 5013)

Significance of religious law in Judaism. Babylonian background of biblical law. Biblical creation of the person as a legal category. Rabbinic transformations of biblical norms. Covenant in Christianity/Islam. Contemporary Jewish literature/philosophy.

**JwSt 5111. Problems in Historiography and Representation of the Holocaust.** (3 cr. Prereq—JwSt 3521 or RelS 3521 or #)

Focuses on issues connected with the Holocaust. Inclusiveness of other groups, Holocaust vs. "Shoah," historiographical conflicts about perpetrators, an examination of the problems of representation in literature and art, problems of narrative theology after Auschwitz.

**JwSt 5112. Jewish Mysticism, Magic, and Kabbalah.** (3 cr; A-F only)

Mystical traditions from early rabbinic traditions to Zohar (Book of Splendor) in 13th century. Literature

of heavenly ascent (Hekhalot, Merkavah), Book of Creation (Sefer Yetzirah), precursors of Zohar—the Bahir. Schools of Provence, Gerona, and Zohar. Tension between legal/mystical aspects, magical theurgic techniques, evolution of doctrine of Sefirot, mystical interpretation of Scripture, erotic dimension.

**JwSt 5115. Mishnah and Midrash in Translation.** (3 cr)  
Jewish law studies as mirror of society and as way to actualize its value. Original socioreligious contexts, current applications. Biblical interpretations addressing moral, theological, legal, and literary problems.

**JwSt 5513. Scripture and Interpretation.** (3 cr; A-F only. §RelA 5513)

Idea of divine revelation, its impact upon religion/literature. How history of Bible's creation, transmission, and interpretation help us think critically about role of idea of revelation in religious traditions. What is revelation? How does belief that a text is revealed affect the way it is read within the community for which it constitutes revelation?

**JwSt 5900. Topics in Jewish Studies.** (1-3 cr [max 6 cr])  
Topics specified in *Class Schedule*.

**JwSt 5992. Directed Readings.** (1-12 cr [max 12 cr]. Prereq—#)

Guided individual reading or study.

## Journalism and Mass Communications (Jour)

*School of Journalism and Mass Communication  
College of Liberal Arts*

**Jour 5101. Advanced News Writing and Reporting.** (3 cr; A-F only. Prereq—Enrollment in MA in health journalism or #)

Techniques of newspaper reporting and writing. Hands-on approach. What makes news. Basics of AP style. Thinking critically. Generating story ideas. Interviewing sources. Writing news stories and features. Exercises, discussion.

**Jour 5251. Psychology of Advertising.** (3 cr; A-F only. Prereq—Jour major or jour minor or design comm premajor or design comm major or graphic design premajor or graphic design major or IDIM major or ICP major or BIS major or #; Psy 1001 recommended)

Psychological principles, research techniques, and applications in advertising/selling. Consumer attitudes/behavior. Psychological mechanisms upon which effectiveness of advertisements/commercials depends.

**Jour 5316. Theories of Visual Communication.** (3 cr; A-F only. Prereq—[3006, [jour major or jour minor or IDIM major or ICP major or BIS major]] or #)

Perspectives on study/analysis of visual communication. Message structure, systems of production, use of visual media. Contributions from sociology, anthropology, psychology, and history.

**Jour 5501. Communication and Public Opinion.** (3 cr; A-F only. Prereq—Non-jour major or jour major with course appr on prog plan or prejour with adviser approval)

Theories of communication, persuasion, attitude change. Functions of interpersonal/mediated communication in diffusion of information and in opinion formation.

**Jour 5541. Mass Communication and Public Health.** (2 cr; A-F only. Prereq—Jour major or jour minor or grad major or IDIM major or ICP major or BIS major)

Role, function, effect of mass media on public health. Planned/unplanned effects. Review/analysis of literature on how theories, models, assumptions of mass communication research relate to public health.

**Jour 5601W. History of Journalism.** (3 cr; A-F only. Prereq—Jour major or jour minor or IDIM major or ICP major or BIS major)

Development of American newspapers/periodicals from beginnings in Europe to present day. Rise of radio/television. Relation of communications development to political, economic, social trends.

**Jour 5606W. Literary Aspects of Journalism.** (3 cr; A-F only. Prereq—Jour major or jour minor or IDIM major or ICP major or BIS major)

Literary aspects of journalism as exemplified in, and influenced by, works of English/American writers past/present. Lectures, discussions, weekly papers.

**Jour 5725. Management of Media Organizations.** (3 cr; A-F only. Prereq—Non-jour major or jour major with course appr on prog plan or prejour with adviser approval)

Introduction to concepts/principles of media management. Strategic planning, leadership, organizational strategies, ethical/legal issues. Working in teams. Balance sheets, income statements. Motivating/promoting people.

**Jour 5771. Media Ethics: Principles and Practice.** (3 cr; A-F only. Prereq—Non-jour major or jour major with course appr on prog plan or prejour with adviser approval)

What it means to act "ethically." Tools to identify/analyze ethical issues. Ethical norms of print/broadcast journalism, photojournalism, public relations, and advertising.

**Jour 5777. Contemporary Problems in Freedom of Speech and Press.** (3 cr; A-F only. Prereq—Jour major or jour minor or IDIM major or ICP major or BIS major)

Legal/constitutional derivation of freedom of speech/press. Emphasizes case law, judicial theories, doctrines, tests, and values. Symbolic, commercial, compelled speech, speech plus, petition/assembly, leading press cases, legal research techniques.

**Jour 5825. World Communication Systems.** (3 cr; A-F only. Prereq—Non-jour major or jour major with course appr on prog plan or prejour with adviser approval)

Mass media systems of world, described/analyzed regionally/nationally. Historical roots. Social, economic, cultural context. Contemporary conditions/prospects. Relevance of journalism/mass communication to international affairs.

**Jour 5990. Special Topics in Mass Communication.** (1-4 cr; A-F only. Prereq—Jour major or approved IDIM major or ICP major or BIS major)

Topics specified in *Class Schedule*.

**Jour 5993. Directed Study.** (1-3 cr [max 6 cr]; A-F only. Prereq—[Jour major or jour minor or approved IDIM major or ICP major or BIS major], GPA of at least 3.00, #, Δ, □)  
Directed study/projects.

**Jour 8001. Studies in Mass Communication I.** (3 cr; A-F only)

Historical development of mass communication studies in social sciences, humanities, and legal areas; survey of research literature utilizing individualistic and structural approaches to mass communication.

**Jour 8002. Studies in Mass Communication II.** (3 cr; A-F only. Prereq—8001)

Literature on history of the field, cultural and humanistic approaches to its study, and legal and ethical issues.

**Jour 8003. The Changing Media Environment.** (3 cr; A-F only. Prereq—Grad mass communication major)

Nonprofessional skills course. Prepares entering graduate students to work in the changing media environment, emphasizing its political, social, economic, legal, ethical and technological implications nationally and globally; students produce scholarly research about changing media.

**Jour 8191. Proseminar in Health Journalism.** (4 cr; A-F only. Prereq—Enrolled in MA in health journalism)

Skills/tools necessary to report on health/medical news for various media. Working in multiple media. Working with quantitative/technical information.

**Jour 8192. Proseminar in Advanced Health Journalism.** (4 cr; A-F only. Prereq—Enrolled in MA in health journalism)

Skills/tools necessary to report on health/medical news for various media. Ethics, investigative skills. Reporting for specialized audiences. Second of two-course sequence.



**Jour 8195. Information Technology and Health.** (2 cr; A-F only. Prereq—Grad student; enrollment in MA in health journalism preferred)  
Trends in use/application of selected technologies.

**Jour 8317. Seminar: Visual Communication Research.** (3 cr; A-F only. Prereq—4316, [[8001, 8002] or #])  
Theoretical approaches, analysis of research methods, development of research designs/projects.

**Jour 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**Jour 8442. Seminar: Broadcast News.** (3 cr; A-F only. Prereq—4442 or #)  
Major issues. Confrontations between federal government and network news departments. Historical studies.

**Jour 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**Jour 8501. Seminar: The Process of Quantitative Mass Communication Research.** (3 cr; A-F only. Prereq—9 cr soc sci, EPsy 5260 or equiv or ¶EPsy 5260)  
Logic of social sciences research. Relationship between theory and research, concept explication, measurement, instrumentation, and design issues.

**Jour 8502. Seminar: Multi-method research in Mass Communication.** (3 cr; A-F only. Prereq—8501, [EPsy 5260 or equiv or ¶EPsy 5260])  
Quantitative/qualitative research principles/techniques applied to mass communication and kindred questions. Reliability, generalizability, and validity in their classic/contemporary senses. Survey methods, focus groups, interviews, other methods. Emphasizes "triangulation" of diverse methods.

**Jour 8513. Seminar: Ethnographic Methods in Mass Communication Research.** (3 cr; A-F only. Prereq—[8001, 8002] or #)  
Theoretical foundations in anthropology/sociology. Field projects.

**Jour 8514. Seminar: Mass Communication Theory.** (3 cr; A-F only. Prereq—8001, 8002)  
Research paradigms, concepts, and findings for developing a general theory of mass communication.

**Jour 8601. Seminar: Methods in Mass Communication History Research.** (3 cr; A-F only. Prereq—5601, #)  
Critical analysis of research in journalism/communication history. Research designs/methods. Development of a research project.

**Jour 8602. Seminar: History of Mass Communication.** (3 cr; A-F only. Prereq—5601)  
Research in history/development of U.S. mass media.

**Jour 8603. Seminar: Theories and Models in Mass Communication History Research.** (3 cr; A-F only. Prereq—5601, #)  
Literature on theory in historical research. Uses of theoretical models in historical explanations. Role of theory in historical research, debate about uses. Specific works in journalism/communication history in context of theoretical models. Development of major paper examining models/theories relevant to student's project.

**Jour 8620. Seminar: Advertising Research.** (3 cr; A-F only. Prereq—5251 or #)  
Advertising as persuasive communication. Current research/theory related to advertising decision-making process. Measurement issues in advertising and in market research.

**Jour 8651. Seminar: Mass Media and Social Change.** (3 cr; A-F only. Prereq—8001 or 8002 or equiv)  
Interplay between social theories and media studies. Pragmatism, structural-functionalism, Marxism, political economy, cultural studies, globalization.

**Jour 8662. Seminar: Literary Aspects of Journalism.** (3 cr; A-F only. Prereq—5606)  
Research in literary aspects of journalism exemplified in careers/works of American/British writers.

**Jour 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Jour 8671. Seminar: Communication Ethics—Public/Civic Journalism.** (3 cr; A-F only)  
Historical underpinnings, philosophical debate, theoretical dynamics, legal concerns, ethical implications.

**Jour 8673. Seminar: Media Management.** (3 cr; A-F only. Prereq—[4725 or 4726] recommended)  
Management issues in media organizations. Relation to dynamics of organization structure, employees, markets, economics/finances.

**Jour 8675. Seminar: Issues in Information Access and Communication.** (3 cr; A-F only)  
Societal, industry, technological, and policy aspects/developments that affect information access, particularly through mass media.

**Jour 8678. Seminar: Constitutional Law—Theories of Freedom of Expression.** (3 cr; A-F only. Prereq—5777 or #)  
Problems of constitutional/tort law affecting the press. Underlying theories.

**Jour 8679. Seminar: Research Methods in Media Ethics and Law.** (3 cr; A-F only)  
Research at intersection of first amendment and media ethics.

**Jour 8681. Seminar: Media and Globalization.** (3 cr; A-F only. Prereq—4801 or 5825 or #)  
Main problems/currents. Concepts, research, policy relevant to global development. Issues of freedom/constraint, media technology, role of journalism in world affairs.

**Jour 8721. Seminar: Communication Agencies as Social Institutions.** (3 cr [max 3 cr]; A-F only. Prereq—4721 or equiv or #)  
Influence/effects of mass communication, internal dynamics of media organizations, criticism/modes of reform. Theoretical frameworks for analysis.

**Jour 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Jour 8801. Seminar: Comparative Research in Mass Communication, a Cross-National Approach.** (3 cr; A-F only. Prereq—4801 or 5825)  
Comparative research designs/strategies. Analysis of production, presentation, transmission, and consumption of mass media products/services (particularly news, entertainment, and information) across national borders. Theoretical concerns, empirical problems, policy. Ethical issues involving research on form/content of mass communication within/between countries.

**Jour 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

**Jour 8990. Special Problems in Mass Communication.** (3-4 cr [max 12 cr]; A-F only)  
Topics specified in *Class Schedule*.

**Jour 8993. Directed Study.** (1-6 cr; A-F only. Prereq—Grad mass comm major or minor, #, Δ)

## Kinesiology (Kin)

### School of Kinesiology

### College of Education and Human Development

**Kin 5001. Foundations of Human Factors/Ergonomics.** (3 cr; A-F only)  
Variability in human performance as influenced by interaction with designs of machines and tools, computers and software, complex technological systems, jobs and working conditions, organizations, and sociotechnical institutions. Emphasizes conceptual, empirical, practical aspects of human factors/ergonomic science.

**Kin 5103. Developmental/Adapted Physical Education.** (3 cr; A-F only)

Introduction to physical education for students with disabilities, emphasizing conceptual, organizational, and administrative issues. Topics include historical and legal foundations, service components, individualized education plans, professional roles, and assessment of movement skills.

**Kin 5104. Physical Activities for Persons with Disabilities.** (3 cr; A-F only)

Different approaches to providing physical education service and related movement interventions for persons with disabilities. Topics: movement behavior foundations, movement skill progressions, unique considerations for specific impairments, and sport for persons with disabilities

**Kin 5106. Adapted Aquatics.** (2 cr. Prereq—If certification as Adapted Aquatic Instructor desired, then current American Red Cross Water Safety Instructor or equivalent YMCA certification is required)  
Introduction to adapted aquatics for students in kinesiology and leisure studies, physical therapy, and those interested in working with people with disabilities. Topics: teaching approaches, programming, accommodations/adaptations, assessments, individualized plans. Activities: pool sessions with/without clients, groups, site observations.

**Kin 5111. Sports Facilities.** (3 cr; A-F only. \$Rec 5111. Prereq—Kin or Rec grad student or MED student)  
Steps in planning/building facilities for athletics, physical education, and sport for college, professional, and public use.

**Kin 5115. Event Management in Sport.** (3 cr; A-F only. Prereq—Grad student, #)  
Techniques/principles of planning, funding, and managing sport events. Collegiate championships, non-profit events, benefits, professional events.

**Kin 5121. Application of Basic Sciences to Kinesiology.** (3 cr; A-F only)  
Examination of how knowledge from the basics of science can lead to differing perspectives from which to approach questions directed to kinesiological inquiry.

**Kin 5122. Applied Exercise Physiology.** (3 cr; A-F only. Prereq—4385 or equiv or #)  
Mechanisms of cardiorespiratory and muscular responses to exercise; application of exercise physiology to assessment of work capacity, athletic conditioning, and requirements of human powered vehicles; low to moderate exercise as an intervention in lowering risk for common health problems.

**Kin 5126. Sport Psychology.** (3 cr. Prereq—3126 or equiv or #)  
Theory and research in sport psychology. Focus on the psychological study of human behavior in sport and physical activity settings.

**Kin 5132. Motor Development.** (3 cr; A-F only. Prereq—3133 or #)  
Developmental aspects of human movement behavior/learning. Life span change of motor skills.

**Kin 5135. Motor Control and Learning.** (3 cr. Prereq—3133 or #)  
Main theoretical ideas/research that have advanced motor control/learning over last three decades.

**Kin 5136. Psychology of Coaching.** (3 cr)  
Psychological dimensions of coaching across age levels, including coaching philosophy, leadership, communication skills, motivation, and mental skills training for performance enhancement.

**Kin 5141. Nutrition for Health and Physical Performance.** (3 cr; A-F only. Prereq—FScN 1112 or equiv)  
Requirements and physiologic roles of nutrients and physical activity in promotion of health/performance. Assessment of energy requirements. RDAs, food composition/safety, weight management. Prevention of chronic diseases; emphasizes coronary heart disease.

**Kin 5152. Curriculum Development in Physical Education.** (2 cr; A-F only. Prereq–Init lic/MEd phys ed student)  
Trends, issues, and challenges in early childhood/K-12 physical education. Potential effect on curriculum.

**Kin 5171. Foundations of Kinesiology.** (3 cr; A-F only. Prereq–Kin major or #)  
Introduction to the emerging field of kinesiology, broadly conceived as the study of human movement. Development and emergence of the term kinesiology and the scholarly, political, and educational ramifications of its development.

**Kin 5196. Practicum: Developmental/Adapted Physical Education.** (1-4 cr [max 4 cr]; S-N only. Prereq–5103 or equiv or #)  
Observation of, participation in physical education instruction for students with disabilities. Current issues in developmental/adapted physical education. Exchange of ideas/problems.

**Kin 5235. Advanced Biomechanics II: Kinetics.** (3 cr; A-F only. Prereq–[3112 or equiv], PMed 5135, undergrad college physics, intro calculus.)  
Kinetic aspects of human movement (single/multi-joint torques, simple inverted pendulum models, mass-spring systems). Analysis of experimental data and of computer simulations. Lectures, seminars, lab.

**Kin 5328. International and Comparative Sport and Physical Education: The Olympic Games.** (3 cr; A-F only. Prereq–Grad or #)  
Explores the role the Olympic Games has played and continues to play in the global village. Advanced insight into the substance, nature, and significance of sport to nation building and the international and comparative sociocultural process.

**Kin 5365. Health Promotion Program Design and Implementation.** (3 cr; A-F only. Prereq–3001)  
Study of behavioral change methodology and theory related to nutrition, weight control, exercise, stress management, healthy lifestyles, and lifetime health. Application of these concepts in health promotion settings including work sites, managed care organizations, clinics, fitness centers, and educational institutes.

**Kin 5371. Sport and Society.** (3 cr; A-F only. Prereq–[3126, grad student] or #)  
Sport, sporting processes, social influences, systems. Structures that have effected and exist within/among societies, nations, and cultures. Contemporary issues such as social differentiation, violence, and honesty.

**Kin 5375. Competitive Sport for Children and Youth.** (3 cr)  
Cognitive, behavioral, and biological factors having important implications for competitive sport participants from early childhood through high school age. Emphasis on translating sport science research into practical implications for youth sport coaches, teachers, and administrators.

**Kin 5385. Exercise for Special Populations.** (2 cr; A-F only. Prereq–Undergrad physiology or biology)  
Exercise testing and prescription with modifications required because of special considerations associated with aging, gender differences, environmental conditions, and the presence of medical conditions.

**Kin 5421. Sport Finance.** (3 cr; A-F only. Prereq–Grad student, #)  
Introduction to financial analysis in sport. Cash flow statements, budgeting issues, traditional/innovative revenue producing strategies available to sport organizations. Discussion, practical analysis of current market.

**Kin 5435. Advanced Theory and Techniques of Exercise Science.** (3 cr; A-F only. Prereq–[3385, 4385, Kin major] or #)  
Theoretical constructs, in-depth description of procedures used in exercise science research and clinical settings. Laboratory exercises, lectures.

**Kin 5461. Foundations of Sport Management.** (3 cr; A-F only. Prereq–[Kin or Rec] student or #)  
Theories/techniques in administration/management of sport enterprises. Organizational theory/policy, practical examples of sport management skills/strategies.

**Kin 5485. Electrocardiogram, Graded Exercise Testing, and Prescription.** (3 cr; A-F only. Prereq–[3385, 4385] or #)  
Introduction to electrocardiogram. Placement/interpretation, use in clinical exercise testing and exercise prescription. Hands-on experience in electrocardiogram for exercise testing.

**Kin 5511. Women in Sport and Leisure.** (3 cr; A-F only. \$Rec 5511)  
Critically examines women’s involvement in/contributions to sport, physical activity, and leisure.

**Kin 5601. Ethics in Sport Management.** (2 cr; A-F only. Prereq–Grad student, #)  
How we develop morally. Sport and perpetuation of violence in society. Moral reasoning. Moral/ethical conduct in sport. Issues explored from historical, philosophical, and sociological perspectives. Critical reading, writing, discussion.

**Kin 5621. Advanced Athletic Training: Evaluation of Athletic Injury.** (3 cr; A-F only. Prereq–3114, [3027 or CBN 1027])  
Theory, principles, techniques to recognize/evaluate athletic injury to all major body parts.

**Kin 5622. Therapeutic Modalities in Athletic Training.** (3 cr; A-F only. Prereq–3114)  
Theoretically based guide for the use of therapeutic modalities for the management of athletic injuries in a practical setting.

**Kin 5631. Programming and Promotion in Sport.** (3 cr; A-F only. Prereq–Grad student, #)  
Introduction to marketing concepts as they apply to sport industry. Consumer behavior, market research, marketing mix, corporate sponsorship, licensing. Discussion, practical application.

**Kin 5696. Practicum in Kinesiology.** (1-6 cr [max 6 cr]; S-N only. Prereq–Grad student in Kin, #)  
Practical experience in kinesiology under supervision of a University adviser and an agency supervisor.

**Kin 5697. Student Teaching: Coaching.** (1-10 cr [max 10 cr]; S-N only. Prereq–Admission to coaching program, #)  
Student coaching experience under supervision of a mentor coach.

**Kin 5720. Special Topics in Kinesiology.** (1-8 cr [max 9 cr]. Prereq–Upper div undergrad or grad student in kin or #)  
Current issues in the broad field and subfields in kinesiology, or related coursework in areas not normally available through regular offerings.

**Kin 5723. Psychology of Sport Injury.** (3 cr. Prereq–Intro psych course)  
Psychosocial bases of risk factors preceding sport injury, responses to the occurrence of sport injury, and the rehabilitation process. Lecture, discussion, guest lecture, interviews, and presentation experience.

**Kin 5725. Organization and Management of Physical Education and Sport.** (3 cr; A-F only. Prereq–Grad/init lic or #)  
Comprehensive analysis of organization and management of physical education and sport in educational settings. Focus on management and planning processes, management skills, functions, roles, decision making, leadership, shared systems, and organizational motivation. For physical education teachers, coaches, community sport administrators.

**Kin 5726. Physical Education—Teaming and Trekking.** (2 cr; A-F only. Prereq–Kin major, MEd student, or #)  
Development of cooperative and team-building activities, group planning, and leadership skills in preparation for a two-day trip in a state park using practiced outdoor skills of camping, canoeing, and backpacking. Must be comfortable in water.

**Kin 5727. Physical Education—An Adventure Experience.** (1 cr; A-F only. Prereq–Kin major, MEd student, or #)  
Group and individual initiatives in an experientially based program emphasizing participation in leadership, group cooperation, problem solving, low ropes, climbing walls, sensible risk taking, and trust-oriented activities.

**Kin 5740. Topics: Coaching of Individual, Dual, or Team Sports.** (1-9 cr [max 9 cr]; A-F only. Prereq–PEL)  
Instruction at the advanced level, including analyses of skills, game strategies, specific techniques of coaching, and methods of training and conditioning.

**Kin 5801. Legal Aspects of Sport and Recreation.** (4 cr; A-F only. \$Rec 5801. Prereq–Kin or rec major)  
Legal issues related to recreation, park, and sport programs/facilities in public/private sectors.

**Kin 5941. Neural Basis of Movement.** (3 cr; A-F only. Prereq–[[3111, CBN 1027] or equiv], [Phsl 3051 or equiv])  
Overview of various neural subsystems involved in controlling human/primate sensorimotor behavior. Effects of brain lesions on overt behavior, possibilities for rehabilitation. Systems theory approach. Lectures, seminars, class presentations.

**Kin 5981. Research Methodology in Kinesiology, Recreation, and Sport.** (3 cr; A-F only. \$Rec 5981. Prereq–3151 or equiv)  
Defines/reviews various types of research in exercise/sport science, physical education, and recreation studies. Qualitative research, field studies, and methods of introspection as alternative research strategies to traditional scientific paradigm.

**Kin 5992. Readings in Kinesiology.** (1-9 cr [max 9 cr]; A-F only. Prereq–CEHD student, grad, #)  
Independent study under tutorial guidance.

**Kin 5995. Research Problems in Applied Kinesiology.** (1-6 cr [max 6 cr]; A-F only. Prereq–Grad student or MEd student in kin or #)  
Selected topics in physical activity/human performance.

**Kin 8122. Seminar: Exercise Physiology.** (2-6 cr [max 6 cr]; A-F only. Prereq–5122 or equiv or #)  
Classic and contemporary literature in exercise physiology and allied disciplines, emphasizing contributions of major leaders in the field and opportunities for interdisciplinary research.

**Kin 8126. Seminar: Sport Psychology.** (3 cr; A-F only. Prereq–5126 or #)  
Literature, theoretical constructs, research methodology, design. Focuses on student-selected topics/problems.

**Kin 8132. Seminar: Motor Development.** (3 cr; A-F only. Prereq–5132 or equiv or #)  
Contemporary research literature focusing on motor skill development from before birth to senescence; emphasizes interaction between physical, environmental, and performer constraints, and coordination and control of movement.

**Kin 8135. Seminar: Motor Control and Learning.** (3 cr [max 6 cr]; A-F only. Prereq–5135 or equiv or #)  
Advanced reading and discussion of research on motor control, motor learning, and human performance.

**Kin 8211. Perception and Action.** (3 cr. Prereq–[CEHD or Psy] grad student or #)  
Survey of theory/research on use of perceptual information for control of action. Focuses on behavioral research on perceptual guidance of daily activities (e.g., standing, walking, driving). Perceptual control in context of expertise (e.g., sports). Perceptual-motor development.

**Kin 8333. FTE: Master’s.** (1 cr; NGA. Prereq–Master’s student, adviser and DGS consent)

**Kin 8444. FTE: Doctoral.** (1 cr; NGA. Prereq–Doctoral student, adviser and DGS consent)

**Kin 8607. Seminar: International and Comparative Physical Education and Sport.** (3 cr; A-F only. Prereq-#) Comparative analysis of selected physical education and sport delivery systems, structures, sport policies, and management of practices and systems of selected countries. Sociocultural impact and issues concerning conduct of sport.

**Kin 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Kin 8696. Internship: Applied Sport Psychology.** (3-6 cr [max 6 cr]; S-N only. Prereq-5126, 8126, kin PhD student, #) Supervised internship; emphasis on educational sport psychology approaches to athletic performance enhancement and psychological adjustment to sport injury.

**Kin 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Kin 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

**Kin 8980. Graduate Research Seminar in Kinesiology.** (1 cr [max 9 cr]; S-N only. Prereq-Grad kin major, #) Reporting and discussion of student and faculty research activity.

**Kin 8995. Research Problems in Kinesiology.** (1-9 cr [max 9 cr]; S-N only. Prereq-Kin PhD student or #)

## Laboratory Medicine and Pathology (LaMP)

*Department of Laboratory Medicine and Pathology  
Medical School*

**LaMP 5100. General and Systemic Pathology for Dental Students.** (4 cr; A-F only. Prereq-Regis dental student) Causes, courses, mechanisms and outcomes of disease. Required as preparation for clinical dental practice and oral pathology.

**LaMP 5125. Chronobiology.** (2-6 cr; A-F only) How to interpret biologic time series and how to use them in practice as well as in designing chronobiology experiments. Chronobiologic procedures of data collection and analysis, interpretation of the output in clinical practice.

## Landscape Architecture (LA)

*Department of Landscape Architecture  
College of Architecture and Landscape Architecture*

**LA 5201. Making Landscape Spaces and Types.** (6 cr; A-F only. Prereq-BED accelerated status or LA grad or #) Design exploration using 3-D models and historical precedent studies to create outdoor spaces for human habitation and use. Application of the basic landscape palette of landform, plants, and structures to give physical, emotional, cognitive, and social definition to created places.

**LA 5202. Landscape Analysis Workshop.** (1 cr; S-N only) Introduction to field techniques for site analysis, including vegetation, soil, and landform description. One-week session, before fall term, at lake Itasca Forestry and Biological Station.

**LA 5203. Ecological Dimensions of Space Making.** (6 cr; A-F only. Prereq-LA major or #; recommended for both BED and Grad students) Design studio experience drawing on ecological, cultural, aesthetic influences to explore development of design ideas responsive to ecological issues and human experience.

**LA 5204. Landscape Ecology.** (3 cr; A-F only. Prereq-B.E.D. accelerated status or LA grad student or #) Relationships among spatial patterns, temporal patterns, ecological processes in landscape. Factors affecting landscape patterns, measurement of landscape pattern, material transport through landscape, effects of landscape pattern on population dynamics, landscape planning.

**LA 5301. Introduction to Drawing in Architecture and Landscape Architecture.** (3 cr; A-F only. §1301. Prereq-LA grad student, accelerated B.E.D. student) Perceiving/representing material environment. Sketching/drawing conventions, visual phenomena/forms.

**LA 5351. AutoCAD I.** (3 cr; A-F only. Prereq-B.E.D. major or LA grad or #; may not be taken for graduate credit) Basic concepts, tools, and techniques of computer-aided drawing. Introduction to current AutoCAD Release software. Strategies and techniques for producing dimensioned and annotated drawings. Introduction to 3-D drawing capabilities. Use of dimension variables, attributes, blocks, symbols, and creation of customized menus.

**LA 5352. AutoCAD II.** (3 cr; A-F only. Prereq-Arch 5351 or LA 5351, B.E.D. major or LA grad or #; may not be taken for graduate credit) Intermediate concepts, tools, and techniques of computer-aided drawing with current AutoCAD Release software. Strategies and techniques for producing dimensioned and annotated drawing. Use of dimension variables, attributes, blocks, symbols, and creation of customized menus.

**LA 5371. Computer Methods I.** (1 cr. Prereq-B.E.D. accelerated status or LA grad or #) Introduction to current techniques, programs, and new editions of computer programs, and their application to landscape architecture computing.

**LA 5372. Computer Methods II.** (1 cr. Prereq-Arch/LA 5371, LA grad or #) Current techniques and computer programs, and their application to landscape architecture computing.

**LA 5373. Computer Methods III.** (3 cr. Prereq-Arch/LA 5372, LA grad or #) Advanced techniques and computer programs, and their application to landscape architecture computing in design, theory, and technology.

**LA 5400. Topics in Landscape Architecture.** (1-3 cr [max 12 cr]; A-F only. Prereq-B.E.D. accelerated status or LA grad or #) Current topics in landscape architecture. Taught by regular or visiting faculty in their areas of specialization.

**LA 5401. Directed Studies in Emerging Areas of Landscape Architecture.** (1-6 cr [max 12 cr]. Prereq-B.E.D. accelerated status or LA grad or #) Independent studies under the direction of landscape architecture faculty.

**LA 5402. Directed Studies in Landscape Architecture History and Theory.** (1-6 cr [max 12 cr]; A-F only. Prereq-B.E.D. accelerated status or LA grad or #) Independent studies under the direction of landscape architecture faculty.

**LA 5403. Directed Studies in Landscape Architecture Technology.** (1-6 cr [max 12 cr]; A-F only. Prereq-B.E.D. accelerated status or LA grad or #) Independent studies under the direction of landscape architecture faculty.

**LA 5404. Directed Studies in Landscape Architecture Design.** (1-6 cr [max 12 cr]; A-F only. Prereq-B.E.D. accelerated status or LA grad or #) Independent studies under the direction of landscape architecture faculty.

**LA 5405. Interdisciplinary Studies in Landscape Architecture.** (1-6 cr [max 12 cr]; A-F only. Prereq-B.E.D. accelerated status or LA grad or #) Research, planning, and/or design projects. Topics vary.

**LA 5413. Introduction to Landscape Architectural History.** (3 cr [max 3 cr]; A-F only. Prereq-One course in history at 1xxx or higher) Introductory course examines the multiple roots of landscape architecture by examining the making of types of landscapes over time. Emphasis on ecological and environmental issues, and issues related to political, economic, and social contexts of landscape architectural works.

**LA 5431. History of Landscape Architecture: Individual Influences.** (3 cr; A-F only) Assessment of influences of individuals on formation of the profession of landscape architecture from 1800 to present. Lectures, presentations, field trips, readings, papers, projects.

**LA 5571. Landscape Construction: Landform Systems and Spatial Performance.** (3 cr; A-F only. Prereq-Accelerated BED student or LA grad student) Theory and professional applications of landform systems for design. Landform typology, representation methods, manipulation techniques, use of land survey data, earthwork construction issues. Spatial accommodation of vehicles in landscape architecture, including road design.

**LA 5572. Plants in Design.** (3 cr; A-F only. Prereq-[5201, 5203, plant identification course] or #) Design principles for using plants in landscape. Cultural/ecological principles in design projects of various scales. Lectures, presentations, field trips, readings, projects.

**LA 5573. Landscape Technology: Introduction to Geographic Information Systems.** (3 cr; A-F only. Prereq-Jr or sr B.E.D. major or LA grad or #) GIS as an analytical tool to solve geographical problems of regional landscape design and resource management. Topics include application techniques, analytical procedures, data characteristics, data sources, input/output methods, and implementation.

**LA 5574. Identification of Minnesota Flora.** (3 cr; A-F only. Prereq-BED accelerated status or LA grad student or #) Introduction to identification of approximately 500 plants commonly used by landscape architects and environmental designers in Minnesota. Students develop a working knowledge of over 250 plants. Focuses on plant selection techniques, plant landscape associations, and issues of plants for use in standard landscape architectural settings. Regular field sessions.

**LA 8201. Designing Landscapes for Dwelling and Settlement.** (6 cr; A-F only. Prereq-5203, 5571, grad land arch major, §8202 or #) Professional design studio. Hypothetical projects include development of schematic master plans for site layout, grading, and planting. Design for residential, commercial, and civic uses with attention to zoning and other controls, environmental quality, human behavior, markets, project finance, and technics. Requires concurrent registration in LA 8202.

**LA 8202. Design of Planned Developments.** (2-3 cr. Prereq-Grad land arch major or #) Issues related to planned community developments: historical precedents; design for residential, commercial, and civic uses; role of zoning and other controls; deed restrictions; preparation of design brief; environmental quality; human behavior; market; project finance; and techniques of site development.

**LA 8203. Making Regional Landscape Space.** (6 cr; A-F only. Prereq-8202, grad land arch major, §8204 or #) Design exploration of landscape ecology, landscape perception, regional economics, and public policy as informants of design decision-making in regional landscapes at or exceeding township level. Geographic information systems as design tools.

**LA 8204. Regional Landscape Space.** (3 cr; A-F only. Prereq—Grad land arch major or #)  
Theoretical investigations and current advances in use of landscape ecology, landscape perception, regional economics, and public policy as informants of design decision-making in regional landscapes at or exceeding township level. Geographic information systems as design tools.

**LA 8205. Urban Form Options: Landscape Architecture Studio.** (6-8 cr. Prereq—2 yrs of studio, grad land arch major or #)  
Urban landscape design issues, theories, and problems explored via formal/spatial inquiry in studio, reading, and the exposition of ideas in paired seminar. Urban systems, gathering spaces, ecology, infrastructure, recreation, and public space.

**LA 8301. Landscape Architecture: Research Issues and Methods.** (3 cr; A-F only. Prereq—8201 or #8201, grad land arch major or #)  
Alternative methodological approaches to landscape architectural research and consideration of their appropriateness for contemporary research topics.

**LA 8302. Professional Practice.** (3 cr; A-F only. Prereq—8205, grad land arch major or #)  
Office and project management case studies. Organizational behavior, marketing, sales, strategic planning, financial and cost accounting, insurance, legal issues and contracts.

**LA 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**LA 8400. Topics in Landscape Architecture.** (1-3 cr [max 12 cr]. Prereq—Grad land arch major or #)  
Seminar offered by regular or visiting faculty in their area of specialization. Content varies with interest of instructor.

**LA 8401. Directed Studies in Emerging Areas of Landscape Architecture.** (1-6 cr [max 12 cr]; A-F only. Prereq—Grad land arch major or #)

**LA 8402. Directed Studies in Landscape Architecture History and Theory.** (1-6 cr [max 12 cr]; A-F only. Prereq—Grad land arch major or #)

**LA 8403. Directed Studies in Landscape Architecture Technology.** (1-6 cr [max 12 cr]; A-F only. Prereq—Grad land arch major or #)

**LA 8404. Directed Studies in Landscape Architecture Design.** (1-6 cr; A-F only. Prereq—Grad land arch major or #)

**LA 8405. Interdisciplinary Studies in Landscape Architecture.** (1-6 cr [max 12 cr]; A-F only. Prereq—Grad land arch major or #)  
Research, planning, and/or design project. Sample topics: energy efficient design, historic preservation, urban revitalization, agricultural land use, computerized land-use planning, housing.

**LA 8406. Concepts of Landscape Evaluation.** (3 cr; A-F only. Prereq—Grad land arch major or #)  
Philosophical basis for wide-ranging approaches to evaluating qualitative aspects of landscape. Aesthetic factors and integration of landscape evaluation into regional design decision-making.

**LA 8407. Perception Manipulation in Design of Exterior Space.** (3 cr. Prereq—Grad land arch major or #)  
Historic and modern design devices that alter one's sense of spatial control and arrangement to create illusionary situations in exterior environment. Organized to inform and test principles of perception distortion in exterior space.

**LA 8408. 18th-Century Landscape Theory: Nature and the Sublime, the Beautiful, and the Picturesque.** (3 cr; A-F only. Prereq—Grad land arch or arch major or #)  
Eighteenth-century landscape architectural theory underpinned most modern western traditions in landscape architecture. These theoretical positions framed the nature of Nature in the context of human experience through treatises and works of landscape architecture.

**LA 8409. Fitting Buildings to the Land.** (3 cr; A-F only. Prereq—Land arch or arch grad student with 1 yr grad design or #)  
Exercises and projects in site manipulation to adjust structures and attendant uses and circulation to specific land parcels.

**LA 8554. Project Programming.** (1 cr; A-F only. Prereq—8203, grad land arch major or #)  
Individual research in preparation for final studio.

**LA 8555. Advanced Landscape Planning and Design.** (6 cr; A-F only. Prereq—8205, grad land arch major or #)  
Advanced studies in area of student's choice.

**LA 8574. Landscape Storm Water Management.** (3 cr. Prereq—8201, grad land arch major or #)  
Theory and applications of hydrology and storm water management techniques. Applied hydrology, catchment delineation, storm water runoff models, and storm water management techniques (detention ponds, swales, channels, culverts, small storm sewer systems, run-off systems, sedimentation, and erosion control systems).

**LA 8575. The Art and Ecology of Landscape Detail.** (3 cr. Prereq—Grad LA major or #)  
Design of pavements, enclosures, decks, lighting, electrical, and irrigation systems for landscape architecture. Theory/principles of design of light structures, properties/use of materials, construction communication. Landscape integrity and economic viability as performance issues.

**LA 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

## Language, Teaching, and Technology (LgTT)

*Institute of Linguistics, ESL, and Slavic Languages and Literatures*

*College of Liberal Arts*

**LgTT 5101. Applications of Technology in Language Teaching.** (3 cr)  
Explore uses of technology in language teaching; theoretical background, demonstrations, and applications.

**LgTT 5110. Technology in the Second Language Classroom.** (2 cr. \$5611)  
Examine, evaluate, and use technology in language teaching. Theoretical background, demonstration, hands-on exploration.

**LgTT 5611. Technology in Second Language Instruction.** (3 cr. Prereq—SLC postbac or #)  
Using audio, video, and computer technology in second language teaching/learning in classroom, independent study, and distance education environments.

**LgTT 5710. Special Topics in Language Teaching and Technology.** (1-3 cr [max 12 cr])  
Examine, evaluate, apply specific area of technology to K-higher education, second/foreign language teaching/learning in classroom, independent study, distance education environments.

## Latin (Lat)

*Department of Classical and Near Eastern Studies*  
*College of Liberal Arts*

**Lat 5012. Latin Prose Composition.** (3 cr. Prereq—3114 or Δ)  
Advanced understanding of Latin grammar, syntax, diction, and prose style through graduated exercises in prose composition.

**Lat 5032. Text Criticism.** (3 cr. Prereq—3114)  
Theory and practice. Elements of paleography and manuscript study. Basic tools for analyzing a textual apparatus with some independence; constructing a critical edition of a literary text.

**Lat 5310. Latin Literature: History.** (3 cr [max 12 cr])  
One or more appropriate authors studied each semester.

**Lat 5320. Latin Literature: Epistles and Essays.** (3 cr [max 12 cr])  
One or more appropriate authors studied each semester.

**Lat 5330. Latin Literature: Oratory.** (3 cr [max 12 cr])  
One or more appropriate authors studied each semester.

**Lat 5340. Latin Literature: Epic and Pastoral.** (3 cr [max 12 cr])  
One or more appropriate authors studied each semester.

**Lat 5350. Latin Literature: Lyric and Elegiac Poetry.** (3 cr [max 12 cr])  
One or more appropriate authors studied each semester.

**Lat 5360. Latin Literature: Latin Dramatists.** (3 cr [max 12 cr])  
One or more appropriate authors studied each semester. Authors vary.

**Lat 5370. Latin Literature: Satire.** (3 cr [max 12 cr]. Prereq—Grad student or #)  
One or more authors.

**Lat 5380. Latin Literature: Legal Texts.** (3 cr [max 12 cr])  
One or more appropriate authors studied each semester.

**Lat 5390. Literature: Religious Texts.** (3 cr [max 12 cr]. Prereq—3114)  
Reading and discussion of religious texts from Latin antiquity, such as Varro's *Antiquitates Divinae*, Cicero's *De natura deorum*, Apuleius's *Metamorphoses*, or Christian writers (Tertullian, Cyprian, Lactantius, Jerome, Augustine).

**Lat 5410. Latin of Late Antiquity.** (3 cr [max 12 cr]. Prereq—34xx or equiv or #)  
Pagan and Christian Latin literature selected from authors of the 3rd to 6th centuries A.D. Topics specified in *Class Schedule*.

**Lat 5420. Medieval Latin.** (3 cr [max 12 cr]. Prereq—34xx or equivalent or #)  
Literature from 6th to 15th centuries. Authors and genres vary; topics specified in *Class Schedule*.

**Lat 5621. Latin Paleography.** (3 cr. Prereq—Three 3xxx-5xxx Latin cr or #)  
Analysis of various hands used in manuscripts of Latin authors with attention to date and provenance; transmission of ancient Latin literature.

**Lat 5715. Introduction to the Historical-Comparative Grammar of Greek and Latin.** (3 cr. Prereq—# or 2 yrs college Greek)  
Historical and comparative grammar of Greek and Latin from their Proto-Indo-European origins to the classical norms.

**Lat 5717. History of Latin.** (3 cr)  
Reading and analysis of documents illustrating the stylistic registers and evolution of the Latin language from its earliest attestations through the Middle Ages.

**Lat 5993. Directed Studies.** (1-4 cr [max 18 cr]. Prereq—#, Δ)  
Guided individual reading or study.

**Lat 5994. Directed Research.** (1-12 cr [max 20 cr]. Prereq—#, Δ)  
Guided research on original topic chosen by student.

**Lat 5996. Directed Instruction.** (1-12 cr [max 20 cr]. Prereq—#, Δ)  
Supervised teaching internship.

**Lat 8120. Latin Text Course.** (3 cr [max 15 cr]. Prereq—3111 or Δ; not for students in dept of Classical and Near East Studies)  
Students attend 3xxx Latin courses. Supplementary work at discretion of instructor.

**Lat 8262. Survey of Latin Literature I.** (3 cr)  
Extensive readings in variety of works from republican and early Augustan period.

**Lat 8263. Survey of Latin Literature II.** (3 cr)  
Variety of works from Augustan and imperial periods.

**Lat 8267. Graduate Survey of Latin Literature of Late Antiquity.** (3 cr. Prereq-#, Δ)  
Latin literature of 3rd to 6th centuries A.D., including Ammianus and Augustine.

**Lat 8910. Seminar.** (3 cr [max 30 cr])  
Various topics in Latin literature examined in depth with emphasis on current scholarship and original student research.

## Liberal Studies (LS)

### College of Continuing Education

**LS 5100. Liberal Studies Seminar.** (1-4 cr [max 24 cr]; A-F only)  
Interdisciplinary topics.

**LS 5125. Field Experience.** (1-8 cr; A-F only. Prereq-MLS student or #)  
Off-campus observation, experience, and evaluation in interdisciplinary field of study.

**LS 5950. Special Topics.** (1-4 cr [max 12 cr]; A-F only. Prereq-MLS student or #)  
Special interdisciplinary topics.

**LS 5993. Directed Studies.** (1-4 cr [max 15 cr]. Prereq-Grad student, Δ)  
Guided individual reading or study.

**LS 5994. Directed Research.** (1-4 cr [max 15 cr]. Prereq-#)  
Tutorial for qualified graduate students.

**LS 8001. Introduction to Interdisciplinary Inquiry.** (3 cr; A-F only. Prereq-MLS student)  
Required course. Emphasizes what students need to know or be able to do to successfully complete their individually crafted program, including critical thinking, clear writing, and interdisciplinary research.

**LS 8002. Final Project for Graduate Liberal Studies.** (3 cr; A-F only. Prereq-MLS; all MLS coursework must be completed by end of sem)  
Students synthesize/complete final project.

**LS 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

## Linguistics (Ling)

### Institute of Linguistics, ESL, and Slavic Languages and Literatures

#### College of Liberal Arts

**Ling 5001. Introduction to Linguistics.** (4 cr. \$3001, \$3011. Prereq-Grad or #)  
Phonetics, phonology, morphology, syntax, semantics, and historical-comparative linguistics; language learning and psychology of language; linguistic universals; language in society.

**Ling 5005. Applications of Linguistics.** (3 cr. Prereq-3001 or 3011 or 5001 or #)  
Relationships between linguistics and neighboring disciplines. Applications to practical fields such as lexicography, orthography, translation/interpreting, language planning, reading, language teaching, bilingual education, education of the deaf, and correction of language disorders. Computer applications, forensic applications. Topics vary with each offering.

**Ling 5101. Language Types and Linguistic Universals.** (3 cr. Prereq-3001 or 3011 or 5001 or #)  
Comparison of languages and language types; cross-linguistic similarities and universals of language, and their explanation.

**Ling 5105. Field Methods in Linguistics I.** (4 cr. Prereq-5201, 5302 or #)  
Techniques for obtaining and analyzing linguistic data from unfamiliar languages through direct interaction with a native speaker.

**Ling 5106. Field Methods in Linguistics II.** (4 cr. Prereq-5105)  
Techniques for obtaining and analyzing linguistic data from unfamiliar languages through direct interaction with a native speaker.

**Ling 5201. Introduction to Syntax.** (3 cr. Prereq-3001 or 3011 or 5001 or #)  
Examination of syntactic phenomena and constructions in a variety of languages; principles of grammar construction and evaluation; syntactic theories as instruments of grammatical analysis.

**Ling 5202. Syntactic Theory.** (3 cr. Prereq-5201)  
A thorough foundation in modern syntactic theory through the investigation of a number of syntactic phenomena in various languages. Emphasizes syntactic argumentation and the development of constraints on grammar formalisms.

**Ling 5205. Semantics.** (3 cr. Prereq-5202 or #)  
Analysis of sentence meaning with attention to semantic properties and relations such as analyticity, entailment, quantification, and generativity. Philosophical background; formal techniques of semantic analysis; how sentence meaning depends on word meaning, syntax, and context. The role of semantics in grammatical theory.

**Ling 5206. Linguistic Pragmatics.** (3 cr. Prereq-5201, 5205 or #)  
The analysis of linguistic phenomena in relation to beliefs and intentions of language users; speech act theory, conversational implicature, presupposition, information structure, relevance theory, discourse coherence.

**Ling 5301. Introduction to Phonetics.** (4 cr. \$3301. Prereq-3001 or 3011 or 5001 or #5001 or #)  
Phonetic analysis and transcription of speech. Exploration of articulatory and acoustic correlates of speech sounds. Extensive practice transcribing. Emphasis on narrow transcription of human speech. One section focuses on universal phonetics, another provides emphasis on English.

**Ling 5302. Introduction to Phonology.** (3 cr. Prereq-5301)  
Concepts and types of information needed for describing patterns in the sounds of words, for all speakers of all human languages, including current theoretical frameworks. Extensive practice identifying and analyzing phonological patterns in the words of a language.

**Ling 5303. Phonological Theory.** (3 cr. Prereq-5302 or #)  
Further exploration of the phonology of human languages. The course will prepare students to read papers in the literature and to do informed research in phonology.

**Ling 5461. Conversation Analysis.** (3 cr. \$Comm 5461, \$Spch 5461. Prereq-3001 or 3011 or 5001 or #)  
Discourse processes. Application of concepts through conversation analysis.

**Ling 5462. Field Research in Spoken Language.** (3 cr. \$Comm 5462, \$Spch 5462. Prereq-5461 or Comm 5461 or #)  
Transcribing and analyzing talk and movement related to talk. Applying concepts to recorded conversations.

**Ling 5501. Introduction to Language Acquisition.** (3 cr. Prereq-3001 or 3011 or 5001 or #)  
Overview of first and second language acquisition. Does not fulfill degree requirements for majors in linguistics or the MA in ESL.

**Ling 5505. Introduction to Second Language Acquisition.** (3 cr. Prereq-3001 or 3011 or 5001, a course on phonological and grammatical structure of a language)  
Introduction to research on the language and learning processes of second-language learners: the linguistic structure of their interlanguage, the cognitive and social factors which influence their acquisition of a new language.

**Ling 5601. Introduction to Historical Linguistics.** (3 cr. \$3601. Prereq-3001 or 3011 or 5001)  
Historical change in phonology, syntax, semantics and the lexicon; linguistic reconstruction; genetic relationship among languages.

**Ling 5701. Sociolinguistics.** (3 cr. Prereq-3001 or 3011 or 5001 or #)  
Social determinants of linguistic diversity, variation, and change. Topics may include social and regional dialects, language style and register, style-shifting and code-switching, the quantitative study of speech, linguistic and social inequality.

**Ling 5721. Bilingualism.** (3 cr. Prereq-3001 or 3011 or 5001 or #)  
Sociolinguistic theory and methods in the study of bilingualism; language ecology in multilingual societies; language and language behavior in the bilingual individual; language in ethnic conflict; implications for public policy and planning.

**Ling 5801. Introduction to Computational Linguistics.** (3 cr. Prereq-3001 or 3011 or 5001 or #; programming experience helpful)  
Methods and issues in computer understanding of natural language. Programming languages and their linguistic applications. Lab projects.

**Ling 5802. Computational Linguistics.** (3 cr. Prereq-5801 or #)  
Computer processing of natural language. Applications to such areas as speech recognition and information retrieval.

**Ling 5900. Topics in Linguistics.** (1-4 cr [max 12 cr]. Prereq-#)  
Topics vary. See *Class Schedule*.

**Ling 5931. Fundamentals of Contemporary English.** (3 cr. Prereq-3001 or 3011 or 5001 or #)  
Word and sentence structure of contemporary English.

**Ling 5932. Descriptive Studies of Modern English.** (3 cr. Prereq-3001 or 3011 or 5001, 5201 or 5931 or #)  
Studies of selected aspects of the morphology, syntax, and/or semantics/pragmatics of modern English with emphasis on analysis of written or recorded texts.

**Ling 5993. Directed Study.** (1-3 cr [max 10 cr]. Prereq-#, Δ, □)  
Directed study for Linguistics.

**Ling 8005. Research Paper Workshop.** (3 cr [max 12 cr]; S-N only. Prereq-[5105, 5202, 5205, 5302] or [#; grad ling major])  
Workshop on research methodology/writing in Linguistics.

**Ling 8200. Topics in Syntax and Semantics.** (3 cr [max 9 cr]. Prereq-5202, 5205 or #)  
Syntax and semantics of natural language, with particular emphasis on the interface between the two.

**Ling 8210. Seminar in Syntax.** (3 cr. Prereq-5202, 5205 or #)  
Current issues in syntactic theory. Topics vary.

**Ling 8220. Seminar in Semantics.** (3 cr [max 9 cr]. Prereq-5202, 5205, 5206 or #)  
Current issues in semantics. Topics vary.

**Ling 8221. Formal Semantics of Natural Language.** (3 cr; A-F only. \$Phil 8221. Prereq-Phil 5201 or #)  
Truth-conditional model-theoretic semantics applied to treatment of opacity, intensionality, quantification, and related phenomena in natural language.

**Ling 8300. Topics in Phonetics and Phonology.** (3 cr [max 9 cr]. Prereq-5303 or #)

**Ling 8320. Seminar in Phonology.** (3 cr [max 9 cr]. Prereq-5303 or #)  
Current issues in phonological theory. Topics vary.

**Ling 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**Ling 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**Ling 8500. Topics in Second Language Acquisition.** (3 cr [max 9 cr]. Prereq-5001, 5505)

**Ling 8531. Research Methods in Language Acquisition.** (3 cr. Prereq-[5001, 5505] or #)  
Based on review of published research, students design and carry out their own studies, writing/presenting research reports at end of term. Focuses on first or second language acquisition, or both, depending on instructor.

**Ling 8666. Doctoral Pre-thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Ling 8777. Thesis Credits: Masters.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Ling 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

**Ling 8900. Seminar: Topics in Linguistics.** (3 cr [max 9 cr]. Prereq-#)

**Ling 8920. Topics in Language and Cognition.** (3 cr [max 6 cr]. Prereq-5001 or #)  
Language-related issues in cognitive science from a linguistic perspective. Serves as elective for cognitive science minor, but only for linguistics nonmajors.

**Ling 8991. Independent Study.** (1-4 cr [max 15 cr]. Prereq-#)

## Logistics Management (LM)

*Department of Marketing and Logistics Management*

*Curtis L. Carlson School of Management*

**LM 8892. Readings in Logistics Management.** (1-8 cr [max 16 cr]. Prereq-Adviser consent or #)  
Readings useful to student's individual program or objectives that are not available in regular courses.

**LM 8894. Graduate Research in Logistics Management.** (1-8 cr [max 16 cr]. Prereq-Adviser consent or #)  
Individual research on an approved topic appropriate to student's program and objectives.

## Management (Mgmt)

*Department of Strategic Management and Organization*

*Curtis L. Carlson School of Management*

**Mgmt 5004. Negotiations.** (2 cr; A-F only)  
Art and science of securing agreements between two or more parties who are interdependent and who are seeking to maximize their own outcomes; understanding individual, group, and organizational behavior in the context of these competitive situations; theory and process of negotiation applied to broad spectrum of problems faced by managers and professionals.

**Mgmt 5019. Business, Natural Environment, and Global Economy.** (2 cr; A-F only. Prereq-MBA student)  
Resource deployment policies that affect the natural environment. Sustainability. Local/global environmental threats, how government policies address these issues. Business strategies/practices that produce "win-win" outcomes.

**Mgmt 5050. Management of Innovation and Change.** (2 cr; A-F only. Prereq-3001, CSOM upper div)  
Applying theories/research on how new organizational programs, products, and technologies are developed/implemented. Diagnostic skills. How innovation unfolds.

**Mgmt 5101. Advanced Topics.** (4 cr; A-F only)  
Specialized topics in management that vary and may include downsizing, ethics, trust, risk, alliances, organizational identity, organizational change,

industry definition, team performance, organizational renewal, competitive advantage, hypercompetition, managing the knowledge worker, competence acquisition and preservation, and negotiation.

**Mgmt 5175. Managing in Newly Emerging Global Markets.** (2 cr)  
Understanding the institutional and cultural environments in major new emerging markets. Focus is on two or three countries from emerging markets (such as China, India, Eastern Europe, Mexico, Brazil and others), the problems and opportunities provided by these environments, and how to do business in these countries.

**Mgmt 5177. The Business Plan.** (2 cr; A-F only. Prereq-[4008, Acct 5160] or #)  
Understanding the structure of business plans. Critically analyzing business plans. Formulating an original business plan.

**Mgmt 8101. Theory Building and Research Design.** (4 cr. Prereq-Business admin PhD student or #)  
Problem formulation, conceptual modeling, theory building, and research design in the social and behavioral sciences.

**Mgmt 8201. Foundations of Business, Government, and Society.** (4 cr. Prereq-Business admin PhD student or #; offered alt yrs)  
Considers works in political and legal philosophy, ethics, and economics.

**Mgmt 8202. Seminar in International Management.** (4 cr. Prereq-Business admin PhD student or #; offered alt yrs)  
Overview of the field of international management research.

**Mgmt 8203. International Management/Business, Government, and Society Seminar.** (4 cr. Prereq-Business admin PhD student or #)  
Topics vary.

**Mgmt 8204. Topics in Business, Government, and Society I.** (2 cr; A-F only. Prereq-PhD student or #)  
Topics vary.

**Mgmt 8205. Topics in Business, Government, and Society II.** (2 cr; A-F only. Prereq-PhD student or #)  
Topics vary.

**Mgmt 8301. Seminar in Organizational Behavior.** (4 cr. Prereq-Business admin PhD student or #; offered alt yrs)  
Major theories and current research on individual behavior and group processes in organizations from a micro perspective.

**Mgmt 8302. Seminar in Organizations Theory.** (4 cr. Prereq-Business admin PhD student or #; offered alt yrs)  
Major theories and current research on organizational and interorganizational topics from a macro perspective.

**Mgmt 8303. Organizations Seminar.** (4 cr. Prereq-Business admin PhD student or #)  
Topics vary.

**Mgmt 8304. Topics in Organizations I.** (2 cr; A-F only. Prereq-PhD student or #)  
Topics vary.

**Mgmt 8305. Topics in Organizations II.** (2 cr; A-F only. Prereq-PhD student or #)  
Topics vary.

**Mgmt 8401. Seminar in Strategy Content.** (4 cr. Prereq-Business admin PhD student or #; offered alt yrs)  
Review of research in strategy formulation.

**Mgmt 8402. Seminar in Strategy Process.** (4 cr. Prereq-Business admin PhD student or #; offered alt yrs)  
Examines research on process by which strategy is formulated and implemented in firms.

**Mgmt 8403. Strategy Seminar.** (4 cr. Prereq-Business admin PhD student or #)  
Strategic management. Topics vary.

**Mgmt 8404. Topics in Strategy I.** (2 cr; A-F only. Prereq-PhD student or #)  
Topics vary.

**Mgmt 8405. Topics in Strategy II.** (2 cr; A-F only. Prereq-PhD student or #)  
Topics vary.

**Mgmt 8892. Readings in Management Theory and Administration.** (1-8 cr [max 16 cr]. Prereq-Business admin PhD student or #, adviser consent)  
Intensive research on a management topic; major term paper.

**Mgmt 8894. Graduate Research in Management Theory and Administration.** (1-8 cr [max 16 cr]. Prereq-Business admin PhD student or #, adviser consent)  
Research project on a management problem of interest to student; may be completed in cooperation with a business firm.

## Management of Technology (MOT)

*Institute of Technology*

**MOT 5991. MOT Independent Study.** (1-3 cr [max 3 cr]; S-N only. Prereq-MOT grad student)  
Independent study in MOT-related topic.

**MOT 8111. Marketing Management in Technology-Based Organizations.** (2 cr; A-F only. Prereq-Grad MOT major)  
Emphasizes marketing industrial products. Overall consideration of marketing strategy. Product strategy, including pricing, promotion, product mix, and sales and distribution decisions.

**MOT 8112. Management Accounting.** (2 cr; A-F only. Prereq-Grad MOT major)  
Introduction to methods for estimating and analyzing product costs and for using cost information to make product mix and pricing decisions. Cases from manufacturing firms illustrate principles of activity-based costing. Uses of cost data in managerial decision making, budgeting and control, and financial statement analysis.

**MOT 8113. Operations Management for Competitive Advantage.** (2.5 cr; A-F only. Prereq-Grad MOT major)  
Strategic framework to describe key relationships between operations and other business functions to achieve optimized operational decisions. Product-process design, production-inventory control. Quality improvement, quality-in-the-product development process. Just-in-time production, work force issues, role of technology.

**MOT 8114. Technology, Fundamental Structure.** (1 cr. Prereq-Grad MOT major)  
Technology, technology-related management procedures, general business disciplines, management functions. Developing a macro-mindset that is comprehensive, future-focused, global, and change-oriented.

**MOT 8121. Managing in a Technological Environment.** (2 cr; A-F only. Prereq-Grad MOT major)  
General management principles with applications to management of professional, technical, and research and development personnel. Discussions, readings, cases, and projects.

**MOT 8122. Financial Management for Technology-Based Organizations.** (2 cr; A-F only. Prereq-Grad MOT major)  
Creating value within the organization. Financial methods important to managers of technology-based organizations, including budgeting capital, projecting financial needs, and managing working capital.

**MOT 8133. Communications in a Technical Environment.** (2 cr; A-F only. Prereq-Grad MOT major)  
Oral and written communication. Introductory and specialized workshops on topics such as presentation skills, memo and report writing, listening skills, and visual aid design and integration.

**MOT 8212. New Product Development.** (2 cr; A-F only. Prereq–Grad MOT major)  
Need for and problems of organizational integration in development of product policy. Execution of development process for new product. Necessary organizational interactions among marketing, research/development, and operations in design/delivery of products.

**MOT 8213. Business, Government, and Macroeconomics.** (2 cr; A-F only. Prereq–Grad MOT major)  
Business–government relations, especially as they affect scientific and technical issues; global competitiveness; macro-economic policies influencing corporations' domestic and international strategies and operations. Effects of legal and economic forces on management and technical strategies of corporations.

**MOT 8214. Technology Foresight and Forecasting.** (2 cr; A-F only. Prereq–Grad MOT major)  
Introduction to methods of technology assessment/forecasting. Application to study of the history of technology/industry. Technological developments and their economic, social, and industrial impacts.

**MOT 8221. Project Management and Leadership.** (2 cr; A-F only. Prereq–Grad MOT major)  
Principles and methods for planning and controlling a project, including development of a project plan, resource planning and scheduling (PERT/CPM), project monitoring, and termination. Leadership for effective teamwork. Skills to effectively manage interdisciplinary project teams.

**MOT 8224. Pivotal Technologies.** (2 cr; A-F only. Prereq–MOT grad major)  
Technologies expected to play pivotal roles in industrial development. State-of-the-art technology, principal barriers to its commercialization. Student groups develop/present concepts for applying technology to industry. Lectures by guest experts, international field experience.

**MOT 8231. Managing Information Resources in a Technology-Based Organization.** (1.5 cr; A-F only. Prereq–Grad MOT major)  
Information technologies such as database management systems and telecommunications. Managerial issues such as power/politics of information systems, role of information technology infrastructures, information systems as competitive weapons.

**MOT 8232. Managing Innovation in a Technological Environment.** (2 cr; A-F only)  
Reviews managing innovation based on scientific studies. Inputs, processes, outputs of innovation ventures from concept through implementation. Focuses on developing a "road map" to guide an innovation manager. Conditions that facilitate/inhibit innovation. Typical patterns of innovation development. Adopting innovations developed elsewhere.

**MOT 8233. Strategic Management of Technology.** (2 cr; A-F only. Prereq–Grad MOT major)  
Technology from perspective of a general manager as a key strategic resource for building competitive advantage of an organization. Important links between technology and strategic planning. Technology and global competition; creating, acquiring, and leveraging technology competence.

**MOT 8234. Capstone Project.** (1-2 cr [max 3 cr]; A-F only. Prereq–Completion of two semesters, grad MOT major)  
Practicum carried out in cooperation with home organization of each participant. Full development, analysis, and proposed resolution of a significant issue. Students expected to perform adequate research in problem areas as well as apply concepts and methods learned in the MOT program working with a faculty adviser and a current organization mentor.

**MOT 8333. FTE: Master's.** (1 cr; NGA. Prereq–Master's student, adviser and DGS consent)

**MOT 8900. Conflict Management.** (0.5 cr. Prereq–Grad MOT major)  
Theory and methods for applying conflict management techniques in organizations. Cooperative and competitive models of conflict, basics of bargaining, conflict strategies, communication styles, listening skills, dispute resolution, third-party mediation, and use of computers for conflict mediation.

**MOT 8910. Corporate Responsibility.** (1 cr; A-F only. Prereq–Grad MOT major)  
Principles of stakeholder management. Ethical framework for responsible management of investors, employees, suppliers, customers, and external community. Moral leadership, trust in organizations, and quality control. New metaphors and techniques for managing the socially responsible organization.

**MOT 8920. Science and Technology Policy.** (1.5 cr; A-F only. Prereq–MOT grad student)  
Contribution of science/technology to economic growth/development. Why characteristics of technology R&D necessitate government intervention. Role of government in science/technology R&D and policy. How Congress operates in science/technology areas. How to participate in workings of Congress.

**MOT 8930. Topics in Emerging Technologies.** (0.5 cr; S-N only. Prereq–MOT grad student)  
Invited speakers give half- or full-day seminars on special topics in emerging technologies (e.g., energy systems, tissue engineering, thermal spray coating technology).

**MOT 8940. Managing Intellectual Property.** (0.5 cr; S-N only. Prereq–MOT grad student)  
Characteristics of Intellectual Property (IP). Patents, trademarks, copyrights, know-how. Legal protection of IP. Effect of IPR acquisition, its asset valuation on company market valuation. IP as bargaining chip.

**MOT 8950. International Residency.** (1.5 cr; A-F only. Prereq–MOT grad student)  
Twelve-day visit to educational/manufacturing organizations in Asia Pacific Region. Lectures by local university faculty on economic/managerial practices. Visits to plants, both domestically owned and joint ventures with U.S. companies. First-hand cultural/business experience. Written assignment required.

## Managerial Communications (MCom)

### Business Career Center

#### Curtis L. Carlson School of Management

**MCom 5400. Managerial Communications for the HR Professional.** (2 cr; A-F. Prereq–HRIR student)  
Memo writing, oral presentations, and team communication required of HR professional. Emphasizes hands-on, experiential learning, including videotaping.

## Manufacturing Systems (MS)

### Institute of Technology

**MS 5101. Manufacturing Strategy and Operations Management.** (3 cr; A-F only. Prereq–Grad MS major)  
Strategic roles of manufacturing, process technology, operations management, and market strategies; their impact on manufacturing. Overview of operations functions such as demand forecasting, capacity planning, inventory planning, inventory control, materials management, Kanban & JIT, facility selection, strategic alliances, and outsourcing.

**MS 5102. Manufacturing Processes.** (3 cr; A-F only. Prereq–Grad MS major)  
Descriptions/models of commonly used manufacturing processes. Process descriptions,

capabilities/performance, models relating process parameters to part/process characteristics, control. Different kinds of manufacturing processes. Lab.

**MS 5103. Quality Engineering.** (3 cr; A-F only. Prereq–Grad MS major)  
Overview of statistical, engineering, and management approaches to quality improvement. Economics of quality. Quality improvement teams/organization. Information systems. Problem-solving. QFD. Reliability engineering. Design of experiments. Statistical process control. Process validation. Capabilities studies. Quality standards, audits, and certification. TQM.

**MS 5104. Design of Manufacturing Systems.** (3 cr; A-F only. Prereq–Grad MS major)  
Design/analysis of flow lines, assembly systems, cellular manufacturing, flexible manufacturing, and automated systems. Control issues in facility layout, scheduling, batch sizing, group technology, and bottleneck management. Modeling/analysis of tools. Computer simulation/operations research).

**MS 5105. Financial Decision Making in Manufacturing.** (2 cr; A-F only. Prereq–Grad MS major)  
Fundamental topics in engineering economics, such as risk and uncertainty, equity and debt, accounting, cost accounting, time value of money, investments, and capital. Skills developed in budget management, capital cost justification, cost estimation, value engineering, equipment depreciation and replacement, and creating business plans.

**MS 5106. Intelligent Decision Support Systems in Engineering.** (3 cr; A-F only. Prereq–Grad MS major)  
Methods for identifying where to apply DSSs, technologies for building them, strategies for evaluating their effectiveness. Examples from many engineering areas.

**MS 5107. Simulation of Manufacturing Systems.** (1 cr; A-F only. Prereq–MS grad student, #)  
Using integrated simulation/animation environment to create, analyze, and evaluate realistic models for various manufacturing, assembly, and material handling systems. Experimental design for simulation. Random number generation, selecting input distributions, evaluating simulation output.

**MS 5199. Topics in Manufacturing Systems.** (1 cr [max 7 cr]; A-F only. Prereq–MS grad student)  
See *Class Schedule*.

**MS 5201. Project Management.** (1 cr; A-F only. Prereq–Grad MS major)  
Practical understanding of project management. Project planning; scheduling; budgeting; staffing; task and cost control; and communicating with, motivating, and managing team members.

**MS 5202. Technology Forecasting.** (1 cr; A-F only. Prereq–Grad MS major)  
Introduction to methods of technology assessment/forecasting. Applications to history of technology/industry. Technological developments and their economic, social, and industrial impacts.

**MS 5203. Minimizing Environmental Impacts in Manufacturing.** (2 cr; A-F only. Prereq–Grad MS major)  
Process engineering approach to waste management and pollution control in the manufacturing industry. Regulatory framework. Waste minimization. Resource recovery. Chemical, physical, and biological treatment processes. Disposal practices. Case studies in treatment/disposal. Site visits.

**MS 5204. Automated Machining Processes.** (1 cr; A-F only. Prereq–Grad MS major)  
Description and demonstration of automated machine tools and machining cells. Machining center configuration and operation, machine tool controller, machining code generation, in-process sensing and control, cell controllers, and system simulation.

**MS 5205. Issues in Quality.** (1 cr; A-F only. Prereq–Grad MS major)  
Design/implementation of quality systems. Specifying the condition, process, and context for implementations. Technology in the service of quality. Applying technology to achieve customer interaction. International quality. The transplanted executive.

**MS 5206. Industrial Safety.** (1 cr; A-F only. Prereq—Grad MS major)  
Occupational safety and health/product safety for engineers. Fundamental safety concepts, engineering intervention principles. Standards, laws, and regulations governing safety of work places/products. Hazards and their engineering control, the human element, management of safety/health.

**MS 5207. Design for Manufacturability.** (1 cr; A-F only. Prereq—Grad MS major)  
Machine design practice plans for assembly of components into systems. Basic design principles.

**MS 5208. Plasma Processing.** (1 cr; A-F only. Prereq—Grad MS major)  
Plasma coating processes, manufacturing issues. Details of technologies such as plasma spraying and diamond deposition. Lab demonstrations.

**MS 5209. Micro Electrical Mechanical Systems.** (1 cr; A-F only. Prereq—Grad MS major)  
Introduces MEMS by presenting various micro-fabrication techniques such as integrated circuit micro-fabrication processes, bulk micromachining, bonding, and high-spectration processes. MEMS design processes. MEMS applications. Future of MEMS.

**MS 5210. Robotics.** (1 cr; A-F only. Prereq—Grad MS major)

**MS 5211. Fabrication of Plastics and Composite Materials.** (1 cr; A-F only. Prereq—Grad MS major)  
Standard methods of making polymer and polymer composite parts. Standard test methods, both destructive and nondestructive. Students make polymer parts and test them. Lab.

**MS 5502. ISE: Public Interactions.** (1 cr [max 4 cr]; A-F only. Prereq—ISE grad student)  
Techniques for effective public communication. How to run a successful public hearing. Resources for publishing public notices.

**MS 5900. Directed Study.** (1-3 cr; A-F only)  
Directed study/research in manufacturing systems. Topics chosen in collaboration with instructor.

**MS 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**MS 8760. Computer-assisted Product Realization: Capstone Project.** (4 cr; A-F only. Prereq—Grad manufacturing systems major)  
Students experience the complete part design to production process. Manufacturing process design and commercial software packages for use, in part, in process design.

## Marathi (Mar)

*Department of Asian Languages and Literatures  
College of Liberal Arts*

**Mar 5992. Directed Readings.** (3-5 cr [max 12 cr]. Prereq—#, Δ, □)  
Individualized guided reading or study of modern Marathi texts.

**Mar 5994. Directed Research.** (3-5 cr [max 12 cr]. Prereq—#, Δ, □)  
Directed research on a subject agreed upon by student and instructor.

## Marketing (Mktg)

*Department of Marketing and Logistics  
Management*

*Curtis L. Carlson School of Management*

**Mktg 8811. Seminar: Consumer Behavior.** (4 cr. Prereq—MBA 6210 or equiv, business admin PhD student or #; offered alt yrs)  
Theories and research in consumer behavior and related disciplines of social and cognitive psychology. Perspective primarily from information processing or social cognition. Consumer categorization, memory, beliefs, attitudes, and attitude change.

**Mktg 8831. Seminar: Inter-Organizational Relations.** (4 cr. Prereq—MBA 6210 or equiv, business admin PhD student or #; offered alt yrs)  
From an efficiency perspective, inter-organizational networks involved in task of moving goods and services from point of production to point of consumption. Literature covering the functional, institutional, analytical, and methodological traditions, as well as the behavioral school of thought and transaction cost and relational contracting.

**Mktg 8841. Seminar: Theory and Methods of Measurement.** (4 cr. Prereq—MBA 6210 or equiv, business admin PhD student or #; offered alt yrs)  
Issues surrounding validity and reliability of measures developed as key indicators of constructs in a behavioral context. Various methods of measurement such as indicators of reliability, Multi-Trait Multi-Method, exploratory factor analysis, and confirmatory factor analysis using Lisrel.

**Mktg 8851. Seminar: Marketing Management and Strategy.** (4 cr. Prereq—MBA 6210 or equiv, business admin PhD student or #; offered alt yrs)  
Topics in marketing management and formulation and implementation of marketing strategies. Exposes students to diversity of thought, within marketing and the strategic management literature.

**Mktg 8890. Seminar: Marketing Topics.** (4 cr [max 8 cr]. Prereq—MBA 6210 or equiv, business admin PhD student or #; offered alt yrs)  
Current topics and problems of interest considered in depth. Topics vary with each offering.

**Mktg 8892. Readings in Marketing.** (1-8 cr [max 16 cr]. Prereq—MBA 6210 or equiv, business admin PhD student or #)  
Readings useful to student's individual program and objectives that are not available in regular courses.

**Mktg 8894. Graduate Research in Marketing.** (1-8 cr [max 16 cr]. Prereq—MBA 6210 or equiv, business admin PhD student or #)  
Individual research on an approved topic appropriate to student's program and objectives.

## Master of Business Taxation (MBT)

*Department of Strategic Management and Organization*

*Curtis L. Carlson School of Management*

**MBT 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

## Master of Healthcare Administration (MHA)

*Curtis L. Carlson School of Management*

**MHA 8750. Seminar: Alternative Patterns of Healthcare.** (2 cr; A-F only)  
Social and psychological components of health and medical care. Organization and delivery of healthcare services, their problems and perspectives; focus on the patient, provider of care, and environment in which healthcare services are dispensed.

**MHA 8762. Contemporary Problems in Healthcare.** (2 cr; A-F only. Prereq—PhD Student)  
Current concepts, problems, principles, and future developments of health and healthcare selected by students; developing models, based on current literature and research; verbal and written presentations from policy and issue perspectives.

**MHA 8763. External Forces Affecting Health Services Delivery.** (2 cr; A-F only. Prereq—PhD student)  
Guidance in development of concepts, models, and principles of financing, social policy making, and organizing and human resource development for health services delivery. Written paper and teaching presentation required.

**MHA 8764. Research Applications to Health Services Delivery.** (2 cr; A-F only. Prereq—PhD Student)  
Tutorial guidance and supervised course development covering research design, application, analysis, and presentation in health services delivery.

**MHA 8780. Non-Parametric Statistical Methods in Healthcare Research.** (2 cr; A-F only. Prereq—Theoretical stat course, parametric stat course)  
Development of student-selected, non-parametric statistics and its application to health-care delivery and research.

**MHA 8782. Research Practicum.** (2 cr; A-F only. Prereq—PhD student)  
Field experience in healthcare research. Supervised independent and team research on selected topics and problems.

**MHA 8790. Seminar: Political Aspects of Healthcare.** (2 cr; A-F only. Prereq—HSP&A grad major or #)  
Interrelationships between government, politics, and healthcare; political and social basis of health legislation and community decision making in provision and modification of health services.

## Materials Science (MatS)

*Department of Chemical Engineering and Materials Science  
Institute of Technology*

**MatS 5221. Introduction to Polymer Chemistry.** (3 cr; A-F only. Prereq—[3501, Chem 2302] or #)  
Condensation, radical, ionic, emulsion, ring-opening, metal-catalyzed polymerizations. Chain conformation, solution thermodynamics, molecular weight characterization, physical properties.

**MatS 5223W. Polymer Laboratory.** (2 cr; A-F only. Prereq—5221 or Chem 5221 or 8221 or #)  
Synthesis, characterization, and physical properties of polymers. Free radical, condensation, emulsion, anionic polymerization. Infrared spectroscopy/gel permeation chromatography. Viscoelasticity, rubber elasticity, crystallization.

**MatS 5517. Electron Microscopy.** (3 cr; A-F only)  
Transmission electron microscope, scattering and diffraction, electron sources, lenses, apertures and resolution, specimen preparation, diffraction patterns, kikuchi diffraction, planar defects, strain fields, high resolution imaging, X-ray spectrometry.

**MatS 5521. Thin Films and Interfaces.** (3 cr. Prereq—IT upper div or grad student, MatS 4013 or #)  
Fundamentals of vacuum science; vapor pressures and thin film deposition processes (physical and chemical vapor deposition, sputtering, laser ablation); thermodynamics and kinetics of thin film growth; epitaxy; film stability and reactions; structure-property relationship; multilayers and diffusion barriers; characterization techniques to include photon, electron, and ion spectroscopies. Computer-based homework problems.

**MatS 5531. Electrochemical Engineering.** (3 cr. Prereq—MatS 3011 or #, upper div IT or grad)  
Fundamentals of electrochemical engineering. Topics include electrochemical mass transfer electrokinetics, thermodynamics of cells, modern sensors, formation of thin films and microstructured materials. Computer-based problems will be assigned.

**MatS 8001. Structure and Symmetry of Materials.** (3 cr; A-F only)  
Comprehensive description of structure of materials, including metals, semiconductors, organic crystals, polymers, and liquid crystals. Atomic and molecular ordering, influence of intermolecular forces on symmetry and structure. Principles of scattering and use of X-ray, neutron, and electron diffraction.

**MatS 8002. Thermodynamics and Kinetics.** (3 cr; A-F only)  
First three laws of thermodynamics, free energy, equilibrium constants, fugacity and activity relationships, solution models, order-disorder transitions, phase transitions. Elementary statistical

mechanics. Applications to materials systems, including surface energies, multicomponent equilibria, reaction kinetics, mass transport, diffusion.

**MatS 8003. Electronic Properties.** (3 cr; A-F only. Prereq-#)

Basic physical theory of bonding in metals, alloys, and semiconductors. Review of modern physics, statistical physics, and solid state physics. Structure of matter emphasizing electronic processes. Techniques for predicting and understanding electronic structure of solids. Transport theory, elementary theory of magnetism, and superconductivity.

**MatS 8004. Mechanical Properties.** (3 cr; A-F only)

Defects in crystalline materials, including point defects, dislocations, and grain boundaries. Structure and movement of defects related to mechanical behavior of materials. Tools used to understand crystals and crystallography.

**MatS 8005. Dislocations and Interfaces.** (3 cr; A-F only)

Structure and properties at an advanced level. Influence of bonding and crystallography on structures of dislocations cores. CSL and DSCL theory of grain boundaries and of structures of phase boundaries in heterojunctions including thin film epilayers. Effect of defects on electrical, optical, magnetic, and superconducting behavior of materials.

**MatS 8114. Structure and Symmetry in Soft**

**Materials.** (2 cr; A-F only. Prereq-8001 or equiv or #) Molecular interactions, packing, symmetry operations/structure. X-ray/neutron scattering in soft materials, including organic/liquid crystals, amphiphiles, and polymers.

**MatS 8204. Computational Methods and Applications to Problems in Materials Science and Engineering.** (2 cr; A-F only. Prereq-Grad student,

knowledge of programming languages such as Fortran) Implementation of computational methods/applications to numerical problems in materials science and engineering. Emphasizes implementation to applications.

**MatS 8211. Physical Chemistry of Polymers.** (3 cr;

A-F only. Prereq-Undergrad physical chem or #) Introduction to polymer physical chemistry. Chain conformations; thermodynamics of polymer solutions, blends, and copolymers; light, neutron, and X-ray scattering; dynamics in dilute solutions and polymer characterization; dynamics of melts and viscoelasticity; rubber elasticity, networks, and gels; glass transitions; crystallization.

**MatS 8212. Solid State Reaction Kinetics.** (3 cr. Prereq-8002)

Reactions between ceramic solids in terms of transport mechanisms. Thermodynamics of point defects in binary and ternary ionic solids, diffusion in the bulk and along line and surface defects, chemical and electrochemical potential gradients, reactions at interfaces, practical examples drawn from oxidation and solid/solid reactions of ceramics.

**MatS 8213. Electronic Properties of Materials.** (3 cr; A-F only. Prereq-#)

Band theory studied by tight binding, pseudopotential, K.P. and KKR techniques. Optical and transport properties. Experimental techniques for characterizing electronic properties, including photoemission, Auger spectroscopy, and optical spectroscopy. Microelectronic materials, metal-semiconductor, and other interface phenomena.

**MatS 8214. Electronic Properties and Applications of Organic Materials.** (3 cr; A-F only. Prereq-#)

Introduction to current and prospective applications of organic materials in electronic, electroluminescent, and photoconductive devices. Bonding, electronic structure, charge carriers, transport mechanisms, luminescence, and photoconductivity in molecular crystals and conducting polymers.

**MatS 8215. Electronic Ceramics.** (3 cr; A-F only. Prereq-#)

Electronic properties of ceramics; electronic and ionic conduction; dielectric behavior; ferroelectric, piezoelectric, pyroelectric, and electrooptic properties.

Relationships between structure (crystal structure, microstructure) and properties. Introduction to applications (e.g., capacitors, sensors, actuators).

**MatS 8216. Contact and Fracture Mechanics.** (3 cr; A-F only)

Theories of indentation contact and fracture resistance emphasizing structure/property relationships. Surfaces, thin film interfaces, coatings, and bulk behavior. Theoretical basis and experimental techniques for measuring mechanical behavior at the nano-scale. Lab exercises.

**MatS 8217. Advanced Electron Microscopy.** (3 cr; A-F only. Prereq-5517)

Theory/application of scanning/transmission electron microscopy.

**MatS 8218. Thin Film Growth and Epitaxy.** (3 cr; A-F only)

Principles of epitaxial growth. Growth models, thermodynamics, kinetics, homoepitaxial growth, continuum models of homoepitaxial growth, models of heteroepitaxial growth, surfaces, interfaces, defects, coincident lattices, experimental methods of growth, characterization.

**MatS 8219. Science of Porous Media.** (3 cr; A-F only. §ChEn 5103, §ChEn 8103)

Geometry and topology of porous materials. Fundamentals of flow, transports, and deformation in them. One- and two-phase Darcy flows, convective dispersion in microporous materials. Relations of macroscopic properties and behavior to microscopic structures and mechanisms. Nanoporous materials. Examples from nature and technology.

**MatS 8221. Introduction to Polymer Chemistry.** (4 cr; A-F only. Prereq-[3502, Chem 2302] or #)

Condensation, radical, ionic, emulsion, ring-opening, metal-catalyzed polymerizations. Chain conformation, solution thermodynamics, molecular weight characterization, physical properties.

**MatS 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**MatS 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**MatS 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**MatS 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**MatS 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

**MatS 8993. Directed Study.** (1-12 cr)

**MatS 8994. Directed Research.** (1-12 cr)

**MatS 8995. Special Topics.** (1-4 cr)

New or experimental courses offered by department or visiting faculty.

## Mathematics (Math)

### School of Mathematics

### Institute of Technology

**Math 5067. Actuarial Mathematics I.** (4 cr. Prereq-4065, [one sem [4xxx or 5xxx] [probability or statistics] course]) Future lifetime random variable, survival function. Insurance, life annuity, future loss random variables. Net single premium, actuarial present value, net premium, net reserves.

**Math 5068. Actuarial Mathematics II.** (4 cr. Prereq-5067)

Multiple decrement insurance, pension valuation. Expense analysis, gross premium, reserves. Problem of withdrawals. Regulatory reserving systems. Minimum cash values. Additional topics at instructor's discretion.

**Math 5075. Mathematics of Options, Futures, and Derivative Securities I.** (4 cr; A-F only. Prereq-Two yrs calculus, basic computer skills)

Mathematical background (e.g., partial differential equations, Fourier series, computational methods, Black-Scholes theory, numerical methods—including Monte Carlo simulation). Interest-rate derivative securities, exotic options, risk theory. First course of two-course sequence.

**Math 5076. Mathematics of Options, Futures, and Derivative Securities II.** (4 cr; A-F only. Prereq-5075)

Mathematical background such as partial differential equations, Fourier series, computational methods, Black-Scholes theory, numerical methods (including Monte Carlo simulation), interest-rate derivative securities, exotic options, risk theory.

**Math 5165. Mathematical Logic I.** (4 cr. Prereq-2283 or 3283 or Phil 5201 or CSci course in theory of algorithms or #)

Theory of computability: notion of algorithm, Turing machines, primitive recursive functions, recursive functions, Kleene normal form, recursion theorem. Propositional logic.

**Math 5166. Mathematical Logic II.** (4 cr. Prereq-5165)

First-order logic: provability/truth in formal systems, models of axiom systems, Godel's completeness theorem. Godel's incompleteness theorem: decidable theories, representability of recursive functions in formal theories, undecidable theories, models of arithmetic.

**Math 5248. Cryptology and Number Theory.** (4 cr. Prereq-2 sems soph math)

Classical cryptosystems. One-time pads, perfect secrecy. Public key ciphers: RSA, discrete log. Euclidean algorithm, finite fields, quadratic reciprocity. Message digest, hash functions. Protocols: key exchange, secret sharing, zero-knowledge proofs. Probabilistic algorithms: pseudoprimes, prime factorization. Pseudo-random numbers. Elliptic curves.

**Math 5251. Error-Correcting Codes, Finite Fields, Algebraic Curves.** (4 cr. Prereq-2 sems soph math)

Information theory: channel models, transmission errors. Hamming weight/distance. Linear codes/fields, check bits. Error processing: linear codes, Hamming codes, binary Golay codes. Euclidean algorithm. Finite fields, Bose-Chaudhuri-Hocquenghem codes, polynomial codes, Goppa codes, codes from algebraic curves.

**Math 5285H. Honors: Fundamental Structures of Algebra I.** (4 cr. Prereq-[2243 or 2373 or 2573], [2283 or 2574 or 3283])

Review of matrix theory, linear algebra. Vector spaces, linear transformations over abstract fields. Group theory, including normal subgroups, quotient groups, homomorphisms, class equation, Sylow's theorems. Specific examples: permutation groups, symmetry groups of geometric figures, matrix groups.

**Math 5286H. Honors: Fundamental Structures of Algebra II.** (4 cr. Prereq-5285)

Ring/module theory, including ideals, quotients, homomorphisms, domains (unique factorization, euclidean, principal ideal), fundamental theorem for finitely generated modules over euclidean domains, Jordan canonical form. Introduction to field theory, including finite fields, algebraic/transcendental extensions, Galois theory.

**Math 5335. Geometry I.** (4 cr. Prereq-[2243 or 2373 or 2573], [¶2263 or ¶2374 or ¶2574])

Advanced two-dimensional Euclidean geometry from a vector viewpoint. Theorems/problems about triangles/circles, isometries, connections with Euclid's axioms. Hyperbolic geometry, how it compares with Euclidean geometry.

**Math 5336. Geometry II.** (4 cr. Prereq-5335)

Projective geometry, including: relation to Euclidean geometry, finite geometries, fundamental theorem of projective geometry. N-dimensional Euclidean geometry from a vector viewpoint. Emphasizes N=3, including: polyhedra, spheres, isometries.

**Math 5345. Introduction to Topology.** (4 cr. Prereq—[2263 or 2374 or 2573], [¶2283 or ¶2574 or ¶3283]) Set theory. Euclidean/metric spaces. Basics of general topology, including compactness/connectedness.

**Math 5378. Differential Geometry.** (4 cr. Prereq—[2263 or 2374 or 2573], [2243 or 2373 or 2574]; [2283 or 3283] recommended) Basic geometry of curves in plane and in space, including Frenet formula, theory of surfaces, differential forms, Riemannian geometry.

**Math 5385. Introduction to Computational Algebraic Geometry.** (4 cr. Prereq—2263 or 2374 or 2573) Geometry of curves/surfaces defined by polynomial equations. Emphasizes concrete computations with polynomials using computer packages, interplay between algebra and geometry. Abstract algebra presented as needed.

**Math 5467. Introduction to the Mathematics of Wavelets.** (4 cr. Prereq—[2243 or 2373 or 2573], [2283 or 2574 or 3283 or #]; [[2263 or 2374], 4567] recommended) Background theory/experience in wavelets. Inner product spaces, operator theory, Fourier transforms applied to Gabor transforms, multi-scale analysis, discrete wavelets, self-similarity. Computing techniques.

**Math 5481. Mathematics of Industrial Problems I.** (4 cr. Prereq—[2243 or 2373 or 2573], [2263 or 2374 or 2574], familiarity with some programming language) Topics in industrial math, including crystal precipitation, air quality modeling, electron beam lithography. Problems treated both theoretically and numerically.

**Math 5482. Mathematics of Industrial Problems II.** (4 cr. Prereq—[2243 or 2373 or 2573], [2263 or 2374 or 2574], familiarity with some programming language) Topics in industrial math, including color photography, catalytic converters, photocopying.

**Math 5485. Introduction to Numerical Methods I.** (4 cr. Prereq—2243 or 2373 or 2573; some computer skills recommended) Solution of nonlinear equations in one variable. Interpolation, polynomial approximation, numerical integration/differentiation, numerical solution of initial-value problems.

**Math 5486. Introduction To Numerical Methods II.** (4 cr. Prereq—5485) Direct/iterative methods for solving linear systems, approximation theory, methods for eigenvalue problems, methods for systems of nonlinear equations, numerical solution of boundary value problems for ordinary differential equations.

**Math 5487. Computational Methods for Differential and Integral Equations in Engineering and Science I.** (4 cr. Prereq—4242) Numerical methods for elliptic partial differential equations, integral equations of engineering and science. Methods include finite element, finite difference, spectral, boundary integral.

**Math 5488. Computational Methods for Differential and Integral Equations in Engineering and Science II.** (4 cr. Prereq—5487) Numerical methods for time-dependent partial differential equations of engineering/science. Methods include finite element, finite difference, spectral, boundary integral. Applications to fluid flow, elasticity, electromagnetism.

**Math 5525. Introduction to Ordinary Differential Equations.** (4 cr. Prereq—[2243 or 2373 or 2573], [2283 or 2574 or 3283]) Ordinary differential equations, solution of linear systems, qualitative/numerical methods for nonlinear systems. Linear algebra background, fundamental matrix solutions, variation of parameters, existence/uniqueness theorems, phase space. Rest points, their stability. Periodic orbits, Poincare-Bendixson theory, strange attractors.

**Math 5535. Dynamical Systems and Chaos.** (4 cr. Prereq—[2243 or 2373 or 2573], [2263 or 2374 or 2574]) Dynamical systems theory. Emphasizes iteration of one-dimensional mappings. Fixed points, periodic points, stability, bifurcations, symbolic dynamics, chaos, fractals, Julia/Mandelbrot sets.

**Math 5583. Complex Analysis.** (4 cr. Prereq—2263 or 2374 or 2573) Algebra, geometry of complex numbers. Linear fractional transformations. Conformal mappings. Holomorphic functions. Theorems of Abel/Cauchy, power series. Schwarz' lemma. Complex exponential, trig functions. Entire functions, theorems of Liouville/Morera. Reflection principle. Singularities, Laurent series. Residues.

**Math 5587. Elementary Partial Differential Equations I.** (4 cr. Prereq—[2243 or 2373 or 2573], [2263 or 2374 or 2574]) Emphasizes partial differential equations w/physical applications, including heat, wave, Laplace's equations. Interpretations of boundary conditions. Characteristics, Fourier series, transforms, Green's functions, images, computational methods. Applications include wave propagation, diffusions, electrostatics, shocks.

**Math 5588. Elementary Partial Differential Equations II.** (4 cr; A-F only. Prereq—[2243 or 2373 or 2573], [2263 or 2374 or 2574]; 5587 not a prereq but see instructor) Heat, wave, Laplace's equations in higher dimensions. Green's functions, Fourier series, transforms. Asymptotic methods, boundary layer theory, bifurcation theory for linear/nonlinear PDEs. Variational methods. Free boundary problems. Additional topics as time permits.

**Math 5615H. Honors: Introduction to Analysis I.** (4 cr. Prereq—[[2243 or 2373], [2263 or 2374], [2283 or 3283]] or 2574) Axiomatic treatment of real/complex number systems. Introduction to metric spaces: convergence, connectedness, compactness. Convergence of sequences/series of real/complex numbers, Cauchy criterion, root/ratio tests. Continuity in metric spaces. Rigorous treatment of differentiation of single-variable functions, Taylor's Theorem.

**Math 5616H. Honors: Introduction to Analysis II.** (4 cr. Prereq—5615) Rigorous treatment of Riemann-Stieltjes integration. Sequences/series of functions, uniform convergence, equicontinuous families, Stone-Weierstrass Theorem, power series. Rigorous treatment of differentiation/integration of multivariable functions, Implicit Function Theorem, Stokes' Theorem. Additional topics as time permits.

**Math 5651. Basic Theory of Probability and Statistics.** (4 cr. \$Stat 5101. Prereq—[2263 or 2374 or 2573]; [[2243 or 2373], [2283 or 2574 or 3283]] recommended) Logical development of probability, basic issues in statistics. Probability spaces, random variables, their distributions/expected values. Law of large numbers, central limit theorem, generating functions, sampling, sufficiency, estimation.

**Math 5652. Introduction to Stochastic Processes.** (4 cr. Prereq—[2243 or 2373 or 2573], [5651 or Stat 5101]) Random walks, Markov chains, branching processes, martingales, queuing theory, Brownian motion.

**Math 5654. Prediction and Filtering.** (4 cr. Prereq—[2243 or 2373 or 2573], [5651 or Stat 5101]) Markov chains, Wiener process, stationary sequences, Ornstein-Uhlenbeck process. Partially observable Markov processes (hidden Markov models), stationary processes. Equations for general filters, Kalman filter. Prediction of future values of partially observable processes.

**Math 5705. Enumerative Combinatorics.** (4 cr. Prereq—[2243 or 2373 or 2573], [2263 or 2283 or 2374 or 2574 or 3283]) Basic enumeration, bijections, inclusion-exclusion, recurrence relations, ordinary/exponential generating functions, partitions, Polya theory. Optional topics include trees, asymptotics, listing algorithms, rook theory, involutions, tableaux, permutation statistics.

**Math 5707. Graph Theory and Non-enumerative Combinatorics.** (4 cr. Prereq—[2243 or 2373 or 2573], [2263 or 2374 or 2574]; [2283 or 3283 or experience in writing proofs] highly recommended) Basic topics in graph theory: connectedness, Eulerian/Hamiltonian properties, trees, colorings, planar graphs, matchings, flows in networks. Optional topics include graph algorithms, Latin squares, block designs, Ramsey theory.

**Math 5711. Linear Programming and Combinatorial Optimization.** (4 cr. Prereq—2243 or 2373 or 2573) Simplex method, connections to geometry, duality theory, sensitivity analysis. Applications to cutting stock, allocation of resources, scheduling problems. Flows, matching/transportation problems, spanning trees, distance in graphs, integer programs, branch/bound, cutting planes, heuristics. Applications to traveling salesman, knapsack problems.

**Math 5900. Tutorial in Advanced Mathematics.** (1-6 cr [max 120 cr]; A-F only) Individually directed study.

**Math 8001. Preparation for College Teaching.** (1 cr; S-N only. Prereq—; math grad student in good standing or #) New approaches to teaching/learning, issues in mathematics education, components/expectations of a college mathematics professor.

**Math 8141. Applied Logic.** (3 cr; A-F only. Prereq—#) Applying techniques of mathematical logic to other areas of mathematics and computer science. Sample topics: complexity of computation, computable analysis, unsolvability of diophantine problems, program verification, database theory. Course is generally self-contained.

**Math 8142. Applied Logic.** (3 cr [max 3 cr]; A-F only. Prereq—#) Applying techniques of mathematical logic to other areas of mathematics, computer science. Complexity of computation, computable analysis, unsolvability of diophantine problems, program verification, database theory.

**Math 8151. Axiomatic Set Theory.** (3 cr; A-F only. Prereq—5166 or #) Axiomatic development of basic properties of ordinal/cardinal numbers, infinitary combinatorics, well founded sets, consistency of axiom of foundation, constructible sets, consistency of axiom of choice and of generalized continuum hypothesis.

**Math 8152. Axiomatic Set Theory.** (3 cr; A-F only. Prereq—8151 or #) Notion of forcing, generic extensions, forcing with finite partial functions, independence of continuum hypothesis, forcing with partial functions of infinite cardinalities, relationship between partial orderings and Boolean algebras, Boolean-valued models, independence of axiom of choice.

**Math 8166. Recursion Theory.** (3 cr; A-F only. Prereq—Math grad student or #) Analysis of concept of computability, including various equivalent definitions. Primitive recursive, recursive, partial recursive functions. Oracle Turing machines. Kleene Normal Form Theorem. Recursive, recursively enumerable sets. Degrees of unsolvability. Arithmetic hierarchy.

**Math 8167. Recursion Theory.** (3 cr; A-F only. Prereq—8166, #) Sample topics: complexity theory, recursive analysis, generalized recursion theory, analytical hierarchy, constructive ordinals.

**Math 8172. Model Theory.** (3 cr; A-F only. Prereq—Math grad student or #) Interplay of formal theories, their models. Elementary equivalence, elementary extensions, partial isomorphisms. Lowenheim-Skolem theorems, compactness theorems, preservation theorems. Ultraproducts.

**Math 8173. Model Theory.** (3 cr; A-F only. Prereq-8172 or #)

Types of elements. Prime models, homogeneity, saturation, categoricity in power. Forcing.

**Math 8190. Topics in Logic.** (1-3 cr [max 12 cr]; A-F only. Prereq-#; offered for one year or one semester as circumstances warrant)

**Math 8201. General Algebra.** (3 cr; A-F only. Prereq-4xxx algebra or equiv or #)

Groups through Sylow, Jordan-Hölder theorems, structure of finitely generated Abelian groups. Rings and algebras, including Gauss theory of factorization. Modules, including projective and injective modules, chain conditions, Hilbert basis theorem, and structure of modules over principal ideal domains.

**Math 8202. General Algebra.** (3 cr; A-F only. Prereq-8201 or #)

Classical field theory through Galois theory, including solvable equations. Symmetric, Hermitian, orthogonal, and unitary form. Tensor and exterior algebras. Basic Wedderburn theory of rings; basic representation theory of groups.

**Math 8207. Theory of Modular Forms and L-Functions.** (3 cr; A-F only. Prereq-8202 or #)

Zeta and L-functions, prime number theorem, Dirichlet's theorem on primes in arithmetic progressions, class number formulas; Riemann hypothesis; modular forms and associated L-function; Eisenstein series; Hecke operators, Poincaré series, Euler products; Ramanujan conjectures; Theta series and quadratic forms; waveforms and L-functions.

**Math 8208. Theory of Modular Forms and L-Functions.** (3 cr; A-F only. Prereq-8207 or #)

Applications of Eisenstein series: special values and analytic continuation and functional equations of L-functions. Trace formulas. Applications of representation theory. Computations.

**Math 8211. Commutative and Homological Algebra.** (3 cr; A-F only. Prereq-8202 or #)

Selected topics.

**Math 8212. Commutative and Homological Algebra.** (3 cr; A-F only. Prereq-8211 or #)

Selected topics.

**Math 8245. Group Theory.** (3 cr; A-F only. Prereq-8202 or #)

Permutations, Sylow's theorems, representations of groups on groups, semi-direct products, solvable and nilpotent groups, generalized Fitting subgroups, p-groups, co-prime action on p-groups.

**Math 8246. Group Theory.** (3 cr; A-F only. Prereq-8245 or #)

Representation and character theory, simple groups, free groups and products, presentations, extensions, Schur multipliers.

**Math 8251. Algebraic Number Theory.** (3 cr; A-F only. Prereq-8202 or #)

Algebraic number fields and algebraic curves. Basic commutative algebra. Completions: p-adic fields, formal power series, Puiseux series. Ramification, discriminant, different. Finiteness of class number and units theorem.

**Math 8252. Algebraic Number Theory.** (3 cr; A-F only. Prereq-8251 or #)

Zeta and L-functions of global fields. Artin L-functions. Hasse-Weil L-functions. Tchebotarev density. Local and global class field theory. Reciprocity laws. Finer theory of cyclotomic fields.

**Math 8253. Algebraic Geometry.** (3 cr; A-F only. Prereq-8202 or #)

Curves, surfaces, projective space, affine and projective varieties. Rational maps. Blowing-up points. Zariski topology. Irreducible varieties, divisors.

**Math 8254. Algebraic Geometry.** (3 cr; A-F only. Prereq-8253 or #)

Sheaves, ringed spaces, and schemes. Morphisms. Derived functors and cohomology, Serre duality. Riemann-Roch theorem for curves, Hurwitz's theorem. Surfaces: monoidal transformations, birational transformations.

**Math 8270. Topics in Algebraic Geometry.** (1-3 cr [max 12 cr]; A-F only. Prereq-Math 8201, Math 8202; offered for one year or one semester as circumstances warrant)

**Math 8271. Lie Groups and Lie Algebras.** (3 cr; A-F only. Prereq-8302 or #)

Definitions and basic properties of Lie groups and Lie algebras; classical matrix Lie groups; Lie subgroups and their corresponding Lie subalgebras; covering groups; Maurer-Cartan forms; exponential map; correspondence between Lie algebras and simply connected Lie groups; Baker-Campbell-Hausdorff formula; homogeneous spaces.

**Math 8272. Lie Groups and Lie Algebras.** (3 cr; A-F only. Prereq-8271 or #)

Solvable and nilpotent Lie algebras and Lie groups; Lie's and Engel's theorems; semisimple Lie algebras; cohomology of Lie algebras; Whitehead's lemmas and Levi's theorem; classification of complex semisimple Lie algebras and compact Lie groups; representation theory.

**Math 8280. Topics in Number Theory.** (1-3 cr [max 12 cr]; A-F only. Prereq-#; offered for one yr or one semester as circumstances warrant)

**Math 8300. Topics in Algebra.** (1-3 cr [max 12 cr]; A-F only. Prereq-Grad math major or #; offered as one yr or one sem crse as circumstances warrant)

Selected topics.

**Math 8301. Manifolds and Topology.** (3 cr; A-F only. Prereq-[Some point-set topology, algebra] or #)

Classification of compact surfaces, fundamental group/covering spaces. Homology group, basic cohomology. Application to degree of a map, invariance of domain/dimension.

**Math 8302. Manifolds and Topology.** (3 cr; A-F only. Prereq-8301 or #)

Smooth manifolds, tangent spaces, embedding/immersion, Sard's theorem, Frobenius theorem. Differential forms, integration. Curvature, Gauss-Bonnet theorem. Time permitting: de Rham, duality in manifolds.

**Math 8306. Algebraic Topology.** (3 cr; A-F only. Prereq-8301 or #)

Singular homology, cohomology theory with coefficients. Eilenberg-Stenrod axioms, Mayer-Vietoris theorem.

**Math 8307. Algebraic Topology.** (3 cr; A-F only. Prereq-8306 or #)

Basic homotopy theory, cohomology rings with applications. Time permitting: fibre spaces, cohomology operations, extra-ordinary cohomology theories.

**Math 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**Math 8360. Topics in Topology.** (1-3 cr [max 12 cr]; A-F only. Prereq-8301 or #; offered as one yr or one sem crse as circumstances warrant)

Selected topics.

**Math 8365. Riemannian Geometry.** (3 cr; A-F only. Prereq-8301 or basic point-set topology or #)

Riemannian metrics, curvature. Bianchi identities, Gauss-Bonnet theorem, Meyers's theorem, Cartan-Hadamard theorem.

**Math 8366. Riemannian Geometry.** (3 cr; A-F only. Prereq-8365 or #)

Gauss, Codazzi equations. Tensor calculus, Hodge theory, spinors, global differential geometry, applications.

**Math 8370. Topics in Differential Geometry.** (1-3 cr [max 12 cr]; A-F only. Prereq-8301 or 8365; offered for one yr or one sem as circumstances warrant)

Current research in Differential Geometry.

**Math 8380. Topics in Advanced Geometry.** (1-3 cr [max 12 cr]; A-F only. Prereq-8301, 8365, #; offered for one year or one semester as circumstances warrant)

**Math 8385. Calculus of Variations and Minimal Surfaces.** (3 cr; A-F only. Prereq-4xxx partial differential equations or #)

Comprehensive exposition of calculus of variations and its applications. Theory for one-dimensional problems. Survey of typical problems. Necessary conditions. Sufficient conditions. Second variation, accessory eigenvalue problem. Variational problems with subsidiary conditions. Direct methods.

**Math 8386. Calculus of Variations and Minimal Surfaces.** (3 cr; A-F only. Prereq-8595 or #)

Theory of multiple integrals. Geometrical differential equations, i.e., theory of minimal surfaces and related structures (surfaces of constant or prescribed mean curvature, solutions to variational integrals involving surface curvatures), all extremals for variational problems of current interest as models for interfaces in real materials.

**Math 8387. Mathematical Modeling of Industrial Problems.** (3 cr; A-F only. Prereq-[5xxx numerical analysis, some computer experience] or #)

Mathematical models from physical, biological, social systems. Emphasizes industrial applications. Modeling of deterministic/probabilistic, discrete/continuous processes; methods for analysis/computation.

**Math 8388. Mathematical Modeling of Industrial Problems.** (3 cr; A-F only. Prereq-8597 or #)

Techniques for analysis of mathematical models. Asymptotic methods; design of simulation and visualization techniques. Specific computation for models arising in industrial problems.

**Math 8390. Topics in Mathematical Physics.** (1-3 cr [max 12 cr]; A-F only. Prereq-8601; offered for one yr or one sem as circumstances warrant)

Current research.

**Math 8401. Mathematical Modeling and Methods of Applied Mathematics.** (3 cr; A-F only. Prereq-4xxx numerical analysis and applied linear algebra or #)

Dimension analysis, similarity solutions, linearization, stability theory, well-posedness, and characterization of type. Fourier series and integrals, wavelets, Green's functions, weak solutions and distributions.

**Math 8402. Mathematical Modeling and Methods of Applied Mathematics.** (3 cr; A-F only. Prereq-8401 or #)

Calculus of variations, integral equations, eigenvalue problems, spectral theory. Perturbation, asymptotic methods. Artificial boundary conditions, conformal mapping, coordinate transformations. Applications to specific modeling problems.

**Math 8431. Mathematical Fluid Mechanics.** (3 cr; A-F only. Prereq-5xxx numerical analysis of partial differential equations or #)

Equations of continuity/motion. Kinematics. Bernoulli's theorem, stream function, velocity potential. Applications of conformal mapping.

**Math 8432. Mathematical Fluid Mechanics.** (3 cr. Prereq-8431 or #)

Plane flow of gas, characteristic method, hodograph method. Singular surfaces, shock waves, shock layers. Viscous flow, Navier-Stokes equations, exact solutions. Uniqueness, stability, existence theorems.

**Math 8441. Numerical Analysis and Scientific Computing.** (3 cr. Prereq-[4xxx analysis, 4xxx applied linear algebra] or #)

Approximation of functions, numerical integration. Numerical methods for elliptic partial differential equations, including finite element methods, finite difference methods, and spectral methods. Grid generation.

**Math 8442. Numerical Analysis and Scientific Computing.** (3 cr. Prereq-8441 or #; 5477-5478 recommended for engineering and science grad students)

Numerical methods for integral equations, parabolic partial differential equations, hyperbolic partial differential equations. Monte Carlo methods.

**Math 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**Math 8445. Numerical Analysis of Differential Equations.** (3 cr; A-F only. Prereq–4xxx numerical analysis, 4xxx partial differential equations or #) Finite element and finite difference methods for elliptic boundary value problems (e.g., Laplace’s equation) and solution of resulting linear systems by direct and iterative methods.

**Math 8446. Numerical Analysis of Differential Equations.** (3 cr; A-F only. Prereq–8445 or #) Numerical methods for parabolic equations (e.g., heat equations). Methods for elasticity, fluid mechanics, electromagnetics. Applications to specific computations.

**Math 8450. Topics in Numerical Analysis.** (1-3 cr [max 12 cr]; A-F only. Prereq–Grad math major or #; offered for one yr or one sem crse as circumstances warrant) Selected topics.

**Math 8470. Topics in Mathematical Theory of Continuum Mechanics.** (1-3 cr [max 12 cr]; A-F only. Prereq–#; offered for one year or one semester as circumstances warrant)

**Math 8501. Theory of Ordinary Differential Equations.** (3 cr; A-F only. Prereq–4xxx ODE or #) Existence, uniqueness, continuity, and differentiability of solutions. Linear theory and hyperbolicity. Basics of dynamical systems. Local behavior near a fixed point, a periodic orbit, and a homoclinic or heteroclinic orbit. Perturbation theory.

**Math 8502. Dynamical Systems and Differential Equations.** (3 cr; A-F only. Prereq–8501 or #) Selected topics: stable, unstable, and center manifolds. Normal hyperbolicity. Nonautonomous dynamics and skew product flows. Invariant manifolds and quasiperiodicity. Transversality and Melnikov method. Approximation dynamics. Morse-Smale systems. Coupled oscillators and network dynamics.

**Math 8503. Bifurcation Theory in Ordinary Differential Equations.** (3 cr; A-F only. Prereq–8501 or #) Basic bifurcation theory, Hopf bifurcation, and method averaging. Silnikov bifurcations. Singular perturbations. Higher order bifurcations. Applications.

**Math 8505. Applied Dynamical Systems and Bifurcation Theory I.** (3 cr; A-F only. Prereq–5525 or 8502 or #) Static/Hopf bifurcations, invariant manifold theory, normal forms, averaging, Hopf bifurcation in maps, forced oscillations, coupled oscillators, chaotic dynamics, co-dimension 2 bifurcations. Emphasizes computational aspects/applications from biology, chemistry, engineering, physics.

**Math 8506. Applied Dynamical Systems and Bifurcation Theory II.** (3 cr; A-F only. Prereq–5587 or #) Background on analysis in Banach spaces, linear operator theory. Lyapunov-Schmidt reduction, static bifurcation, stability at a simple eigenvalue, Hopf bifurcation in infinite dimensions invariant manifold theory. Applications to hydrodynamic stability problems, reaction-diffusion equations, pattern formation, and elasticity.

**Math 8520. Topics in Dynamical Systems.** (1-3 cr [max 12 cr]; A-F only. Prereq–8502, #; offered for one yr or one sem as circumstances warrant) Current research.

**Math 8530. Topics in Ordinary Differential Equations.** (1-3 cr; A-F only. Prereq–8502, #; offered for one year or one semester as circumstances warrant)

**Math 8540. Topics in Mathematical Biology.** (1-3 cr [max 12 cr]; A-F only. Prereq–#) Offered for one year or one semester as circumstances warrant.

**Math 8571. Theory of Evolutionary Equations.** (3 cr; A-F only. Prereq–8502 or #) Infinite dimensional dynamical systems, global attractors, existence and robustness. Linear semigroups, analytic semigroups. Linear and nonlinear reaction diffusion equations, strong and weak solutions, well-posedness of solutions.

**Math 8572. Theory of Evolutionary Equations.** (3 cr; A-F only. Prereq–8571 or #) Dynamics of Navier-Stokes equations, strong/weak solutions, global attractors. Chemically reacting fluid flows. Dynamics in infinite dimensions, unstable manifolds, center manifolds perturbation theory. Inertial manifolds, finite dimensional structures. Dynamical theories of turbulence.

**Math 8580. Topics in Evolutionary Equations.** (1-3 cr [max 12 cr]; A-F only. Prereq–8572 or #; offered for one yr or one semester as circumstances warrant)

**Math 8581. Applications of Linear Operator Theory.** (3 cr; A-F only. Prereq–4xxx applied mathematics or #) Metric spaces, continuity, completeness, contraction mappings, compactness. Normed linear spaces, continuous linear transformations. Hilbert spaces, orthogonality, projections.

**Math 8582. Applications of Linear Operator Theory.** (3 cr; A-F only. Prereq–8581 or #) Fourier theory. Self-adjoint, compact, unbounded linear operators. Spectral analysis, eigenvalue-eigenvector problem, spectral theorem, operational calculus.

**Math 8583. Theory of Partial Differential Equations.** (3 cr; A-F only. Prereq–[Some 5xxx PDE, 8601] or #) Classification of partial differential equations/characteristics. Laplace, wave, heat equations. Some mixed problems.

**Math 8584. Theory of Partial Differential Equations.** (3 cr; A-F only. Prereq–8583 or #) Fundamental solutions/distributions, Sobolev spaces, regularity. Advanced elliptic theory (Schauder estimates, Garding’s inequality). Hyperbolic systems.

**Math 8590. Topics in Partial Differential Equations.** (1-3 cr; A-F only. Prereq–8602; offered for one yr or one sem as circumstances warrant) Research topics.

**Math 8600. Topics in Advanced Applied Mathematics.** (1-3 cr [max 12 cr]; S-N only) Offered for one yr or one semester as circumstances warrant. Topics vary. For details, contact instructor.

**Math 8601. Real Analysis.** (3 cr; A-F only. Prereq–5616 or #) Set theory/fundamentals. Axiom of choice, measures, measure spaces. Borel/Lebesgue measure, integration, fundamental convergence theorems, Riesz representation.

**Math 8602. Real Analysis.** (3 cr; A-F only. Prereq–8601 or #) Radon-Nikodym, Fubini theorems.  $C(X)$ .  $L_p$  spaces (introduction to metric, Banach, Hilbert spaces). Stone-Weierstrass theorem. Basic Fourier analysis. Theory of differentiation.

**Math 8640. Topics in Real Analysis.** (3 cr [max 12 cr]; A-F only. Prereq–8602 or #; offered for one yr or one sem as circumstances warrant) Current research.

**Math 8641. Spatial Ecology.** (3 cr; S-N only. Prereq–Two semesters calculus, theoretical population ecology or four semesters more robust calculus, course in statistics or probability or #) Introduction: role of space in population dynamics and interspecific interaction; includes single species and multispecies models, deterministic and stochastic theory, different modeling approaches, effects of implicit/explicit space on competition, pattern formation, stability diversity and invasion. Recent literature. Computer lab.

**Math 8651. Theory of Probability Including Measure Theory.** (3 cr. Prereq–5616 or #) Probability spaces. Distributions/expectations of random variables. Basic theorems of Lebesgue theory. Stochastic independence, sums of independent random variables, random walks, filtrations. Probability, moment generating functions, characteristic functions. Laws of large numbers.

**Math 8652. Theory of Probability Including Measure Theory.** (3 cr. Prereq–8651 or #) Conditional distributions and expectations, convergence of sequences of distributions on real line and on Polish spaces, central limit theorem and related limit theorems. Brownian motion, martingales and introduction to other stochastic sequences.

**Math 8654. Fundamentals of Probability Theory and Stochastic Processes.** (3 cr. Prereq–8651 or 8602 or #) Review of basic theorems of probability for independent random variables; introductions to Brownian motion process, Poisson process, conditioning, Markov processes, stationary processes, martingales, super- and sub-martingales, Doob-Meyer decomposition.

**Math 8655. Stochastic Calculus with Applications.** (3 cr. Prereq–8654 or 8659 or #) Stochastic integration with respect to martingales, Ito’s formula, applications to business models, filtering, and stochastic control theory.

**Math 8659. Stochastic Processes.** (3 cr. Prereq–8652 or #) In-depth coverage of various stochastic processes and related concepts, such as Markov sequences and processes, renewal sequences, exchangeable sequences, stationary sequences, Poisson point processes, Levy processes, interacting particle systems, diffusions, and stochastic integrals.

**Math 8660. Topics in Probability.** (1-3 cr [max 12 cr]) Offered for one year or one semester as circumstances warrant.

**Math 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq–Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Math 8668. Combinatorial Theory.** (3 cr; A-F only) Basic enumeration, including sets and multisets, permutation statistics, inclusion-exclusion, integer/set partitions, involutions and Polya theory. Partially ordered sets, including lattices, incidence algebras, and Mobius inversion. Generating functions.

**Math 8669. Combinatorial Theory.** (3 cr; A-F only. Prereq–8668 or #) Further topics in enumeration, including symmetric functions, Schensted correspondence, and standard tableaux; non-enumerative combinatorics, including graph theory and coloring, matching theory, connectivity, flows in networks, codes, and extremal set theory.

**Math 8680. Topics in Combinatorics.** (1-3 cr [max 12 cr]; A-F only. Prereq–Grad math major or #; offered as one yr or one sem crse as circumstances warrant) Selected topics.

**Math 8701. Complex Analysis.** (3 cr; A-F only. Prereq–5616 or #) Foundations of holomorphic functions of one variable; relation to potential theory, complex manifolds, algebraic geometry, number theory. Cauchy’s theorems, Poisson integral. Singularities, series, product representations. Hyperbolic geometry, isometries. Covering surfaces, Riemann-Hurwitz formula. Schwarz-Christoffel polygonal functions. Residues.

**Math 8702. Complex Analysis.** (3 cr; A-F only. Prereq–8701 or #) Riemann mapping, uniformization, Dirichlet problem. Dirichlet principle, Green’s functions, harmonic measures. Approximation theory. Complex analysis on tori (elliptic functions, modular functions, conformal moduli). Complex dynamical systems (Julia sets, Mandelbrot set).

**Math 8777. Thesis Credits: Master’s.** (1-18 cr [max 50 cr]; NGA. Prereq–Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Math 8790. Topics in Complex Analysis.** (1-3 cr [max 12 cr]; A-F only. Prereq–8702 or #; offered for one yr or one sem as circumstances warrant) Current research.

**Math 8801. Functional Analysis.** (3 cr; A-F only.

Prereq–8602 or #)

Motivation in terms of specific problems (e.g., Fourier series, eigenfunctions). Theory of compact operators. Basic theory of Banach spaces (Hahn-Banach, open mapping, closed graph theorems). Frechet spaces.

**Math 8802. Functional Analysis.** (3 cr; A-F only.

Prereq–8801 or #)

Spectral theory of operators, theory of distributions (generalized functions), Fourier transformations and applications. Sobolev spaces and pseudo-differential operators. C-star algebras (Gelfand-Naimark theory) and introduction to von Neumann algebras.

**Math 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer; 24 cr required)**Math 8990. Topics in Mathematics.** (1-6 cr [max 24 cr];

S-N only. Prereq–#)

Readings, research.

**Math 8991. Independent Study.** (1-6 cr [max 24 cr];

S-N only. Prereq–#)

Individually directed study.

**Math 8992. Directed Reading.** (1-6 cr [max 24 cr];

S-N only. Prereq–#)

Individually directed reading.

**Math 8993. Directed Study.** (1-6 cr [max 24 cr]; S-N only.

Prereq–#)

Individually directed study.

## Mathematics Education (MthE)

### Department of Curriculum and Instruction

#### College of Education and Human Development

**MthE 5011. Arithmetic Structures in School**

**Mathematics.** (3 cr. Prereq–Enrollment in math init lic program or tchg exper)

Pedagogy, content, and instructional strategies for teaching arithmetic. Content and issues relevant to the K-8 mathematics curriculum. Instructional materials and technology appropriate for elementary or middle school arithmetic. Credit hours and targeted level vary with particular classes.

**MthE 5021. Algebraic Structures in School**

**Mathematics.** (3 cr. Prereq–Tchg exper or #)

Pedagogy, content, and instructional strategies for teaching arithmetic. Content and issues relevant to the algebra curriculum. Instructional materials and technology appropriate for arithmetic. Each offering of the course will focus on either elementary/middle or middle/secondary grade levels.

**MthE 5031. Geometric Structures in School**

**Mathematics.** (3 cr. Prereq–Enrollment in math init lic program)

Pedagogy, content, and instructional strategies for teaching school geometry. Content and issues relevant to the geometry curriculum. Instructional materials and technology appropriate for geometry. Each offering will focus on either elementary/middle or middle/secondary grade levels.

**MthE 5100. Topics in Mathematics Education.** (1-6 cr

[max 12 cr]. Prereq–Ed or grad student)

Issues, materials, and instructional techniques focusing on a single current topic of particular relevance to secondary school and college mathematics teachers.

**MthE 5101. Teaching Elementary School**

**Mathematics.** (3 cr. Prereq–Tchg license or student elem ed or special ed or #)

Modern trends, methods, and materials used to convey mathematical ideas.

**MthE 5155. Rational Number Concepts and**

**Proportionality.** (3 cr. Prereq–Educ student or #)

The relationship between the development of rational number concepts and proportional reasoning skills.

Examination of how newer school curricula treat these concepts. Application of materials in the classroom and analysis of results. Reading and responding to current research.

**MthE 5161. Developing Leadership in School**

**Mathematics.** (3 cr. Prereq–Tchg exper or #)

Current developments in the psychology and pedagogy of mathematics education as related to the evolving nature of mathematics education objectives. Emerging use of technology in the mathematics classroom. Techniques for the development of supervisory abilities. Characteristics of effective staff development.

**MthE 5170. Historical Topics in the Mathematics**

**Classroom.** (1-3 cr)

Historical underpinnings of school mathematics content and methodology. Cross-cultural contributions in the development of mathematical ideas.

Development of lessons, activities, and materials for school use.

**MthE 5171. Teaching Problem Solving.** (3 cr)

Investigation of fundamental concepts and principles of problem solving, reasoning, and proof. Emphasis on activities and applications appropriate for junior and senior high classes. Pedagogical experiences to prepare teachers to teach problem solving, reasoning, and proof in classrooms.

**MthE 5172. Teaching Probability and Statistics.** (3 cr)

Investigation of fundamental concepts and principles of probability and statistics. Emphasis on activities and applications appropriate for junior and senior high school classes. Pedagogical experiences to prepare teachers to integrate quantitative literacy accurately and effectively in classrooms.

**MthE 5174. Ethics, Psychophysical Human**

**Development, and the Internet.** (1 cr)

Investigation of concepts and themes common to ethics, mathematics, physical science, human development, and the Internet. Emphasis on developing understanding of fundamental concepts and principles, on problem solving in a distributed intelligence environment (WWW) and on activities appropriate for K-12 classes.

**MthE 5313. Teaching and Learning Mathematics in**

**the Middle School.** (3 cr. Prereq–Tchg exper or #)

Mathematics learning, instruction methods, mathematical topics, and assessment procedures appropriate for the middle grades. Examination of newer curricular materials. Illustration of successful instructional techniques. Discussion of the relationship between the nature of the learner and effective instruction.

**MthE 5314. Teaching and Learning Mathematics.** (3 cr.

Prereq–Math Ed or MEd or CI MEd or grad student or #)

Methods, materials, and curriculum development. Principles of learning. Review of research. Preparation/evaluation of tests, units, and materials of instruction. Recent developments in mathematics curriculum and in instructional alternatives. Issues in teaching/learning. Program planning/evaluation.

**MthE 5355. Mathematics for Diverse Learners.** (3 cr.

Prereq–Teaching license or student in elem ed or special ed or #)

Mathematical concepts and methods for exceptional students, both low achieving and gifted. Experimental materials and methods designed for underachieving students.

**MthE 5366. Technology-Assisted Mathematics**

**Instruction.** (3 cr)

Technology—including computers, programmable and graphing calculators, and video—as instructional tools in mathematics; design and evaluation of technology-based mathematics lessons; the effect of technology on the mathematics curriculum; managing the technology-enriched classroom.

**MthE 5696. Student Teaching in Mathematics.** (1-8 cr

[max 8 cr]; S-N only. Prereq–MEd/init lic student or #)

Student teaching in secondary school mathematics classes.

**MthE 5993. Directed Studies in Mathematics**

**Education.** (2 cr; S-N only. Prereq–Math ed MEd student, #)

Secondary school classroom teaching project to improve specific teaching skills, planned by student, approved/directed by student's adviser.

**MthE 8501. Theory and Classical Research in**

**Mathematics Education.** (3 cr. Prereq–Grad math educ major)

Critical review of research and relevant theoretical formulations; criteria for appraising research methods; educational implications.

**MthE 8571. Research in Mathematics Education.** (3 cr.

Prereq–5313, 8501)

Designed for advanced graduate students in mathematics education. Presentation and discussion of Ph.D. thesis proposals and other contemporary research.

**MthE 8591. Seminar: Mathematics Education.** (1-3 cr.

Prereq–Math educ PhD student)

Problems of mathematics instruction from kindergarten through junior college; opportunity to develop proposals and design models for empirical research.

**MthE 8995. Problems: Mathematics Education.** (1-3 cr

[max 12 cr]. Prereq–PhD educ major with math educ concentration)

Students survey most recent literature and design and prepare research reports on special topics.

## Mechanical Engineering (ME)

### Department of Mechanical Engineering

#### Institute of Technology

**ME 5080. Topics in Mechanical Engineering.** (4 cr.

Prereq–Upper div IT or grad student, submission of permission form, #)

Topics vary each semester.

**ME 5090. Advanced Engineering Problems.** (1-4 cr.

Prereq–ME upper div, #)

Special investigations in various fields of mechanical engineering and related areas including an independent study project.

**ME 5101. Vapor Cycle Systems.** (4 cr; A-F only. Prereq–IT

upper div or grad student)

Vapor compression and absorption refrigeration systems; heat pumps; vapor power cycle analysis, regeneration, reheat, compound cycle modifications, combines gas turbine—vapor cycle systems.

**ME 5103. Thermal Environmental Engineering.** (4 cr;

A-F only. Prereq–IT upper div or grad, 3322 or 3323)

Thermodynamic properties of moist air; psychrometric charts; HVAC systems; solar energy; human thermal comfort; indoor air quality; heating and cooling loads in buildings.

**ME 5105. HVAC System Design.** (4 cr; A-F only.

Prereq–5103, [IT upper div or grad student])

Design procedures used for heat exchangers, cooling towers, hydronic systems, and air handling systems. HVAC system design for a commercial building.

**ME 5113. Aerosol/Particle Engineering.** (4 cr; A-F only.

Prereq–IT upper div or grad student)

Kinetic theory, definition, theory and measurement of particle properties, elementary particle mechanics, particle statistics; Brownian motion and diffusion, coagulation, evaporation and condensation, sampling and transport.

**ME 5115. Air Quality and Air Pollution Control.** (4 cr;

A-F only. Prereq–IT upper div or grad student)

Air pollution sources, atmospheric transport, transformations, fate, and emissions control. Air pollution meteorology, dispersion, chemistry of secondary pollutant formation, standards and regulation. Control devices and techniques for gaseous and particulate emissions. Cyclones, electrostatic precipitators, wet and dry scrubbers, combustion modification.

**ME 5116. Cleanroom Technology and Particle Monitoring.** (4 cr; A-F only. Prereq—IT upper div or grad student)

Fundamentals of cleanroom technology for microelectronics manufacturing; airborne and liquid-borne particulate contaminants; particle monitors; optical and condensation particle counters, wafer surface scanner, microscopy; filter performance and testing; cleanroom design and operation; high purity systems; particle detection in processing equipment.

**ME 5133. Aerosol Measurement Laboratory.** (4 cr; A-F only. Prereq—IT upper div or graduate student) Principles of aerosol measurement. Single particle analysis by optical and electron microscopy. Aerosol samplers and inertial collectors. Integral mass concentration and number concentration detectors. Size distribution by laser particle counter and differential mobility particle sizer. Aerosol generation and instrument calibration.

**ME 5221. Computer-Assisted Product Realization.** (4 cr; A-F only. Prereq—3221, AEM 3031, CSci 1113, MatS 2001)

Injection molding with emphasis on design of manufacturing processes. Tooling design and specification of processing conditions using computer-based tools; process simulation software and computer-controlled machine tools. Simultaneous process and part design. Production of tooling and parts. Part evaluation.

**ME 5223. Materials in Design.** (4 cr. Prereq—3221) Fundamental properties of engineering materials. Fabrication, treatment. Physical and corrosive properties. Failure mechanism, cost and value analysis as related to material selection and specification.

**ME 5228. Introduction to Finite Element Modeling, Analysis, and Design.** (4 cr; A-F only. Prereq—IT upper div or grad, 3221, AEM 3031, CSci 1113, MatS 2001) Finite elements as principal analysis tool in computer-aided design (CAD); theoretical issues and implementation aspects for modeling and analyzing engineering problems encompassing stress analysis, heat transfer, and flow problems for linear situations. One-, two-, and three-dimensional practical engineering applications.

**ME 5231. Digital and Analog Control Laboratory.** (4 cr; A-F only. Prereq—ME or AEM upper div or grad student, 5281 or equiv)

Lab experiments illustrate and apply control theory to mechanical engineering systems. Emphasis on real-life control design and implementation, including dynamic modeling, controller design, analysis and simulation, hardware implementation, measurement techniques, sensor calibration, data acquisition, and processing.

**ME 5241. Computer-Aided Engineering.** (4 cr; A-F only. Prereq—IT upper div or grad, 3222, CSci 1113 or equiv) Apply computer-aided engineering to mechanical design. Engineering design projects and case studies using computer-aided design and finite element analysis software; design optimization and computer graphical presentation of results.

**ME 5243. Advanced Mechanism Design.** (4 cr; A-F only. Prereq—Upper div IT or grad, 3222 or equiv, basic kinematics and dynamics of machines; knowledge of CAD packages such as Pro-E helpful) Analytical methods of kinematic, dynamic, and kinetoelastodynamic analysis and synthesis of mechanisms. Computerized design for function, path, and motion generation based on Burmeister theory.

**ME 5247. Stress Analysis, Sensing, and Transducers.** (4 cr; A-F only. Prereq—AEM 3031, MatS 2001) Electrical resistance strain gage theory and technology. Gage characteristics, selection, and use. Bridge circuits and temperature and stray strain compensation. Signal conditioning. Data analysis. Photoelasticity techniques. Interpretation of fringe patterns. Sensor principles and performance. Transducer design and characterization.

**ME 5248. Vibration Engineering.** (4 cr. Prereq—Upper div IT or grad, 3281)

Apply vibration theory to design; optimize isolators, detuning mechanisms, viscoelastic suspensions and structures. Use modal analysis methods to describe free vibration of complex systems, relating to both theoretical and test procedures.

**ME 5281. Analog and Digital Control.** (4 cr. Prereq—3281)

Continuous and discrete time feedback control systems. Frequency response, stability, poles and zeros; transient responses; Nyquist and Bode diagrams; root locus; lead-lag and PID compensators, Nicols-Ziegler design method. Digital implementation aliasing; computer-aided design and analysis of control system.

**ME 5286. Robotics.** (4 cr; A-F only. Prereq—[3281 or equiv], [upper div ME or AEM or CSci or grad student]) Manipulator forward/inverse kinematics, homogeneous transformations, coordinate frames, Jacobian/velocity control, task primitives/programming, computational issues. Determining path trajectories. Reaction forces, manipulator dynamics/control. Vehicle kinematics, dynamics, and guidance. Lab project demonstrates concepts.

**ME 5341. Case Studies in Thermal Engineering and Design.** (4 cr; A-F only. Prereq—IT upper div or grad student, 3321, 3322)

Characteristics of applied heat transfer problems: nature of problem specification, incompleteness of needed knowledge base, accuracy issues. Categories of applied heat transfer problems (e.g., materials processing, turbomachinery, cooling of electronic equipment, biomedical thermal therapeutic devices, heat exchangers, HVAC systems).

**ME 5344. Thermodynamics of Fluid Flow with Applications.** (4 cr; A-F only. Prereq—3321, 3322, [IT upper div or grad student])

Conservation of mass, momentum, and energy for compressible gas flows. Relevant thermodynamic properties. Nozzles, diffusers, thrust producers, shocks. Fluid-wall frictional interactions. Wall heat transfer, internal heat release. Temperature recovery. Mass addition. Chemical thermodynamics/applications.

**ME 5348. Heat Transfer in Electronic Equipment.** (4 cr. Prereq—Upper div IT or grad student, 3322 or 3324)

Technology trends and packaging needs of microelectronic components; thermal characteristics, heat transfer mechanisms, and thermal failure modes of modern electronic and microelectronic equipment; reliability prediction techniques; thermal stress and strain in layered structures and solder joints.

**ME 5351. Computational Heat Transfer.** (4 cr; A-F only. Prereq—IT upper div or grad student, 3322)

Numerical solution of heat conduction and analogous physical processes. Develop and use a computer program to solve complex problems involving steady and unsteady heat conduction, flow and heat transfer in ducts, flow in porous media, and other special applications.

**ME 5361. Plasma-Aided Manufacturing.** (4 cr; A-F only. SEE 5611. Prereq—Upper div IT or grad student, 3321, 3322 or equiv)

Properties of plasmas as a processing medium, process control and system design considerations using specific examples of plasma spray coating, welding, and microelectronics processing.

**ME 5381. Biological Transport Processes.** (4 cr; A-F only. \$ChEn 5753, \$BMEn 5310. Prereq—Upper div IT or grad student, transport class [3322 or ChEn 5103] or #) Fluid, mass, and heat transport in biological systems. Mass transfer across membranes, fluid flow in capillaries, interstitium, veins and arteries. Biotransport issues in single cells and tissues, artificial organs, membrane oxygenators, and drug delivery applications.

**ME 5446. Introduction to Combustion.** (4 cr; A-F only. Prereq—Upper div IT or grad student, 3321, 3322) Thermodynamics, kinetics, energy and mass transport, and pollutants in reacting systems. Reactors, laminar and turbulent flames. Ignition, quenching, and flame stability. Diffusion flames. Combustion in reciprocating engines, furnaces, and turbines, with emphasis on internal combustion engine performance and emissions.

**ME 5461. Internal Combustion Engines.** (4 cr; A-F only. Prereq—IT upper div or grad student, C or better in 3322 or 3324)

Basic spark ignition and diesel engine principles, air, fuel-air and actual engine cycles, cycle modeling, combustion and emissions, knock phenomena, air flow and volumetric efficiency, mixture requirements, ignition requirements and performance. Lectures and complementary labs.

**ME 5462. Gas Turbines.** (4 cr; A-F only. Prereq—Upper div IT or grad student, 3321, #3322)

Gas turbine cycles, regeneration, recuperation, reheat, intercooling, combined cycle plants, and thermochemical regeneration. Axial and radial flow compressors and turbines; combustor designs, energy analysis, emissions, and noise. Turbojet, fanjet, turboprop engine performance. Stationary power plants, vehicular propulsion, hybrid vehicles.

**ME 8113. Advanced Aerosol/Particle Engineering.** (3 cr; A-F only. Prereq—IT grad student or #)

Introduction to kinetic theory, definition, theory, and measurement of particle properties; elementary particle mechanics, particle statistics; Brownian motion and diffusion, coagulation, evaporation and condensation, sampling, and transport.

**ME 8221. New Product Design and Business Development I.** (4 cr; A-F only. \$Entr 6087. Prereq—IT grad student, some design experience)

Students and faculty work with company representatives to develop a product concept, a working physical prototype, and an extensive business plan. Concept design, detail design, manufacturing, marketing, introduction strategy, and profit forecasting. Sponsoring company intends to bring product to market. ME 8222 must be taken in sequence the same year.

**ME 8222. New Product Design and Business Development II.** (4 cr; A-F only. \$Entr 6087. Prereq—8221)

Students and faculty work with company representatives to develop a product concept, a working physical prototype, and an extensive business plan. Concept design, detail design, manufacturing, marketing, introduction strategy, and profit forecasting. Sponsoring company intends to bring product to market. Must be taken in sequence with 8221 the same year.

**ME 8228. Finite Elements in Multidisciplinary Flow/Thermal/Stress and Manufacturing Applications.** (4 cr; A-F only. Prereq—3222, 5341, AEM 3031, CSci 1113)

Multidisciplinary and coupled effects involving flow/heat transfer/stress. In-depth understanding of modeling and analysis in each discipline. Coupling multi-disciplines for engineering problems. Applications to manufacturing and process modeling of, e.g., metals, alloys, polymers.

**ME 8229. Finite Element Methods for Computational Mechanics: Transient/Dynamic Problems.** (4 cr; A-F only. Prereq—5228 or equiv, 5341, AEM 3031, CSci 1113)

Computational mechanics involving transient or dynamic situations; development and analysis of computational algorithms. Stability and accuracy of algorithms, convergence issues; linear/nonlinear situations. Implicit, explicit, mixed, and variable time discretization approaches; modal-based methods for engineering problems

**ME 8243. Topics in Design.** (4 cr [max 12 cr]; A-F only. Prereq—5243)

Topics vary with each offering.

**ME 8262. Topics in Modeling and Analysis of Manufacturing Processes.** (4 cr [max 12 cr]; A-F only. Prereq-3221, AEM 3016)

Advanced topics in Manufacturing. Analytical/numerical modeling of manufacturing processes. Use of computer-based modeling tools and computer controlled manufacturing machines. Comparison of predictions/measurements of process variables and part characteristics. Part production/testing. Processes, technologies, and topics vary with each offering.

**ME 8281. Advanced Control System Design.** (4 cr; A-F only. Prereq-5281)

Loop Shaping. Review of controllability/observability. LQR/LQG/LTR. Repetitive control. Input shaping. Tracking control (feedforward, precompensation). Lyapunov stability. System identification.

**ME 8282. Control of Nonlinear Systems.** (4 cr; A-F only. Prereq-5281)

Introduction to nonlinear systems, bifurcations, chaos, Lyapunov stability. Input-output stability (circle theorem, passivity, Lure'). Input-output and input-state feedback linearization. Lyapunov-based design. Sliding surface control, dynamic surface control. Parameter identification (least squares, gradient, etc). Lyapunov-based adaptive control, integrator backstepping, singular perturbations.

**ME 8287. Topics in Dynamics and Control.** (4 cr [max 12 cr]; A-F only. Prereq-5281)

Topics vary with each offering.

**ME 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**ME 8337. Experimental Methods in the Thermal Sciences.** (3 cr; A-F only)

Planning experiments. Uncertainty, qualification, visualization, analogies. Temperature, pressure, heat flux, and flow measurements. Signal processing and analysis. Introduction to optical diagnostics.

**ME 8341. Advanced Heat Transfer I.** (3 cr. Prereq-3322, IT grad student)

Fundamentals of heat conduction and thermal radiation. Analytical treatment of heat conduction in steady/unsteady problems. Solution of governing equations by separation of variables and by other methods. Basic concepts of radiation, blackbody radiation, and radiative properties. Radiation heat transfer in enclosures and in radiatively participating media such as flames, plasmas, and aerosols.

**ME 8342. Advanced Heat Transfer II.** (3 cr; A-F only. Prereq-8341)

Heat transfer in fluids flowing around bodies and in tubes/ducts. Forced/natural convection. Laminar/turbulent flow regimes. Turbulent transport and modeling. High-speed flows, viscous dissipation, variable property effects. Application to heat exchange devices. Convective mass transfer.

**ME 8345. Computational Heat Transfer and Fluid Flow.** (3 cr. Prereq-IT grad student)

Finite volume method for solution of governing equations for heat transfer and fluid flow. Mathematical models of turbulence. Construction of general computer program. Practical applications.

**ME 8361. Molecular Gas Dynamics.** (3 cr; A-F only. Prereq-IT grad student)

Kinetic theory of gases, Boltzmann equation, Maxwell-Boltzmann distribution, collisions, transport properties. Introduction to quantum mechanics. Statistical thermodynamics, classical/quantum statistics. Partition functions and thermodynamic properties. Irreversible thermodynamics.

**ME 8362. Introduction to Plasma Technology.** (3 cr; A-F only. Prereq-8361)

Fundamentals of gaseous plasmas. Thermal/nonequilibrium plasmas. Types of plasma generation. Electron energy distribution function. Sheaths, glow discharges, electric arcs, RF plasmas. Steady/unsteady plasmas. Plasma heat transfer. Plasma diagnostics.

**ME 8381. Bioheat and Mass Transfer.** (3 cr. Prereq-IT grad student, upper-division transport/fluids course; [physics, biology] recommended)

Analytical/numerical tools to analyze heat/mass transfer phenomenon in cryobiological, hyperthermic, other biomedically relevant applications.

**ME 8390. Advanced Topics in the Thermal Sciences.** (1 cr [max 3 cr]; A-F only)

Topics vary according to instructor.

**ME 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**ME 8462. Turbomachinery.** (3 cr; A-F only. Prereq-IT grad student, 3321, 3322 or equiv or #)

Thermodynamic analysis of energy transfer between fluid and rotor; dimensional analysis; principles of axial, mixed, and radial flow pumps, fans, compressors, and turbines; cascade performance; computer flow simulations; applications to propulsion systems and power plants.

**ME 8646. Reacting Flows.** (3 cr; A-F only. Prereq-8361)

Introduction to simple methods for thermophysical data estimation. Principles/application of chemical kinetics. Simulation of homogeneous/heterogeneous kinetics, including transport. Principles applied to problems in combustion and materials processing (CVD, plasma processing) through computer exercises employing CHEMKIN suite of programs.

**ME 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**ME 8772. Advanced Transportation Technologies Seminar.** (1 cr; S-N only)

Advanced technologies specifically related to transportation. Topics draw from core science/technology areas of human factors, intelligent vehicles, traffic modeling/management, sensing, communications, and controls.

**ME 8773. Graduate Seminar.** (1 cr; S-N only. Prereq-IT grad student)

Recent developments.

**ME 8774. Graduate Seminar.** (1 cr; S-N only. Prereq-8773)

Recent developments.

**ME 8775. Technical Communication.** (1 cr; S-N only)

One-day workshop on presenting a seminar. Students deliver one-hour seminar on technical topic and attend nine other technical seminars.

**ME 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**ME 8794. Mechanical Engineering Research.** (1-6 cr [max 10 cr]. Prereq-#)

Directed research.

**ME 8800. Modern Developments in Mechanical Engineering.** (1 cr [max 2 cr]; S-N only. Prereq-IT grad student)

Seminars on topics in engineering science of importance to mechanical engineers. Invited scholars deliver five-lecture series on each topic; two to five topics each semester.

**ME 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

**ME 8951. Plan B.** (1 cr; S-N only)

Structured environment in which students can complete a M.S. Plan B project.

**ME 8953. Plan B.** (2 cr; A-F only. Prereq-8951)

Structured environment in which students can complete a M.S. Plan B project.

## Medicinal Chemistry (MedC)

*Department of Medicinal Chemistry  
College of Pharmacy*

**MedC 5185. Principles of Biomolecular Simulation.** (3 cr. Prereq-Chem 3502 or #)

Molecular simulation for students in medicinal chemistry, pharmaceuticals, biochemistry, and chemical physics

**MedC 5200. The New Drug Development Process.** (1 cr; A-F only)

New drug development process in the U.S. pharmaceutical industry.

**MedC 5202. Research and Development Process of Pharmaceutical Products.** (2 cr; S-N only)

New drug development process in the U.S. pharmaceutical industry

**MedC 5245. Introduction to Drug Design.** (3 cr; A-F only. Prereq-Chem)

Concepts that govern design/discovery of drugs. Physical, bioorganic, medicinal chemical principles applied to explain rational design, mechanism of action drugs.

**MedC 5494. Advanced Methods in Quantitative Drug Analysis.** (3 cr; A-F only. Prereq-#)

Quantitative methods (HPLC, GC, TLC, and immunoassays) for analysis of drugs and metabolites in biological fluids. Advanced techniques such as capillary electrophoresis, supercritical fluid chromatography, GC-MS, LC-MS, and tandem mass spectrometry. Chromatographic theory and statistical approaches to method validation.

**MedC 5495. Vistas in Medicinal Chemistry Research.** (1 cr; S-N only)

Selected topics of contemporary interest in medicinal chemistry

**MedC 5600. General Principles of Medicinal Chemistry.** (3 cr; A-F only. Prereq-MedC grad student or #)

Fundamental principles of drug receptors as therapeutic targets, drug-receptor interactions, enzyme inhibitors, drug metabolism and disposition.

**MedC 8100. Medicinal Chemistry Seminar.** (1 cr [max 6 cr]. Prereq-Grad med chem major or #)

Current topics.

**MedC 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**MedC 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**MedC 8500. Design of Chemotherapeutic Agents.** (2 cr; A-F only. Prereq-5600 or #)

Modern aspects of designing chemotherapeutic agents. Strategies for enzyme inhibition and metabolic blocks in development of anticancer, antimicrobial, and antiviral agents.

**MedC 8600. Chemical Aspects of Drug Metabolism and Bioactivation.** (2 cr; A-F only. Prereq-5600 or #)

Chemical and enzymatic mechanisms of biotransformation and bioactivation of drugs and other xenobiotics. Reactivity and fate of bioactivated metabolites.

**MedC 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**MedC 8700. Advanced Concepts in Drug Design.** (2 cr; A-F only. Prereq-5600 or #)

Current approaches to rational design of drugs.

**MedC 8760. Design of Peptidomimetics.** (2 cr; A-F only. Prereq-5600 or #)

Current approaches to design and synthesis of mimetics of biologically active peptides. Structural and conformational rationale used in peptidomimetic design.

**MedC 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**MedC 8800. Medicinal Chemistry Laboratory Techniques.** (1-2 cr [max 4 cr]; S-N only. Prereq—Grad med chem major or #)  
Experimental rotations in medicinal chemistry research laboratories.

**MedC 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

**MedC 8900. Research in Medicinal Chemistry.** (1-4 cr [max 8 cr]; A-F only. Prereq—Grad med chem major or #)  
Study and experimental investigation.

## Medieval Studies (MeSt)

*Center for Medieval Studies*  
*College of Liberal Arts*

**MeSt 5610. Advanced Topics in Medieval Studies.** (3-4 cr [max 15 cr]. Prereq—One yr work in some area of Middle Ages, reading knowledge of appropriate language)  
From late antiquity through end of Middle Ages (circa 300-1500 A.D.). Current topics specified in *Class Schedule*.

**MeSt 5993. Directed Studies in Medieval Studies.** (3 cr [max 6 cr]. Prereq—One yr work in some area of Middle Ages, reading knowledge of appropriate language, #)  
Directed study with one of the core faculty of medieval studies program.

**MeSt 8010. Medieval Studies Colloquium.** (1 cr [max 3 cr]; S-N only. Prereq—#)  
Lectures by and discussions with faculty and visiting speakers.

**MeSt 8110. Seminar in Medieval Studies.** (3-4 cr [max 48 cr]; A-F only. Prereq—Appropriate languages, #)  
Offered when feasible.

## Microbiology, Immunology, and Cancer Biology (MICa)

*Department of Microbiology*  
*Medical School*

**MICa 5000. Practicum: Teaching.** (1 cr [max 4 cr]; A-F only. Prereq—[MIMP or MICa] grad major or #)  
Supervised experience in lab instruction. Use of instructional materials, tests/measurement.

**MICa 8001. Integrated Topics in Microbiology, Immunology, and Cancer Biology.** (3 cr; A-F only. Prereq—MICa grad student or #)  
Molecular, structural, and biochemical complexity of microbes. Molecular mechanisms of disease. Cell death/injury. Adaptive immune responses, immunological tolerance.

**MICa 8002. Structure, Function, and Genetics of Bacteria and Viruses.** (4 cr; A-F only. Prereq—8001 or #)  
Structure, function, and metabolism of microorganisms; microbial genetics; molecular virology.

**MICa 8003. Immunity and Immunopathology.** (4 cr. Prereq—8001 or #)  
Lymphocyte activation, signal transduction in lymphocytes, antigen receptor genetics, antigen presentation, lymphoid anatomy, adaptive immune responses to microbes, immunodeficiency, immunopathology, cytokines, transplantation, and autoimmunity.

**MICa 8004. Cellular and Cancer Biology.** (4 cr; A-F only. Prereq—8001 or GCB 8132 or #)  
Fundamental concepts in cellular, molecular, and genetic basis of disease. Molecular basis of inflammation and cancer metastasis. Genetic basis for inherited disorders and gene therapy. Molecular mechanisms of pathogenesis.

**MICa 8005. Topics in Microbiology, Immunology, and Molecular Pathobiology.** (1-4 cr. Prereq—8001, two of 8002 or 8003 or 8004)  
Colloquium format with in-depth readings and discussion on a specialized topic.

**MICa 8006. Protein Sequence Analysis.** (3 cr. Prereq—Biochem course, knowledge of UNIX operating system recommended)  
DNA and protein sequence and protein structure databases; protein sequence analysis; methods for display of sequence comparison and prediction results; Genetics Computer Group (GCG) sequence analysis programs; and current literature and research problems.

**MICa 8007. Cell Biology and Biochemistry of the Extracellular Matrix.** (3 cr; A-F only. Prereq—8002 or 8004 or #)  
Concepts in cell adhesion and tissue composition and importance of cell adhesion in tissue function and disease. Topics range from structure/function/assembly of tissue components to cellular adhesion mechanisms.

**MICa 8008. Mammalian Gene Transfer and Expression.** (2 cr; A-F only. Prereq—#)  
Current gene transfer technology. Applications of genetic modifications in animals, particularly transgenic animals and human gene therapy.

**MICa 8009. Biochemical Aspects of Normal and Abnormal Cell Growth and Cell Death.** (2 cr. Prereq—8004 or [BioC 3021, Biol 4004] or #)  
Aspects of mechanisms involved in growth control at level of nuclear function. Neoplasia in hormonal cancers (such as prostate cancer) and role of protein phosphorylation in normal and abnormal growth. Mechanisms of cell death via apoptosis and its implications in normal and abnormal proliferation.

**MICa 8010. Microbial Pathogenesis.** (3 cr; A-F only. Prereq—MICa grad student or #)  
Molecular mechanisms of bacterial/viral pathogenesis. Strategies of disease causation/interaction with host, regulation of virulence factors, mechanism of virulence factor transmission to other microbes.

**MICa 8011. Current Topics in Immunology.** (3 cr; A-F only. Prereq—MICa 8003 or #)  
Colloquium format. In-depth reading, discussion

**MICa 8094. Research in Microbiology, Immunology, and Cancer Biology.** (1 cr [max 5 cr]; S-N only. Prereq—1st yr MICa grad student)  
One-on-one research training from faculty adviser during laboratory rotation.

**MICa 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**MICa 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**MICa 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**MICa 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**MICa 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

**MICa 8910. Seminar: Faculty Research Topics.** (1 cr [max 10 cr]; S-N only. Prereq—[MIMP or MICa] grad student or #)  
State-of-the-art information presented by scientific experts within/outside the University.

**MICa 8920. Seminar: Student Research Topics.** (1 cr

[max 10 cr]; S-N only. Prereq—[MIMP or MICa] grad student or #)  
Current thesis topics and other aspects of microbiology, immunology, and cancer biology.

## Microbial Engineering (MicE)

*BioTechnology Institute*  
*College of Biological Sciences*

**MicE 5309. Biocatalysis and Biodegradation.** (3 cr. Prereq—Chem through organic chem, microbial or adv chem, knowledge of word proc, e-mail, WWW access; access to college-level sci library recommended)  
Assessing validity of information on biocatalysis and biodegradation; fundamentals of microbial catabolic metabolism as it pertains to biodegradation of environmental pollutants; biocatalysis for specialty chemical synthesis; display of this information on the World Wide Web.

**MicE 5355. Advanced Fermentation and Biocatalysis Laboratory.** (3 cr; A-F only. Prereq—[Biol 3301 or MicB 3301], [grad student in microbial engineering or upper-div major in [microbiology or chem engineering or biochemistry]], #)  
Methods in industrial microbiology, laboratory, and pilot scale fermentation/biocatalysis engineering. Laboratory experiments carried out in fermentation pilot plant. Operation of bench scale and pilot scale bioreactors, designing bioreactors, process optimization, process monitoring/control, scale-up experiments, experimental design, data analysis.

**MicE 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**MicE 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**MicE 8920. Teaching Practicum.** (1 cr [max 4 cr]. Prereq—Grad MicE major)  
Supervised experience in classroom, laboratory, and/or recitation instruction; develops skills in effective use of instructional techniques, materials, tests, and measurements.

**MicE 8990. Biotechnology Seminar.** (1 cr [max 2 cr]. Prereq—First-yr students regis S-N, as they do not make a presentation; second-yr students regis A-F, as they present a seminar)  
Student presentations of thesis research and presentations by invited speakers.

## Microbiology (MicB)

*Department of Microbiology*  
*Medical School*

**MicB 5205. Microbiology and Immunology for Medical Students.** (0-7 cr)  
Basic/clinical human immunology, medical microbiology. Molecular/cellular basis of immune responses, tolerance. Immunologic disease, serology, antimicrobial agents, chemotherapy. Basic/medical bacteriology, parasitology, mycology, virology. Unifying principles governing pathogenesis. Diseases are grouped with organisms important in differential diagnosis.

## Middle Eastern Languages and Cultures (MELC)

*Institute of Linguistics, ESL, and Slavic Languages and Literatures*  
*College of Liberal Arts*

**MELC 5311. Medieval Sages.** (3 cr. \$CAS 5311. Prereq—Background in Iranian, Central Asian, or Islamic studies recommended)  
Study and discussion of the intellectual life of the region from the rise of the Ghaznavids (A.D. 1000) to the fall of the Timurids (A.D. 1500). Ibn Sina (Avicenna), al-Biruni, al-Ghazali, Rumi, Sa'di, and Firdowsi are among the sages whose lives are examined.

**MELC 5526. Islam and Communism.** (3 cr. \$3526, \$CAS 5526)  
Development of medieval Islamic culture in Transoxiana; formation of Sufi orders; rise and development of Communist ideology; introduction of socialist principles into Central Asia; clash of Islamic principles with Communist dicta; Pan-Islamism; Pan-Turkism.

**MELC 5532. Russia and Central Asia.** (3 cr. \$3532, \$CAS 5532)  
Rise and fall of the Mongol Empire, formation of the Chagatai Khanate and the Golden Horde. Russian expansion into Central Asia and rivalry with Britain. Russia and the Central Asian republics during and after the Soviet period.

**MELC 5601. Persian Fiction in Translation.** (3 cr. \$3601, \$CAS 3601, \$CAS 5601)  
Impact of westernization on Iran, from 1920s to present. Materials produced by Iranian writers, film makers, and intellectuals. Internal/external forces that bind contemporary Iranian society to world civilization. Works of Hedayat (especially *Blind Owl*), Chubak, Al-i Ahmad, Daneshvar, and Behrangi are analyzed/interpreted.

**MELC 5602. Persian Poetry.** (3 cr. \$3602, \$CAS 5602)  
Major poetic works of Iran dealing with life at the medieval courts, Sufic poetry, and "new" poetry are studied. Rudaki, Khayyam, Rumi, Hafiz, Yushij, and Farrukhzad are among the poets whose works are examined.

**MELC 5993. Directed Studies.** (1-10 cr. Prereq—#, Δ, □)

**MELC 5994. Directed Research.** (1-10 cr. Prereq—#, Δ, □)

## Molecular, Cellular, Developmental Biology and Genetics (MCDG)

*College of Biological Sciences*

**MCDG 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**MCDG 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**MCDG 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**MCDG 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**MCDG 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

**MCDG 8900. Student Research Seminar.** (1 cr [max 10 cr]; S-N only. Prereq—Grad MCDG major or Δ)  
Presentation and discussion of student thesis research.

**MCDG 8910. Journal Presentations.** (1 cr [max 2 cr]; S-N only. Prereq—Grad MCDG major or Δ)  
Discussion of original scientific literature; for first-year graduate students.

**MCDG 8920. Special Topics.** (1-4 cr [max 8 cr]. Prereq—Grad MCDG major or Δ)

**MCDG 8950. Teaching Practicum.** (1 cr [max 2 cr]; S-N only. Prereq—Grad MCDG major or Δ)  
Supervised experience in classroom, laboratory, and/or recitation instruction; development of skills in effective use of instructional techniques, materials, tests, and measurements.

**MCDG 8993. Directed Studies.** (1-5 cr [max 15 cr]. Prereq—MCDG grad student or #)  
Directed Studies.

**MCDG 8994. Research.** (1-5 cr [max 10 cr]; S-N only. Prereq—MCDG grad student or #)  
Independent research determined by student's interests, in consultation with faculty mentor.

## Molecular Veterinary Bioscience (MVB)

*Department of Veterinary Pathobiology*  
*College of Veterinary Medicine*

**MVB 5200. Statistical Genetics and Genomics.** (4 cr; A-F only)  
Statistical issues in genomics. Gene detection, including statistical analysis/designs for linkage study and for mapping quantitative trait loci. Linkage analysis using pedigree data for codominant/dominant markers. Using radiation hybrid mapping/single cell typing. Design issues in linkage analysis, parentage testing, and marker polymorphism.

**MVB 5594. Directed Research in Molecular Veterinary Biosciences.** (1-4 cr [max 4 cr]; A-F only. Prereq—Jr)  
Special project, addressing specific issue in veterinary medicine, under guidance of faculty member.

**MVB 8100. Research Rotation in Molecular Veterinary Biosciences.** (4 cr [max 8 cr]; A-F only. Prereq—1st yr MVB grad student)  
Directed research laboratory rotations. Experimentation, supplemental reading, research presentations under guidance of faculty member who is potential thesis adviser. Taught by program faculty.

**MVB 8134. Ethical Conduct of Animal Research.** (2 cr; A-F only. Prereq—[Grad or professional school] student or #)  
Ethical considerations in the use of animal subjects in agricultural, veterinary, and biomedical research. Federal, state, and University guidelines relating to proper conduct for acquisition/use of animals for laboratory, observational, epidemiological, and clinical research. Regulatory requirements. Bases for proper conduct. Societal impact on scientific investigations utilizing animal subjects.

**MVB 8201. Mechanisms of Animal Health and Disease I.** (3 cr; A-F only. Prereq—1st yr MVB grad student or approval of crse coordinator)  
Basic mechanisms of animal health. Innate/acquired immunity. Immune avoidance. Cellular basis for pathogenesis of animal diseases. Molecular/genetic mechanisms of host resistance. Host/pathogen interactions.

**MVB 8202. Mechanisms of Animal Health and Disease II.** (3 cr. Prereq—8201)  
Multi-perspective approach to critically evaluating journal articles, as done for peer-reviewed journals. Aspects of host/pathogen interactions, including molecular/genetic mechanisms of host resistance and pathogenesis.

**MVB 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**MVB 8335. Molecular Biology Techniques.** (3 cr. Prereq—Biol 5001, Biol 5003 or equiv or #)  
Basic theory and current methodologies of molecular biology and recombinant DNA technology. Lab work includes DNA and RNA hybridization, gene transfer, and polymerase chain reaction techniques. Primarily for students with limited exposure to molecular biology.

**MVB 8351. Drug-Receptor Interactions.** (2 cr; A-F only. Prereq—[Chem 1011-1012 or equiv, CVM 6055 or equiv, calculus through differential equations] or #)  
Dynamics of interaction between drugs and their receptors. Historical development of drug-receptor theory, factors affecting drug concentration in receptor compartment, determination of agonist and antagonist activity, pharmacodynamics of recombinant receptors, and functional receptor classification.

**MVB 8361. Neuro-Immune Interactions.** (3 cr. Prereq—[MicB 5218 or equiv], [NSc 5561 or equiv])  
Regulatory systems (neuroendocrine, cytokine, and autonomic nervous systems) linking brain and immune systems in brain-immune axis. Functional effects of bidirectional brain-immune regulation. Course is offered fall of even-numbered years.

**MVB 8394. Research in Comparative Biomedical Sciences.** (1-6 cr [max 18 cr]. Prereq—Grad MVB major)  
Directed research determined by student's interests, in consultation with faculty mentor.

**MVB 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**MVB 8494. Research in Molecular Mechanisms of Disease.** (1-6 cr [max 18 cr]. Prereq—Grad MVB major)  
Directed research determined by student's interests, in consultation with faculty mentor.

**MVB 8550. Molecular Veterinary Biosciences Seminar.** (1 cr [max 8 cr]; S-N only. Prereq—Biol sciences grad student)  
Student and faculty presentations of their own research or a directed topic.

**MVB 8560. Research and Literature Reports.** (1 cr [max 8 cr]; S-N only. Prereq—Grad MVB major or #)  
Current developments in cellular and molecular mechanisms of animal health and disease.

**MVB 8570. Comparative Biomedical Sciences Seminar.** (1 cr [max 8 cr]; S-N only. Prereq—Biol sciences grad student)  
Weekly seminar by primarily outside speakers discussing current issues.

**MVB 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**MVB 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**MVB 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

## Museum Studies (MSt)

*Bell Museum of Natural History*

**MSt 5011. Museum History and Philosophy.** (3 cr; A-F only. Prereq—#)  
Historical and philosophical roots of museum development in Europe and North America from the Renaissance to modern day museums and history centers. Emerging philosophical issues faced by museums today.

**MSt 5012. Museum Practices.** (3 cr; A-F only. Prereq—5011 or #)  
Practical aspects of museum work. Standards, practices, responsibilities, and issues, all set in greater museum context. Curatorial and educational duties, collections management, security, funding, boards, public relations, installation, and budgeting.

**MSt 5020. Internship.** (1-4 cr [max 32 cr]; S-N only. Prereq-5011, 5012, Δ)  
Students arrange to perform a professional-level task in a museum of good standing under close supervision of a member of the museum's professional staff. Instructor must approve a work plan and report.

**MSt 8993. Directed Study in Museum Studies.** (1-4 cr [max 16 cr]; A-F only. Prereq-[5012 or ¶5012], #, Δ)  
Study by a student, largely self directed with consultation of a faculty member, on a topic not covered (or not covered in depth) by another course. Program of study is determined jointly by student and advising faculty member.

## Music (Mus)

### School of Music

#### College of Liberal Arts

**Mus 5101. Piano Pedagogy I.** (2 cr. Prereq-8 cr in MusA 1301 or MusA1401 or #)  
Demonstration and discussion of teaching techniques, methods, and materials for group and individual instruction at the elementary, early intermediate, and late intermediate levels.

**Mus 5102. Piano Pedagogy II.** (2 cr. Prereq-8 cr in MusA 1301 or MusA 1401 or #)  
Demonstration and discussion of teaching techniques, methods, and materials for group and individual instruction at the elementary, early intermediate, and late intermediate levels.

**Mus 5111. Advanced Piano Pedagogy I.** (2 cr; A-F only. Prereq-5102 or grad piano major or #)  
Demonstration and discussion of teaching techniques, methods, and materials for group and individual instruction at the intermediate and early advanced levels.

**Mus 5112. Advanced Piano Pedagogy II.** (2 cr; A-F only. Prereq-5101 or grad piano major or #)  
Demonstration and discussion of teaching techniques, methods, and materials for group and individual instruction at the intermediate and early advanced levels.

**Mus 5120. Piano Pedagogy Practicum.** (1 cr [max 4 cr]; A-F only. Prereq-5101-5102 or 5111-5112 or #)  
Supervised teaching of a piano pupil or group of pupils for one semester (minimum 12 weeks for one half-hour per week). Supervising instructor will assist with selection of materials, periodic consultation, and observation (live or video taped) of selected lessons.

**Mus 5131. Advanced Keyboard Skills I.** (2 cr; A-F only. Prereq-3502, sr or grad)  
Diatonic and chromatic harmony at the piano. Realization of figured basses of the 17th and 18th centuries. Performance of choral, orchestral, and chamber music of the 17th to 20th centuries, from open score using all clefs.

**Mus 5132. Advanced Keyboard Skills II.** (2 cr; A-F only. Prereq-3502, sr or grad)  
Diatonic and chromatic harmony at the piano. Realization of figured basses of the 17th and 18th centuries. Performance of choral, orchestral, and chamber music of the 17th to 20th centuries, from open score using all clefs.

**Mus 5141. Piano Literature.** (2 cr; A-F only. Prereq-12 cr of MusA 1301 or MusA 1401 or #)  
Introductory survey of representative keyboard literature from the Baroque to the mid-20th century. Study of typical forms, style features, technical issues, and performance practice for each period.

**Mus 5150. Body Awareness in Activity: The Alexander Technique for Musicians.** (2 cr [max 4 cr])  
Alexander technique with specific applications to music performance. Emphasis on body/mind awareness to promote technical ease and freedom.

**Mus 5151. Organ Literature I.** (3 cr; A-F only. Prereq-3502, 3603, sr or grad or #)  
Organ literature from the 14th century to the mid-18th century. Influence of organ design of various periods and national schools on the literature and its performance.

**Mus 5152. Organ Literature II.** (3 cr; A-F only. Prereq-3502, 3603, sr or grad or #)  
Organ literature of J. S. Bach and of other 19th- and 20th-century composers. Influence of organ design of various periods and national schools on the literature and its performance.

**Mus 5160. Instrumental Accompanying Skills and Repertoire.** (2 cr [max 4 cr]; A-F only. Prereq-Accomp major)  
Performance class in accompanying skills particular to orchestral reductions and non-sonata instrumental accompanying. Repertoire to include, but not be limited to, classical and romantic string concerti, and "encore" pieces.

**Mus 5170. Vocal Accompanying Skills and Repertoire.** (2 cr [max 4 cr]; A-F only. Prereq-French, German and Italian diction, accomp or grad vocal major)  
Performance class (Lieder, melodie, opera) with emphasis on coaching techniques and performance skills of pianists and singers.

**Mus 5181. Advanced Piano Literature I.** (2 cr; A-F only. Prereq-Grad piano maj or #)  
Literature for piano from late Baroque period to mid-20th century.

**Mus 5182. Advanced Piano Literature II.** (2 cr; A-F only. Prereq-Grad piano major or #)  
Literature for piano from late Baroque period to mid-20th century.

**Mus 5230. Chorus.** (1 cr [max 8 cr]. Prereq-Choral and/or instrumental music background; audition, #)  
University Women's Chorus, Men's Chorus, Concert Choir and Choral Union. Choirs participate in a variety of programs exploring both Western and non-Western repertoire from the Middle Ages through the 20th century. Concerts include touring, and collaborative campus and community performances.

**Mus 5240. Chamber Singers.** (1 cr [max 8 cr]; A-F only. Prereq-Audition, #)  
Mixed chorus of about 24 voices. Performances each semester of works for small choirs.

**Mus 5241. Vocal Literature I.** (3 cr; A-F only. Prereq-[12 cr in MusA 1304, grad music student] or #)  
Vocal literature of major/minor composers from 17th century to present. Structure, style, performance practice.

**Mus 5242. Vocal Literature II.** (3 cr; A-F only. Prereq-[12 cr in MusA 1104 or MusA 1304, grad music major] or #)  
Vocal literature of major and minor composers from 17th century to present; structure, style, and performance practice.

**Mus 5250. Opera Workshop and Ensemble.** (1 cr [max 8 cr]; A-F only. Prereq-Audition, #)  
Preparation and performance of operatic arias, choruses, and scenes. Participation in fully staged or workshop productions of music theatre repertoire.

**Mus 5260. Stage Movement and Acting for Singers.** (1 cr [max 4 cr]; A-F only. Prereq-Audition, #)  
Basic techniques of stage movement and acting styles, application to various forms of music theatre.

**Mus 5270. Voice Practicum.** (1 cr [max 2 cr]. Prereq-Undergrad sr vocal major or #)  
Teaching voice class or individual students with peer and faculty feedback. Assist in class voice instruction or teach two students weekly in conjunction with two one-hour observation labs. May be taken for two semesters.

**Mus 5271. Diction for Singers I.** (2 cr; A-F only. Prereq-12 cr of MusA 1304 or grad music major or #)  
Principles and techniques of singing in English, Italian, Spanish, German, and French. International Phonetic Association alphabet used.

**Mus 5272. Diction for Singers II.** (2 cr; A-F only. Prereq-12 cr MusA 1304 or grad music major or #)  
Principles and techniques of singing in English, Italian, Spanish, German, and French. International Phonetic Association alphabet used.

**Mus 5275. Vocal Pedagogy I.** (3 cr. Prereq-Sr vocal major or #)  
Advanced study of mind/body preparations for singing, anatomy, and physiology of the vocal mechanism. Voice use and care, historical and comparative pedagogy, learning theories, models and guidelines for teaching, instructional techniques, and diagnosing and solving vocal problems.

**Mus 5276. Vocal Pedagogy II.** (2 cr; A-F only. Prereq-Sr vocal major or #)  
History of solo vocal performance; selection and preparation of beginning level solo vocal repertoire; development of vocal performance skills (interpretation, expression, artistry), recital programming, and vocal career counseling.

**Mus 5277. Vocal Workshop.** (1-2 cr [max 8 cr]; A-F only. Prereq-Music major or #)  
Short term vocal workshops address specific topics including voice science, pedagogy, and performance of vocal repertoire. One workshop focuses on class voice instruction.

**Mus 5279. Group Voice: Performance/Pedagogy.** (2-3 cr; A-F only. Prereq-Performance only track: 2 cr per sem; performance/Pedagogy track: 3 cr per sem; [upper div student or grad student], #)  
Foundations/fundamentals of speech/singing. Vocal production, anatomy, physiology, terminology. Application of vocal techniques in learning/performing repertoire. Teaching methods, including voice/motion exercises.

**Mus 5280. Opera Theatre.** (2 cr [max 16 cr]; A-F only. Prereq-Audition, #)  
Preparation and performance of fully-staged operatic production. Major involvement in singing, acting, and technical aspects of opera.

**Mus 5283. Choral Conducting Technique.** (1 cr; A-F only. Prereq-#)  
Choral conducting, rehearsal techniques, interpretation of music.

**Mus 5284. Choral Conducting I: Gregorian Chant Through Baroque Era.** (3 cr; A-F only. Prereq-#)  
Techniques and rehearsal procedures. Focus on music before 1750 including works by Lassus, Schutz, Bach, and Handel.

**Mus 5285. Choral Conducting II: Classical Era to the Present.** (3 cr; A-F only. Prereq-#)  
Technique and rehearsal procedures. Focus on music after 1750 including works by Mozart, Haydn, Beethoven, Mendelssohn, Brahms, and Stravinsky.

**Mus 5300. Jazz Rhythm Section Techniques.** (1 cr [max 8 cr]; A-F only. Prereq-#)  
Study and function of instruments in the jazz rhythm section. Bass line construction, voicings for piano and guitar, and style patterns for percussion.

**Mus 5336. Jazz Arranging.** (3 cr; A-F only. Prereq-3502 or #)  
Beginning techniques of arranging for jazz combo and jazz ensemble; vocal and instrumental.

**Mus 5340. Jazz Ensemble.** (1 cr [max 6 cr]; A-F only. Prereq-Audition, #)  
A 20-member performing organization covering significant jazz compositions and arrangements written specifically for this medium.

**Mus 5341. Jazz Pedagogy.** (2 cr; A-F only. Prereq-#)  
Teaching methods of vocal and instrumental jazz improvisation, basic arranging techniques, and jazz history; bibliographies and materials.

**Mus 5342. Jazz Theory.** (3 cr; A-F only. Prereq-3502 or #)  
Beginning through advanced techniques for chord construction. Extended chords. Nomenclature in jazz idiom.

**Mus 5380. Gospel Choir.** (1 cr [max 4 cr]; A-F only)  
Performance ensemble. Students explore history of gospel music through experiential/participatory songs. Field songs, songs of struggle. Southern, traditional, and contemporary songs.

**Mus 5390. Jazz Singers.** (1 cr [max 10 cr]; A-F only.  
Prereq–Audition, #)  
Study and performance of representative vocal jazz literature.

**Mus 5410. University Wind Bands.** (1 cr [max 14 cr]; A-F only. Prereq–Audition, #)  
Wind ensemble and symphony bands perform standard and contemporary literature; concerts and tour appearances. Players from all colleges may participate.

**Mus 5415. Literature for Band and Wind Ensemble.** (2 cr; A-F only)  
Ensemble literature for winds and percussion; analysis and study of repertoire from classical period to the present.

**Mus 5420. Orchestra.** (1 cr [max 8 cr]; A-F only.  
Prereq–Audition, #)  
Symphony orchestra performs standard repertory and major works with chorus; concerts and tour appearances. Players from all colleges may participate.

**Mus 5421. Suzuki Violin Pedagogy I.** (2 cr; A-F only.  
Prereq–Violin major or #)  
Philosophy and teaching techniques of Japanese pedagogue Shinichi Suzuki and their applications in Western culture. Discussion, playing experience, and observation of children's lessons in the MacPhail Center Suzuki Program.

**Mus 5422. Suzuki Violin Pedagogy II.** (2 cr; A-F only.  
Prereq–5421 or #)  
Philosophy and teaching techniques of Japanese pedagogue Shinichi Suzuki and their applications in Western culture. Discussion, playing experience, and observation of children's lessons in the MacPhail Center Suzuki Program.

**Mus 5423. Suzuki Pedagogy Practicum.** (1 cr [max 1 cr]; A-F only. Prereq–[[#5424 or #5425], grad music student] or #)  
Supervised teaching of both individual and group lessons. Instructor provides periodic critiques from observation of live or videotaped lessons.

**Mus 5424. Advanced Suzuki Violin Pedagogy I.** (2 cr; A-F only. Prereq–5422 or #)  
Intensive examination of Suzuki techniques for intermediate and advanced violin students in Western society. Discussion, playing experience, observation of children's lessons in the MacPhail Center Suzuki Program, and practical teaching experience.

**Mus 5425. Advanced Suzuki Violin Pedagogy II.** (2 cr; A-F only. Prereq–5424 or #)  
Intensive examination of Suzuki techniques for intermediate and advanced violin students in Western society. Discussion, playing experience, observation of children's lessons in the MacPhail Center Suzuki Program, and practical teaching experience.

**Mus 5426. Final Project in Suzuki Pedagogy.** (1 cr; A-F only. Prereq–Grad music student in violin performance and Suzuki pedagogy program)  
Research project.

**Mus 5427. Violin Pedagogy I.** (2 cr; A-F only.  
Prereq–Violin or viola major or #)  
Private teaching of violin students at beginning, intermediate, and advanced levels. Discussion and demonstrations of pedagogical techniques.

**Mus 5428. Violin Pedagogy II.** (2 cr; A-F only.  
Prereq–Violin or viola major or #)  
Private teaching of violin students at beginning, intermediate, and advanced levels. Discussion and demonstrations of pedagogical techniques.

**Mus 5430. Concerto Grosso Ensemble.** (1 cr [max 8 cr]; A-F only. Prereq–Audition, #)  
Study and performance of string orchestra and small chamber orchestra literature.

**Mus 5440. Chamber Ensemble.** (1 cr [max 8 cr]; A-F only. Prereq–Audition, #)  
Performance of chamber music: duos, trios, quartets, quintets, and other ensemble combinations for instruments and/or voices.

**Mus 5450. Orchestral Repertoire.** (1 cr [max 3 cr]; A-F only. Prereq–#)  
Investigation of practical and performance problems in standard orchestral repertoire with regard to style and interpretation.

**Mus 5464. Cello Pedagogy.** (2 cr; A-F only)  
Concentrated study of cello teaching methods. Provides students with the strategies for teaching cello privately, develops analytical skills, and increases knowledge of cello repertoire. For practical application in conjunction with string technique course.

**Mus 5466. Guitar Pedagogy.** (2 cr; A-F only.  
Prereq–Guitar principal or major or #)  
Historical survey of methods and etudes from late 18th century to present, reflecting variety of content and approach. Works by Aguado, Sor, Giuliani, Tarrega, Segovia, Carlevaro, Duncan, Iznaola, Dodgson, and Brindle.

**Mus 5470. Woodwind Chamber Ensemble.** (1 cr [max 8 cr]; A-F only. Prereq–Audition, #)  
Chamber music performance using homogeneous or mixed combinations of woodwind instruments.

**Mus 5471. Woodwind Literature and Pedagogy I.** (3 cr; A-F only. Prereq–Music major or #)  
A study of the major teaching materials for the five woodwind instruments including methods, duets, and solos used primarily for pedagogical reasons.

**Mus 5472. Woodwind Literature and Pedagogy II.** (3 cr; A-F only. Prereq–Music major or #)  
A study of chamber music involving one or more woodwind instruments. May include additional instruments such as piano, strings, and/or voice.

**Mus 5473. History and Acoustics of Single Reed Instruments.** (2 cr; A-F only. Prereq–Music major or #)  
Study of clarinet and saxophone history and literature, mechanical design and development, acoustics, modern schools of performance, selected teaching and performance techniques.

**Mus 5480. University Brass Choir.** (1 cr [max 8 cr]. Prereq–Audition, #)  
The University Brass Choir is an ensemble of 16 brass and percussion players exploring unique literature that spans 400 years. From the rich antiphonal music of Giovanni Gabrieli (1557-1612) to the works of the 20th century. The Brass Choir performs in Twin Cities churches and concert halls.

**Mus 5481. Trumpet Pedagogy.** (2 cr. Prereq–Sr or grad in music or #)  
Principles of trumpet pedagogy. Discussion of literature, history, and current teaching aids.

**Mus 5485. Transcription for Winds.** (2 cr. Prereq–3502 or #)  
Principles of music manuscript and examination of transcription examples. Transcription projects with score and parts. Smaller projects that involve arrangements and original compositions.

**Mus 5490. Percussion Ensemble.** (1 cr [max 10 cr]; A-F only. Prereq–#)  
Practice and performance of standard and contemporary compositions for percussion instruments in various combinations.

**Mus 5491. Percussion Literature I.** (2 cr; A-F only.  
Prereq–Jr or sr or grad or #)  
Repertoire derived from orchestral and band literature for snare drum, timpani, mallet instruments, and various percussion accessories. Major works of the 20th century written for solo percussion, percussion ensemble, and chamber groups of percussion and non-percussion instruments.

**Mus 5492. Percussion Literature II.** (2 cr; A-F only.  
Prereq–Jr or sr or grad or #)  
Repertoire derived from orchestral and band literature for snare drum, timpani, mallet instruments, and various percussion accessories. Major works of the 20th century written for solo percussion, percussion ensemble, and chamber groups of percussion and non-percussion instruments.

**Mus 5501. Intensive Theory and Analysis of 20th-Century Music.** (4 cr; A-F only. Prereq–3502 or #)  
Designed for music majors only, the course is comprised of an intensive introduction to the theory and analysis of art music in various styles developed during the 20th century.

**Mus 5533. Music Since 1945.** (3 cr; A-F only.  
Prereq–3502, #)  
Examine procedures and techniques of music composed since 1945. Integral serialism, sound mass, electronic music, indeterminacy, improvisation, and minimalism in the works of Babbitt, Ligeti, Davidovsky, Oliveros, Cage, Riley, and Reich.

**Mus 5541. Counterpoint I.** (3 cr; A-F only. Prereq–3501, 3511 or #)  
Practice writing in polyphonic styles of Renaissance and Baroque; species counterpoint, canonic and fugal, and other imitative procedures. Study representative forms: motets, inventions, fugues, and chorale-based idioms. Analysis of works by Lassus, Palestrina, Victoria, Purcell, Buxtehude, Fischer, and Bach.

**Mus 5542. Counterpoint II.** (4 cr; A-F only. Prereq–5541)  
Advanced writing in three and more voice polyphonic styles of Renaissance and Baroque. Analyze works of such composers as Lassus, Palestrina, and Bach; emphasis on canonic and fugal procedures.

**Mus 5550. Composition.** (2 cr [max 8 cr]; A-F only.  
Prereq–3502 or equiv, 3551 or grad, #)  
Original works in various forms. Development of individual compositional style in a post-tonal idiom. Exploration of a variety of forms, performing forces, and techniques.

**Mus 5561. Orchestration I.** (3 cr; A-F only. Prereq–3502)  
Scoring techniques for ensembles in combination and full orchestra; year-long sequence. Score study of representative works from 18th through 20th centuries.

**Mus 5562. Orchestration II.** (3 cr; A-F only. Prereq–5561)  
Scoring techniques for ensembles in combination and full orchestra; year-long sequence. Score study of representative works from 18th through 20th centuries.

**Mus 5571. Schenkerian Analysis for Performers.** (3 cr; A-F only. Prereq–3502)  
Theory/analysis of tonal music using principles developed by Henrich Schenker. Basic concepts/notation, their application to excerpts/short pieces from 18th/19th centuries.

**Mus 5572. Chromaticism in Tonal Music.** (3 cr. Prereq–3502)  
Exploration of chromatic tonal practices through analysis of selected repertoire, completion of written exercises (figured bass, harmonization of melodies, model composition), ear-training, and keyboard exercises.

**Mus 5591. Electronic Music: History, Literature, Principles.** (3 cr; A-F only. Prereq–#, at least jr)  
In-depth survey of electroacoustic music repertoire, from tape/analog music through computer-generated compositions. Basic principles of acoustics, electronic sound generation/manipulation, digital signal processing techniques. Programming languages for digital sound synthesis. Work with editing software, MIDI applications.

**Mus 5592. Digital Music Synthesis and Processing Techniques.** (3 cr; A-F only. Prereq–5591 or #)  
Study of specific dsp topics such as filtering, formant synthesis, reverberation techniques, and additive synthesis. Work with interactive MIDI applications.

**Mus 5597. Music and Text.** (3 cr; A-F only. Prereq–3502)  
Designed for music majors only, this course gives an introduction to the analysis of music with texts such as art song and opera.

**Mus 5611. Resources for Music Research.** (3 cr; A-F only. Prereq–3603)  
Development of skills in identifying, locating, and evaluating resources for research in music. Computer-searching techniques, acquaintance with basic reference sources in the field, preparation of the music research paper.

**Mus 5613. Music History Review for Graduate Students.** (3 cr; S-N only. Prereq–Grad music major, assigned by placement exam; cannot be applied toward requirements for any music degree program)  
History of European art-music tradition and its social contexts from antiquity to 1750: composers, styles, structures, social institutions.

**Mus 5614. Music History Review for Graduate Students II.** (3 cr; S-N only. Prereq–Grad music major, assigned by placement exam; cannot be applied toward requirements for any music degree program)  
History of European art-music tradition and its social contexts from 1750 to present: composers, styles, structures, social institutions.

**Mus 5620. Topics in Opera History.** (3 cr [max 6 cr]; A-F only. Prereq–Grad music major or #)  
Through the study of specific operas, students will examine the ways in which intersections of geography, politics, and musical style influenced and perpetuated operatic production within specific geographical and chronological boundaries. Periods/countries will vary each semester.

**Mus 5644. Music in 20th-Century American Culture.** (3 cr; A-F only. Prereq–3603, 5501 or #)  
Stylistic and cultural bases of cultivated and vernacular traditions and their intersections. Topics include folk and ethnic musics, ragtime, city blues and jazz, rock, musical theater, impact of technology, modernism, nationalism, new accessibility.

**Mus 5647. 20th-Century European/American Music.** (3 cr. Prereq–3603 or equiv, 5501 or equiv, 12 undergrad cr in music history)  
Emphasizes major artistic movements, stylistic turning points, social roles of music. Interactions between high art, popular, ethnic musics; contributions of men and woman as composers and performers.

**Mus 5658. History of the Symphony in the 20th Century.** (3 cr; A-F only. Prereq–3603, 5501 or #)  
History of symphony (and related genres) in Europe and America, ca. 1890 to present. Changing aesthetic concerns, structural, harmonic, and timbral innovations. Sociocultural contexts; analysis and criticism.

**Mus 5666. Stravinsky.** (3 cr; A-F only. Prereq–5502, 12 cr music history)  
Analysis and criticism of representative works; aesthetic concerns as expressed in writings of Stravinsky and others; influence upon European and American composers; biographical issues and contributions to artistic life, particularly the ballet.

**Mus 5668. Beethoven's Symphonies.** (3 cr; A-F only. Prereq–3603, #)  
Analytical overview of selected movements from Beethoven's 9 symphonies. Principles of sonata analysis (norm and deformation); introduction to wider contexts of interpretation and understanding (generic, expressive, social).

**Mus 5804. Folk and Traditional Musics: Selected Cultures of the World.** (3 cr; A-F only. Prereq–1801 or 1804 or music grad or #)  
A study of selected music traditions from 5 to 7 world cultures. Genres, social institutions, concepts, styles, instruments, and usages.

**Mus 5950. Topics in Music.** (1-4 cr [max 15 cr])  
Each offering focuses on a single topic. Topics specified in *Class Schedule*.

**Mus 5993. Directed Studies.** (1-4 cr [max 12 cr]. Prereq–#, Δ, □)  
Guided individual reading or study.

**Mus 8110. Sonata Seminar.** (2 cr [max 8 cr]; A-F only. Prereq–Accompanying emphasis, strings and winds by audition, #)  
Performance in standard Baroque, Classical, and Romantic sonatas for piano and violin, cello, viola, flute, clarinet, or oboe.

**Mus 8112. Instrumental Repertoire: Reduction and Realization.** (2 cr; A-F only. Prereq–Grad student in accompanying/conducting)  
Reducing orchestra scores, representing orchestral reductions at piano, working with conductors. Conductors join course in mid-semester.

**Mus 8131. Advanced Keyboard Skills.** (2 cr; A-F only. Prereq–Grad student in music or #)  
Diatonic/chromatic tonal harmony applied to keyboard. Emphasizes harmonization, transposition, and improvisation. Open score and clef reading using alto, tenor, and soprano clefs.

**Mus 8132. Pedagogy of Sight-Reading for Pianists.** (1 cr; A-F only)  
Pedagogy of sight-reading. Theoretical literature/methods books reviewed/critiqued. Methods of observation, evaluation, and instruction. In-class demonstrations use teacher/student pairings, videotape recording/playback.

**Mus 8151. Seminar in Organ Repertoire.** (3 cr; A-F only. Prereq–Grad student in music or #)  
Repertoire for pipe organ. Readings/presentations on selected areas of repertoire of 15th through 20th centuries. Organ design/construction of various European and American schools, as well as relevant performance practices.

**Mus 8170. Advanced Vocal Accompanying Skills and Repertoire.** (2 cr [max 8 cr]; A-F only. Prereq–[French, German, Italian diction], accompanying or DMA voice emphasis or MM voice emphasis by audition)  
Advanced performance (Lieder, melodie, opera) emphasizing coaching techniques and performance skills of pianists and singers.

**Mus 8171. Song Repertoire and Performance for Pianists and Singers: German Lieder.** (2 cr; A-F only. Prereq–[Grad student with major in vocal performance or in accompanying or in piano], #)  
Surveys standard German-language song repertoire: Mozart, Schubert, Schumann, Brahms, Strauss, Wolf.

**Mus 8172. Song Repertoire and Performance for Pianists and Singers: French Melodies.** (2 cr; A-F only. Prereq–[Grad student with major in vocal performance or in accompanying or in piano], #)  
Surveys standard French melodies: Faure, Chausson, Duparc, Debussy, Ravel, Poulenc, Caplet, Roussel, Satie.

**Mus 8173. Song Repertoire and Performance for Pianist and Singers: 20th Century.** (2 cr; A-F only. Prereq–[Grad student with major in vocal performance or in accompanying or in piano], #)  
Surveys standard 20th-century songs; non-traditional notation, "avant garde" compositions.

**Mus 8174. Song Repertoire and Performance for Pianists and Singers: Italian and English Song.** (2 cr; A-F only. Prereq–[Grad student with major in vocal performance or in accompanying or in piano], #)  
Surveys standard English songs from Elizabethan Age to present, Italian songs, "bel canto" tradition.

**Mus 8175. Song Repertoire and Performance for Pianists and Singers: Russian, Spanish, and other languages.** (2 cr; A-F only. Prereq–[Grad student with major in vocal performance or in accompanying or in piano], #)  
Surveys standard songs in Russian, Spanish, and other languages: Turina, Obradors, Granados, Nin, Rodrigo, Monstsalvatge, Guridi, Tchaikovsky, Rachmaninoff, Prokofiev, Stravinsky, Shostakovich. International Phonetic Alphabet.

**Mus 8181. Operatic Accompaniment Skills and Repertoire.** (2 cr; A-F only. Prereq–Grad student with major in accompanying or in conducting)  
Development of skills required in operatic accompanying/coaching work. Standard opera arias, cultivation of orchestral sound at the piano, stylistic traditions, working with conductors.

**Mus 8237. Score Study: Choral.** (3 cr; A-F only. Prereq–#)  
Analysis of various choral scores ranging from Renaissance through 20th century. Reading of choral and choral/orchestral scores at piano, including scores with C clefs and transposing instrument.

**Mus 8255. Choral Literature: Baroque Era to the Present.** (3 cr; A-F only. Prereq–#)  
Survey of sacred and secular choral works.

**Mus 8299. Performance in Choral Conducting.** (3 cr; A-F only. Prereq–#)  
Preparation and performance of choral conducting recital, with supporting paper.

**Mus 8333. FTE: Master's.** (1 cr; NGA. Prereq–Master's student, adviser and DGS consent)

**Mus 8444. FTE: Doctoral.** (1 cr; NGA. Prereq–Doctoral student, adviser and DGS consent)

**Mus 8470. Wind Ensemble/Band Conducting (Wind Conducting).** (4-12 cr [max 12 cr]; A-F only. Prereq–#)  
Seminar in wind ensemble/band conducting techniques. Work with diverse wind repertoires of differing styles/periods.

**Mus 8471. Wind Ensemble/Band Conducting I.** (4 cr; A-F only. Prereq–Wind conducting emphasis or #)  
Seminar in wind band repertoire of 18th, 19th, and 20th centuries emphasizing stylistic and period practices; techniques of score study, analysis, and interpretation. Practical conducting experience.

**Mus 8472. Wind Ensemble/Band Conducting II.** (4 cr; A-F only. Prereq–Wind conducting emphasis or #)  
Seminar in study of music for small wind ensembles and Harmoniemusik tradition; rehearsal techniques and strategies. Music since 1960; contemporary notation systems; rehearsal techniques and strategies. Practical conducting experience.

**Mus 8479. Performance and Document: Wind Ensemble/Band Conducting.** (2 cr; A-F only. Prereq–8472, #)  
Preparing and performing full wind ensemble or band conducting program with supporting document.

**Mus 8480. Orchestral Conducting.** (4 cr [max 16 cr]; A-F only. Prereq–#)  
Seminar in orchestral conducting techniques, including work with diverse orchestral, operatic, choral, and dance repertoires of differing styles and periods; 17th century to present.

**Mus 8489. Performance and Document: Orchestral Conducting.** (3 cr; A-F only. Prereq–#)  
Preparing and performing full orchestral conducting program with supporting document.

**Mus 8490. Choral Conducting.** (4-12 cr [max 12 cr]; A-F only. Prereq–#)  
Prepare students for careers in conducting. Students study musical scores and conducting/rehearsal techniques.

**Mus 8501. Music Theory Pedagogy.** (3 cr; A-F only. Prereq–Undergrad music degree or #)  
Comparison of pedagogical philosophies/methods in music theory; examination of pedagogical literature; practice teaching; curriculum design.

**Mus 8550. Composition.** (3 cr [max 12 cr]; A-F only. Prereq–#)  
Creation of original musical works in various instrumental and vocal forms; advanced development of writing and realization of musical ideas.

**Mus 8560. Readings in Music Theory.** (3 cr [max 12 cr]; A-F only. Prereq–#)  
Seminars on major theoretical text or group of interrelated texts. Pre-tonal, tonal, post-tonal, or non-Western focus in individual offerings.

**Mus 8565. Text Setting.** (3 cr; A-F only. Prereq–Emphasis in composition or choral conducting or voice or accompanying or music education, #)  
Techniques for many mediums (from jungle to art song to choral settings) through analysis of repertoire and original compositions. Emphasizes sense and sound aspects of language, nature of specific text, and special considerations in writing creatively for voice.

**Mus 8570. Seminar in Composition.** (2 cr [max 4 cr]; A-F only. Prereq—Composition emphasis or #) Aesthetic and professional issues in composition. Survey of professional activities, including résumé and grant writing and concert production.

**Mus 8571. Composers' Laboratory.** (3 cr [max 12 cr]; A-F only. Prereq—8570) Preparing original music composition to specification for possible radio/TV/theatre/film use. Analytic projects based on research into current practice of music criticism/music journalism. Philosophical and sociological research into creative process.

**Mus 8575. Women Composers.** (3 cr; A-F only. Prereq—#) Contributions by women composers to development of European-American art music, primarily from 17th through 20th centuries. Historical and current issues affecting women's access to professional music sphere. Music analysis, listening list, research, and performance components.

**Mus 8580. Topics in Tonal Analysis.** (3 cr [max 12 cr]; A-F only. Prereq—Grad music major who has completed all undergrad requirements in tonal theory and analysis.) Seminar. Sample topics: string quartets of Beethoven, chamber music of Brahms, and significant works by other tonal composers.

**Mus 8581. Schenkerian Theory and Analysis I.** (3 cr; A-F only. Prereq—#) Analysis and critical readings pertaining to theory of tonal music developed by Heinrich Schenker. Application of his method to representative repertoire from 18th and 19th centuries. Contrapuntal writing modeled after presentation in Schenker's *Counterpoint*.

**Mus 8582. Schenkerian Theory and Analysis II: 18th Century.** (3 cr; A-F only. Prereq—8581 or #) Application of Schenkerian theory to 18th-century music, coordinated with critical study of major music treatises from that era.

**Mus 8583. Schenkerian Theory and Analysis III: 19th Century.** (3 cr; A-F only. Prereq—8581 or #) Application of Schenkerian theory to music from 19th century, coordinated with critical study of major music treatises from that era.

**Mus 8590. Topics in 20th-Century Analysis.** (3 cr [max 12 cr]; A-F only. Prereq—Grad music major, #) Seminar explores literatures of 20th-century art music.

**Mus 8631. Seminar: Music in Medieval Europe.** (3 cr; A-F only. Prereq—Undergrad music degree) Selected genres of polyphonic and monophonic music, 9th-14th centuries, for analysis and cultural criticism. Social roles of music and performance traditions; current musicological issues.

**Mus 8632. Seminar: Music in Early Modern Europe.** (3 cr; A-F only. Prereq—Undergrad music degree) Transformation of chanson, madrigal, mass, and motet from 1400 to 1580. Analysis and cultural criticism; social roles of music and performance traditions; current musicological issues.

**Mus 8640. Seminar in Musicology.** (3 cr [max 12 cr]; A-F only. Prereq—Musicology or theory emphasis or #) Topics vary; readings, research, strategies, and methods.

**Mus 8644. Seminar: Advanced Research in Historical Musicology.** (3 cr; A-F only. Prereq—Undergrad music degree) Major reference and research materials in musicology and related disciplines, including databases. Historical methods and historiography. Locating and interpreting primary sources of music and archival documents. Developing research strategies for degree papers and theses. Forms of documentation and historical writing.

**Mus 8645. Current Musicology: Readings.** (3 cr; A-F only. Prereq—Musicology or theory emphasis or #) Readings and topics in recent scholarly and analytical work.

**Mus 8647. Seminar: The Critical Editing of Early Music—Method and Practice.** (3 cr; A-F only. Prereq—Undergrad music degree) Preparation of critical editions from primary sources of vocal and instrumental music (partbooks and tablatures). Nature of musical sources, both manuscripts and prints. Stemmatic filiation, editorial judgment and method, presentation of text.

**Mus 8651. Sonata Theory.** (3 cr; A-F only. Prereq—#) Principles of the classic sonata: norms, types, and deformations. Structural analysis, analytical methodologies, and fundamentals of sonata hermeneutics.

**Mus 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Mus 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Mus 8864. Current Issues in Ethnomusicology.** (3 cr; A-F only. Prereq—#) Ethnomusicological methods, theorizing, and research practice. Current issues in monographs, journals, and anthologies. Fieldwork practicum.

**Mus 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

**Mus 8994. Directed Research.** (1-3 cr [max 12 cr]; A-F only. Prereq—#) Directed research.

**Mus 8999. Recital Credits: Doctoral.** (4 cr [max 20 cr]; A-F only. Prereq—DMA student, #) Registration for recital credits coincides with performance of D.M.A. recital (five recitals for 20 credits).

## Music Applied (Musa)

### School of Music

### College of Liberal Arts

**Note:** MusA 5101 through MusA 5123 are private instruction and the prerequisites are (2 cr [max 8 cr]; A-F only. Prereq—Audition, Δ).

**MusA 5101. Piano—Elective.**  
**MusA 5102. Harpsichord—Elective.**  
**MusA 5103. Organ—Elective.**  
**MusA 5104. Voice—Elective.**  
**MusA 5105. Violin—Elective.**  
**MusA 5106. Viola—Elective.**  
**MusA 5107. Cello—Elective.**  
**MusA 5108. Double Bass—Elective.**  
**MusA 5109. Flute—Elective.**  
**MusA 5111. Oboe—Elective.**  
**MusA 5112. Clarinet—Elective.**  
**MusA 5113. Saxophone—Elective.**  
**MusA 5114. Bassoon—Elective.**  
**MusA 5115. French Horn—Elective.**  
**MusA 5116. Trumpet—Elective.**  
**MusA 5117. Trombone—Elective.**  
**MusA 5118. Euphonium—Elective.**  
**MusA 5119. Tuba—Elective.**  
**MusA 5121. Percussion—Elective.**  
**MusA 5122. Harp—Elective.**  
**MusA 5123. Guitar—Elective.**

**Note:** MusA 5401 through MusA 5423 are private instruction and the prerequisites are (2-4 cr [max 24 cr]; A-F only. Prereq—Audition, Δ).

**MusA 5401. Piano—Secondary.**  
**MusA 5402. Harpsichord—Secondary.**  
**MusA 5403. Organ—Secondary.**  
**MusA 5404. Voice—Secondary.**  
**MusA 5405. Violin—Secondary.**  
**MusA 5406. Viola—Secondary.**  
**MusA 5407. Cello—Secondary.**  
**MusA 5408. Double Bass—Secondary.**  
**MusA 5409. Flute—Secondary.**  
**MusA 5411. Oboe—Secondary.**  
**MusA 5412. Clarinet—Secondary.**  
**MusA 5413. Saxophone—Secondary.**  
**MusA 5414. Bassoon—Secondary.**  
**MusA 5415. French Horn—Secondary.**  
**MusA 5416. Trumpet—Secondary.**  
**MusA 5417. Trombone—Secondary.**  
**MusA 5418. Baritone—Secondary.**  
**MusA 5419. Tuba—Secondary.**  
**MusA 5421. Percussion—Secondary.**  
**MusA 5422. Harp—Secondary.**  
**MusA 5423. Guitar—Secondary.**

**Note:** MusA 8301 through MusA 8324 are private instruction and the prerequisites are (2-4 cr [max 48 cr]; A-F only. Prereq—Audition, Δ).

**MusA 8301. Piano—Major.**  
**MusA 8302. Harpsichord—Major.**  
**MusA 8303. Organ—Major.**  
**MusA 8304. Voice—Major.**  
**MusA 8305. Violin—Major.**  
**MusA 8306. Viola—Major.**  
**MusA 8307. Cello—Major.**  
**MusA 8308. Double Bass—Major.**  
**MusA 8309. Flute—Major.**  
**MusA 8311. Oboe—Major.**  
**MusA 8312. Clarinet—Major.**  
**MusA 8313. Saxophone—Major.**  
**MusA 8314. Bassoon—Major.**  
**MusA 8315. French Horn—Major.**  
**MusA 8316. Trumpet—Major.**  
**MusA 8317. Trombone—Major.**  
**MusA 8318. Euphonium—Major.**  
**MusA 8319. Tuba—Major.**  
**MusA 8321. Percussion—Major.**  
**MusA 8322. Harp—Major.**  
**MusA 8323. Guitar—Major.**  
**MusA 8324. Accompanying/Coaching.**

**Note:** MusA 8501 through MusA 8524 are private instruction and the prerequisites are (2-4 cr [max 8 cr]; A-F only. Prereq—#).

**MusA 8501. Piano: Beyond Requirement.**  
**MusA 8502. Harpsichord: Beyond requirement.**  
**MusA 8503. Organ: Beyond Requirement.**  
**MusA 8504. Voice: Beyond Requirement.**  
**MusA 8505. Violin: Beyond Requirement.**  
**MusA 8506. Viola: Beyond Requirement.**

- MusA 8507. Cello: Beyond Requirement.**
- MusA 8508. Double Bass: Beyond Requirement.**
- MusA 8509. Flute: Beyond Requirement.**
- MusA 8511. Oboe: Beyond Requirement.**
- MusA 8512. Clarinet: Beyond Requirement.**
- MusA 8513. Saxophone: Beyond Requirement.**
- MusA 8514. Bassoon: Beyond Requirement.**
- MusA 8515. French horn: Beyond Requirement.**
- MusA 8516. Trumpet: Beyond Requirement.**
- MusA 8517. Trombone: Beyond Requirement.**
- MusA 8518. Euphonium: Beyond Requirement.**
- MusA 8519. Tuba: Beyond Requirement.**
- MusA 8521. Percussion: Beyond Requirement.**
- MusA 8522. Harp: Beyond Requirement.**
- MusA 8523. Guitar: Beyond Requirement.**
- MusA 8524. Accompanying/Coaching: Beyond Requirement.**

## Music Education (MuEd)

### School of Music

#### College of Liberal Arts

- MuEd 5011. Music in the Elementary Classroom Curriculum.** (2 cr; Prereq—Mus 1001, elem ed grad student, Δ)  
Fundamentals of music, methods, and materials for incorporating singing, rhythmic activities, classroom instruments, movement, listening, appreciation, and creation into context of classroom curriculum.
- MuEd 5112. Research in Music Education: Techniques.** (3 cr; A-F only. Prereq—Grad music ed major or #)  
Methods and techniques employed in investigating and reporting music education problems; proposal development; bibliographic skills involved in conducting a significant review of related research.
- MuEd 5115. Research in Music Education: Measurement.** (3 cr; A-F only)  
Assessment of music behaviors, including test design, interpretation of test results, and evaluation and reporting of student achievement; published tests in music; uses of assessment and measurement in the classroom and in research.
- MuEd 5118. Research in Arts Education: Qualitative.** (3 cr; A-F only. Prereq—Grad student in arts or #)  
Practical/systematic introduction to qualitative research procedures in arts education. Prepares students to develop research proposals. Students participate in a joint field exploration. Those who have established research interests may also work in another setting relevant to their long-term research goals.
- MuEd 5211. Foundations of Music Education.** (3 cr; A-F only)  
An overview of the historical, philosophical, and psychological foundations of music education.
- MuEd 5313. Youth Music: Preferences, Influences, and Uses.** (2 cr; A-F only)  
Youth music preferences and their determinants; how music influences youth behavior; students' and teachers' uses of commercial styles. Particularly appropriate for educators and parents.
- MuEd 5433. Techniques and Materials: Choral Ensembles.** (2 cr; A-F only. Prereq—Music or music ed major or #)  
Research and literature on vocal and choral music education; choral curriculum issues; repertoire selection; rehearsal techniques.

- MuEd 5606. Movement-Based Methods for Music Education.** (2 cr; A-F only. Prereq—Music or music ed major or #)  
Participation in movement activities; study of Dalcroze philosophy and techniques; applications of movement to music education; examination of research.
- MuEd 5611. Teaching Music With Related Arts.** (2 cr; A-F only)  
Methods and materials for teaching music in cultural context including other art forms.
- MuEd 5647. Teaching the Percussion Instruments.** (2 cr; A-F only)  
Contemporary approaches for teaching percussion in the schools; development of curricular materials and practice in performance techniques.
- MuEd 5655. New Dimensions in Music Education.** (2 cr; A-F only)  
Analysis of recent curricular trends and current issues.
- MuEd 5664. Teaching Music on the Internet.** (3 cr; A-F only)  
Home page development techniques, investigation of software and materials, audio and video utilities, and research applications.
- MuEd 5667. Computer-Based Music Instruction.** (3 cr; A-F only. Prereq—Music or music ed major or #)  
Design and development of computer applications for the music classroom. Creating interactive audio and video presentations for music theory, ear training, composition, analysis, music history, and appreciation.
- MuEd 5668. Computerized Music Notation.** (3 cr [max 6 cr])  
Fundamentals of music notation and printing utilizing the computer, MIDI keyboards, and Finale software program. Preparation of instrumental and vocal scores, part extraction and page layout. Basic techniques for sequencing and transcription.
- MuEd 5669. Psychology of Music.** (3 cr; A-F only. Prereq—Psy 1001 or Psy 3604 or #)  
Basic study of the psychology and psychoacoustics of music including hearing, music perception and cognition, values and preferences, musical abilities, musical systems, media music effects, the influence of music on human behavior, and psycho-socio-physiological processes involved in musical behavior.
- MuEd 5750. Topics in Music Education.** (1-4 cr [max 8 cr]; A-F only)  
Each offering focuses on a single topic. Topics specified in *Class Schedule*.
- MuEd 5991. Independent Study.** (1-4 cr [max 8 cr]; A-F only. Prereq—Music ed or music therapy major or grad, #, Δ)  
Independent study project organized by the student in consultation with the appropriate instructor.
- MuEd 8281. Seminar: Philosophical Issues.** (2 cr; A-F only. Prereq—Doctoral student in [music or music education] or #)  
Issues in philosophical foundations of music education.
- MuEd 8282. Seminar: Historical Issues.** (2 cr; A-F only. Prereq—Doctoral student in music or music education or #)  
Issues in historical foundations of music education.
- MuEd 8283. Seminar: Psychological Issues.** (2 cr; A-F only. Prereq—Doctoral student in music or music education or #)  
Issues in psychological foundations of music education.
- MuEd 8284. Seminar: Research and Scholarly Issues.** (2 cr; A-F only. Prereq—Doctoral student in music or music education or #)  
Scholarly/professional expectations of music educators and music therapists in academia and other positions of leadership. Writing for a variety of professional purposes/publications.
- MuEd 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

- MuEd 8880. Master's Research Project.** (1-5 cr [max 5 cr]; A-F only. Prereq—Grad music ed major, #)  
Individual Plan B projects.
- MuEd 8994. Directed Research.** (1-8 cr [max 8 cr]; A-F only. Prereq—#)

## Nanoparticle Science and Engineering (NpSE)

### Institute of Technology

- NpSE 8001. Introduction to Nanoparticle Science and Engineering.** (3 cr; A-F only)  
A broad, interdisciplinary overview of the emerging field of nanoparticle science and engineering. This introductory course, designed for students with diverse backgrounds in science and engineering, covers a wide spectrum of topics—from the synthesis of nanoparticles, to nanoparticle growth and transport, to characterization methods for nanoparticles, to novel nanoparticle-based materials and devices.
- NpSE 8002. Nanoparticle Science and Engineering Laboratory.** (3 cr; A-F only. Prereq—8001, [IT grad student or #])  
Practical exposure to computational and experimental techniques in nanoparticle research. Required for Ph.D. students minoring in nanoparticle science and engineering.
- NpSE 8101. Nanoparticle Science and Engineering Seminar.** (1 cr; S-N only. Prereq—IT grad student or #)  
Broad overview of current research in nanoparticle science and engineering. Topics include areas of nanoparticle synthesis, nanoparticles characterization, nanoparticle-based materials and devices, environmental impact of nanoparticles, and instrumentation for nanoparticle research. Speakers from the University of Minnesota as well as external experts.

## Natural Resources and Environmental Studies (NRES)

### Department of Forest Resources College of Natural Resources

- NRES 5000. Colloquium: Natural Resources and Environmental Studies.** (1 cr [max 6 cr]; A-F only)  
Lectures from experts, readings, discussions of current environmental topics/issues. Topics vary, see *Class Schedule*.
- NRES 5001. Treaty Rights and Natural Resources.** (3 cr [max 6 cr]; A-F only. Prereq—Grad student or #)  
Readings, class discussion about treaty rights reserved by indigenous Americans with respect to use of natural resources. Emphasizes Midwest issues. Web-assisted course.
- NRES 5002. Colloquium: Restoration of Stream Ecosystems.** (1 cr)  
Key concepts/techniques. Overview of stream habitat restoration. Relationship of restoration to natural stream systems, planning, research, watershed groups, interagency coordination, and management decision process.
- NRES 5021. Managing Vegetation Across Ecosystems.** (3 cr. Prereq—Grad student or #)  
Application of ecological concepts such as succession/competition to ecosystems under management. Wetlands, riparian zones, urban interfaces, agriculture, agroforestry. Northern/boreal conifer and hardwood forests. Grasslands (prairie). Emphasizes management objectives, methods, impacts. Evaluating practices for sustainability. Integrating social issues. Regional (Great Lakes area), national, and global case studies.

**NRES 5061. Water Quality and Natural Resources.** (3 cr. Prereq–Grad student or #)  
Issues, parameters, and decision making for managing surface/groundwater resources in Minnesota and globally. Biophysical/human side of water management. Wetlands, exotic species, heavy metal deposition. Cultural, political, and societal dimensions. Case studies, discussions, problem-solving, debates, projects.

**NRES 5101. Conserving our Plant Biodiversity.** (3 cr; A-F only. Prereq–Grad student or #)  
Introduction to principles underlying assessment/conservation of plant biodiversity at individual, population, and community levels. Case studies in management of biodiversity to restore or maintain ecosystem function. Genetics, timber harvesting, invasive species, plant reproduction.

**NRES 5111. Hydrology and Water Quality Field Methods.** (3 cr; A-F only. Prereq–Grad student or #)  
Integrates water quality, surface/groundwater hydrology. Case studies, hands-on field data collection, calculations of hydrological/water quality parameters. Meteorological data, snow hydrology, stream gauging, well monitoring, automatic water samplers. Designing water quality sampling program. Geomorphology, interception, infiltration.

**NRES 5195. Problem Solving in Natural Resources and Environmental Studies.** (4 cr; A-F only. Prereq–Grad student or #)  
Applying problem solving tools/skills in policy, planning, and managerial situations. Students work with ‘real world’ client to produce publishable technical report, present results in professional public forum.

**NRES 5202. Environmental Conflict Management, Leadership, and Planning.** (3 cr; A-F only. Prereq–Grad student or #)  
Negotiation of natural resource management issues. Use of collaborative planning. Case study approach to conflict management, strategic planning, and building leadership qualities. Emphasizes analytical concepts, techniques, and skills.

**NRES 5207. Emerging Issues in Tropical Agriculture and Forestry: Costa Rica.** (3 cr. Prereq–Grad student, #)  
Experiential learning through field trips. From conventional to organic bird-friendly coffee production/marketing. Sustainable management of high-/low-land tropical forests and of biodiversity. Lectures, seminars, labs field work, written project. Offered through CATIE/UofM.

**NRES 5211. Survey, Measurement, and Modeling for Environmental Analysis.** (3 cr. Prereq–Grad student or #)  
Introduction to survey, measurement, and modeling concepts/methods for study of natural resources and environmental issues. Emphasizes survey design for data collection, estimation, and analysis for issues encompassing land, water, air, vegetation, animal, soil, and human/social variables.

**NRES 5241. Natural Resource Policy and Administration.** (3 cr. Prereq–Grad student or #)  
Basic concepts of political/administrative processes important to natural resource policy and program development. Case study approach to policy and legislative process, the participants in policy development, and public programs. Federal/state laws/regulations, international issues.

**NRES 5245. Sustainable Recreation Planning and Policy.** (3 cr; A-F only. Prereq–Grad student or #)  
Overview of policies that affect recreation at local, state, and federal levels. Landscape-level planning. Collaborative relationships as means to implement sustainable natural/social policy. Class project involving all aspects of implementing recreation policy, from public meetings to hands-on evaluation of options.

**NRES 5251. Natural Resources in Sustainable International Development.** (3 cr; A-F only. Prereq–Grad student or #)  
International perspectives on resource use in developing countries. Integration of natural resource issues

with social, economic, and policy considerations. Agriculture, forestry, agroforestry, non-timber forest products, water resources, certification, development issues. Latin American case studies.

**NRES 5261. Economics and Natural Resources Management.** (4 cr; A-F only. Prereq–Grad student or #)  
Microeconomic principles in natural resource management. Tools to address market failure, project analysis, and evaluation. Economic/financial considerations. Benefit/cost analysis methods/examples. Valuation/assessment methods for property/resources. Managing renewable natural resources.

**NRES 5295. GIS in Environmental Science and Management.** (4 cr; A-F only. Prereq–Grad student or #)  
Application of spatial data inventory/analysis in complex environmental planning problems. Spatial data collection. Database development methods, including GPS, DLG, TIGER, NWI data, and spatial analysis. Topics identified by non-University partners.

**NRES 5480. Topics in Natural Resources.** (1-4 cr [max 6 cr]. Prereq–Sr or grad student)  
Lectures by visiting scholar or regular staff member. Topics specified in *Class Schedule*.

**NRES 5482. Biosafety Science and Policy.** (3 cr)  
Scientific/policy approaches to governing equitable/safe use of new biological technologies such as genetic engineering and its products (e.g., growth-enhanced, transgenic fish), hazardous materials, and wastewater treatment.

**NRES 5501. Biological Collections: Curation and Management.** (1 cr. Prereq–One [gen biology or intro to natural resources] course or #)  
Roles/value of biology collections in natural history museums. Conservation of biodiversity record. Students participate in various hands-on curatorial activities. Lectures, tours.

**NRES 5575. Wetlands Conservation.** (3 cr. \$3575. Prereq–Sr or grad student or #)  
Freshwater wetland classification, wetland biota, current/historic status of wetlands, value of wetlands. National, regional, Minnesota wetlands conservation strategies. Ecological principles used in wetland management.

**NRES 5703. Agroforestry in Watershed Management.** (3 cr. Prereq–Grad student or #)  
Biological, physical, and environmental attributes of agroforestry as pertains to watershed management. Coupling production with watershed protection benefits. Implications for policy, economics, and human dimensions in sustainable development. Examples/case studies from North America and developing countries.

**NRES 5811. Environmental Interpretation.** (3 cr; A-F only. Prereq–Grad student or #)  
Theories of interpretation, nonformal teaching pedagogy. Interpretive talks, walks, and programs. Camp leadership. Oral presentation. Newsletter development. Web site design. Development of self-guided trail guides, brochures, and exhibits. Planning, evaluation. Interpretive work in private, state, or federal agencies. Hands-on experience.

## Natural Resources Science and Management (NR)

*Department of Forest Resources*

*College of Natural Resources*

**NR 8333. FTE: Master's.** (1 cr; NGA. Prereq–Master's student, adviser and DGS consent)

**NR 8444. FTE: Doctoral.** (1 cr; NGA. Prereq–Doctoral student, adviser and DGS consent)

**NR 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq–Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**NR 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq–Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**NR 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer; 24 cr required)

## Neuroscience (NSc)

*College of Biological Sciences*

**NSc 5031W. Perception.** (3 cr. Prereq–Psy 3031 or Psy 3051 or #)

Cognitive, computational, and neuroscience perspectives on visual perception. Color vision, pattern vision, image formation in eye, object recognition, reading, impaired vision. Course is biennial: offered fall of odd years.

**NSc 5037. Psychology of Hearing.** (3 cr. Prereq–Psy 3031 or #)

Biological and physical aspects of hearing, auditory psychophysics, theories and models of hearing, perception of complex sounds including music and speech, clinical and other applications.

**NSc 5201. Computational Neuroscience I: Membranes and Channels.** (3 cr. Prereq–Calculus through differential equations)

Comprehensive examination of membrane and ion channels using UNIX workstations to simulate their properties. Hodgkin-Huxley model, nonlinear dynamic systems, voltage- and ligand-gated ion channels, impulse propagation.

**NSc 5202. Theoretical Neuroscience: Systems and Information Processing.** (3 cr. Prereq–[3101, 3102W] recommended)

Concepts of computational/theoretical neuroscience. Distributed representations and information theory. Methods for single-cell modeling, including compartmental/integrate-and-fire models. Learning rules, including supervised, unsupervised, and reinforcement learning models. Specific systems models from current theoretical neuroscience literature. Lecture/discussion. Readings from current scientific literature.

**NSc 5461. Cellular and Molecular Neuroscience.** (4 cr; A-F only. Prereq–NSc grad student or #)

Lectures by team of faculty, problem sets in important physiological concepts, discussion of original research papers.

**NSc 5462. Neuroscience Principles of Drug Abuse.** (2 cr. Prereq–#)

Current research on drugs of abuse, their mechanisms of action, characteristics shared by various agents, and neural systems affected by them. Offered biennially, spring semester of even-numbered years.

**NSc 5481. Invertebrate Neurobiology.** (2 cr; A-F only. \$Ent 5481)

Fundamental principles/concepts underlying cellular bases of behavior and “systems” neuroscience. Particular invertebrate preparations. Offered annually the last 10 weeks of spring semester.

**NSc 5540. Advanced Survey of Biomedical Neuroscience.** (2 cr. Prereq–#; intended for members of biomedical community or students with advanced scientific backgrounds)

Current topics in biomedical neuroscience, accompanied by supporting, fundamental concepts. Intensive, one week course.

**NSc 5551. Itasca Cell and Molecular Neurobiology Laboratory.** (4 cr; S-N only. Prereq–Neuroscience grad or #)

Intensive lab introduction to cellular and molecular aspects of research techniques in contemporary neurobiology; held at Itasca Biological Station. Electrophysiological investigations of neuronal properties, neuropharmacological assays of transmitter action, and immunohistochemical studies in experimental preparations.

**NSc 5561. Systems Neuroscience.** (4 cr; A-F only. Prereq—Neuroscience grad student or #) Principles of organization of neural systems forming the basis for sensation/movement. Sensory-motor/neural-endocrine integration. Relationships between structure and function in nervous system. Team taught. Lecture, laboratory.

**NSc 5661. Behavioral Neuroscience.** (3 cr; A-F only. Prereq—Grad NSc major or grad NSc minor or #) Neural coding/representation of movement parameters. Neural mechanisms underlying higher order processes such as memorization, memory scanning, and mental rotation. Emphasizes experimental psychological studies in human subjects, single cell recording experiments in subhuman primates, and artificial neural network modeling.

**NSc 8026. Neuro-Immune Interactions.** (3 cr. Prereq—5561, MicB 4131) Regulatory systems (neuroendocrine, cytokine, and autonomic nervous systems) linking brain and immune systems in brain-immune axis. Functional effects of bidirectional brain-immune regulation. Course is offered fall of even-numbered years.

**NSc 8207. Seminar: Psychopharmacology.** (1-3 cr [max 12 cr]. Prereq—#) Faculty and postdoctoral fellows interested in psychotropic drugs and chemicals participate. Some seminars devoted to biomedical ethics. Neurochemistry, pharmacology, and behavior as antecedent or consequential variables.

**NSc 8211. Developmental Neurobiology.** (3 cr; A-F only. Prereq—Neuroscience grad student or #) How neuronal types develop. Emphasizes general mechanisms. Experimental data demonstrating mechanisms.

**NSc 8216. Selected Topics in Autonomic and Neuroendocrine Regulation.** (1 cr; S-N only. Prereq—#) Advanced seminar. Course is offered fall and spring semesters.

**NSc 8217. Systems and Computational Neuroscience.** (2 cr; S-N only. Prereq—5561 or #) Advanced seminar.

**NSc 8221. Neurobiology of Pain and Analgesia.** (2 cr. Prereq—#) Pain and analgesia. Course is triennial.

**NSc 8222. Central Regulation of Autonomic Function.** (3 cr; A-F only. Prereq—5561) Neural/hormonal sensory pathways affecting central autonomic nuclei involved in maintenance of homeostasis. Current research on physiological control systems at cellular, organ, and integrative levels. Course is offered fall of odd-numbered years.

**NSc 8247. Anatomy and Physiology of Hearing and Balance.** (3 cr. Prereq—#) Structure/function of auditory/vestibular systems. Network analysis of middle/inner ear mechanics, hair cell biophysics, auditory nerve/CNS electrophysiology, information processing, neural mechanisms subserving balance/gaze, cellular morphology, and computer models.

**NSc 8248. Directed Readings in Auditory Physiology.** (1-2 cr. Prereq—#) Current research on biophysics and physiology of auditory system; topics selected for each student. Written reviews prepared and discussed.

**NSc 8320. Readings in Neurobiology.** (1-4 cr [max 4 cr]) Topics in neurobiology and neurophysiology.

**NSc 8321. Career Skills and Understanding Responsibilities as a Neuroscientist.** (0.5 cr [max 2 cr]; S-N only. Prereq—Neuroscience grad major or #) Information that falls outside of core neuroscience academic curriculum. Areas of practical value for graduate school and career development. Career skills, writing skills, responsible conduct in research.

**NSc 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser approval, □)

**NSc 8334. Laboratory Neuroscience.** (1-3 cr [max 10 cr]; S-N only. Prereq—Grad NSc major) Guided research.

**NSc 8411. Teaching in Neuroscience.** (1 cr [max 4 cr]; S-N only. Prereq—#) Grad students serve as primary instructors in 4151 and work with fellow students and faculty mentors to design curriculum, classroom sessions, exams, and course evaluations.

**NSc 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**NSc 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**NSc 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA)

**NSc 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

## Neuroscience Department (NSci)

Department of Neuroscience  
Medical School

**NSci 5101. Introduction to Neuroscience for Graduate Students.** (3 cr; A-F only. \$3101, \$Biol 3101, \$Phsl 3101. Prereq—[BioC 3021 or BioC 4331], Δ; intended for grad students outside neuroscience program who require comprehensive intro) Basic principles of cellular/molecular neurobiology and nervous system. A term paper supplements lectures. Multiple-choice exams.

**NSci 5110. Dental Neuroscience for Graduate Students.** (2 cr; A-F only. Prereq—BioC 3021, Biol 4004, #; intended for grad students who require a comprehensive grad-level neuroscience course) Structure/function of human nervous system. Lectures and reading assignments emphasize topics pertinent to dentistry.

**NSci 5111. Medical Neuroscience for Graduate Students.** (5 cr; A-F only. Prereq—BioC 3021, Biol 4004, #; intended for grad students who require a comprehensive medically-oriented neuroscience course) Survey of molecular, cellular, and systems neuroscience as related to medicine. Lecture/lab.

**NSci 5913. BrainU 101: Neuroscience in the Classroom.** (3 cr; A-F only. Prereq—[Elementary or middle school or high school or preservice] teacher, #, application) Two-week summer workshop. Week one focuses on training teachers in neuroscience through lectures, activities, and discussion sessions. Week two focuses on designing inquiry-based classroom investigations based on neuroscience education given during week one. Follow-up activities held during the academic year include BrainU staff/faculty classroom presentations and use of training materials.

**NSci 5914. BrainU 202: Neuroscience in the Classroom.** (3 cr; A-F only. Prereq—[5913 or Biol 5190], #, application) One-week summer workshop. Focuses on critiquing previously implemented neuroscience class activities, developing assessment tools, learning peer mentoring, and expanding neuroscience content knowledge. Follow-up activities held during academic year include BrainU staff/faculty classroom presentations, use of training materials, and peer mentoring sessions.

**NSci 5915. BrainU 303: Neuroscience in the Classroom.** (2 cr; A-F only. Prereq—[5913 or Biol 5190], 5914, #, application) One-week summer workshop. Focuses on critiquing previously implemented neuroscience class activities and assessment tools, and expanding neuroscience content knowledge. Follow-up activities held during academic year include BrainU 303 participants' use of training materials and implementation of neuroscience investigations.

## Neurosurgery (NSu)

Department of Neurosurgery  
Medical School

**NSu 8305. Neurosurgical Diagnosis.** (3 cr; S-N only) Neurosurgical diagnosis.

**NSu 8308. Neurosurgical Problems and Management.** (3 cr; S-N only) Neurosurgical problems and management.

**NSu 8311. Operative Neurosurgery.** (3 cr; S-N only) Operative neurosurgery.

**NSu 8316. Neurosurgical Research.** (4 cr; S-N only) Neurosurgical research.

**NSu 8318. Neuroradiological Conference.** (1 cr; S-N only) Neuroradiological conference.

**NSu 8320. Neurosurgical Conference.** (1 cr; S-N only) Neurosurgical conference.

**NSu 8324. Readings in Neurobiology.** (1-15 cr. Prereq—8104, □)

**NSu 8330. Neurosurgery Literature Seminar.** (1 cr; S-N only) Neurosurgery literature seminar.

## Nursing (Nurs)

School of Nursing

**Nurs 5030. Clinical Foundations.** (7 cr [max 21 cr]; A-F only. Prereq—Postbac certificate prog) Foundation for culturally appropriate, ethical, evidence-based nursing practice across the life span. Emphasizes research/theory that underlie art/science of professional nursing. Concepts of person, environment, health, and nursing. Didactic, clinical, and laboratory experiences.

**Nurs 5031. Human Response to Health and Illness: Adults and Elders.** (6 cr; A-F only. Prereq—Postbac certificate prog, #) Individual responses to health/illness, in context of families/environments. Clinical component emphasizes application of nursing process in adult/elderly populations.

**Nurs 5032. Human Response to Health and Illness: Children and Childbearing Families.** (6 cr; A-F only. Prereq—Postbac certificate prog, #) Family responses to health/illness. Emphasizes application of nursing process in children and childbearing families. Seminar and community-based project focus on family as unit of care.

**Nurs 5033. Population Response to Health and Mental Illness.** (5 cr; A-F only. Prereq—Nursing Postbac certificate prog, #) Population-based nursing practice. Emphasizes application of nursing process in promoting mental health and public health, and in preventing illness across life span. Clinical experiences include interactions with individuals, families, communities, and systems.

**Nurs 5034. Clinical Seminar: Nursing Care of Clients With Complex Health Conditions.** (2 cr; A-F only. Prereq—5033, 8100, Postbac certificate prog) Exemplar cases from students' clinical settings used as basis for development of clinical decision-making. Critical analysis of current/emergent nursing care issues associated with caring for complex/diverse populations.

**Nurs 5035. Practicum: Nursing Care for Clients With Complex Health Conditions.** (5 cr; A-F only. Prereq—Postbac certificate prog, #) Clinical decision-making, comprehensive nursing care of clients with complex health problems. In collaboration with a clinical preceptor and a faculty adviser, students develop an individualized learning contract to meet course objectives.

**Nurs 5141. Ethical Issues in Health Care of Elders.**

(3 cr. Prereq—Grad student or nursing sr or #)  
Health care related ethical issues that confront elders, their families, health care providers, and society.

**Nurs 5170. Research Topics.** (1-16 cr [max 16 cr].

Prereq—#)  
Exploration of research topic to meet individual student needs.

**Nurs 5171. SPSS Programming and Data Analysis.**

(2 cr. Prereq—Inferential statistics, [[grad or professional student] or #])  
Skills needed to collect/analyze data using SPSS for Windows. Review of statistical methods.

**Nurs 5172. Decision Making in Health Care.** (2 cr.

Prereq—Grad student, #)  
Selected classical conceptual models of decision making, their particular perspectives/limitations/ usefulness for decision making about health care issues. Models/components used to assess, evaluate, teach, or help healthy people, patients, families, health care professionals, or policy making groups in making health care decisions.

**Nurs 5200. Holistic Health Assessment and Therapeutics for Advanced Practice Nurses.** (3 cr.

Prereq—#)  
Health assessment knowledge/skills for advanced nursing practice with patients across age span, including pregnancy. Selected nursing interventions, complementary therapies examined for application to specific populations/illnesses.

**Nurs 5202. Introduction to Complementary Healing Practices.** (3 cr)

Historical and cultural context of the allopathic and complementary healing traditions. Philosophies and paradigms of selected complementary therapies and culturally based healing traditions; descriptions of selected interventions.

**Nurs 5204. Population Focused Assessment and Intervention.** (2 cr. Prereq—Grad nursing major)

Population focused assessment in health planning. Models of assessment for communities, organizations, other aggregates. Skill development in conducting/ analyzing/using assessment in planning population focused interventions.

**Nurs 5222. Advanced Physiology.** (3 cr. Prereq—Grad nursing major or #)

Systems approach to human physiology/pathophysiology. Physiologic changes across life span. Emphasizes clinical application using population-specific content related to various specialty areas in advanced practice nursing.

**Nurs 5223. Assessment of Psychopathology for Advanced Practice Psychiatric/Mental Health Nursing.** (4 cr. Prereq—Nurs grad or #)

Advanced concepts from nursing theory and research, social sciences, neuropsychology, and neurophysiology used in the assessment of psychiatric symptoms and disorders across the age continuum. During clinical, develop proficiency in the assessment of psychopathology in clients with psychiatric symptoms.

**Nurs 5224. Clinical Pharmacotherapeutics.** (3 cr. Prereq—Grad, #)

Advanced practice nurses in primary care get a foundation in pharmacotherapeutics across the life span. Topics include pharmacodynamics/kinetics/epidemiology, client patterns of medication use, selection of appropriate drugs for selected client conditions, and prescriptive writing privileges for advanced practice nurses.

**Nurs 5225. Psychopharmacology for Advanced Practice Psychiatric/Mental Health Nursing.** (3 cr.

Prereq—Grad student or RN [with master's degree] or #)  
Advanced concepts in neuroscience, psychopharmacology, and clinical management related to psychopharmacologic treatment of psychiatric disorders/symptoms. Application to problems in various clinical settings.

**Nurs 5300. Health Behavior Intervention: Theory and Application.** (3 cr. Prereq—Grad or #)

Interdisciplinary course examines theoretical foundations and research base of intervention strategies to promote health behavior acquisition, behavioral change, and maintenance for adults (individuals and groups). Critical examination of health behavior and patterns and health risk assessment; approaches to program creation.

**Nurs 5340. Group as a Health-Care Intervention.** (2 cr. Prereq—Grad or #)

Theoretical concepts and research findings from the areas of group therapy and dynamics are applied in the development of a model for using group as an intervention for various client populations.

**Nurs 5501. Professional Issues in Nurse-Midwifery.**

(1-2 cr. Prereq—Nurs grad major, #)  
Analysis of professional issues that confront and impact the practice of certified nurse-midwives. History and development of the professional organization including certification, legislation, ethical dimensions, public policy, and clinical practice issues.

**Nurs 5520. Women's Issues: A Health Perspective.**

(3 cr. Prereq—Upper div or grad student)  
Multidisciplinary exploration and analysis of a broad range of women's health issues: physiological, developmental, historical, sociocultural, feminist, nursing and medical. Topics include health promotion and reproductive health issues across the life span.

**Nurs 5522. Sociopolitical Context of Women's Health.**

(1-2 cr [max 3 cr]; S-N only. Prereq—Grad student)  
Women's health issues from multidisciplinary perspective. Sexual/reproductive health issues across life span. Sociocultural issues affecting health, such as poverty/violence.

**Nurs 5601. School Nursing in the Educational System and the Community.** (1-3 cr; A-F only. Prereq—3 yrs of college level courses)

School health problems, assessment/intervention strategies. Integration of research findings. Applications with individuals, families, communities.

**Nurs 5604. Advanced Health Assessment and Interventions With Adolescents.** (2 cr. Prereq—CPSy 5303 or equiv or #)

Integrates knowledge from nursing, public health, health behavior, and adolescent development as framework for developing health assessment/intervention strategies for clinical practice with adolescents.

**Nurs 5800. Nursing Topics.** (1-4 cr [max 8 cr]. Prereq—#)

Course allows students to study a topic not included in regular courses, or for faculty to offer a course to determine interest in a topic.

**Nurs 5801. Policymaking, Health Policy, Political Action and Nursing.** (3 cr)

Analysis of sociocultural values, public policymaking, health care policy, and the relationship to the health care delivery system. The impact of health care policy on the profession and practice of nurses, and on consumers. Enhanced participation of nurses in policymaking and political action.

**Nurs 5802. Spirituality and Nursing Practice.** (2 cr.

Prereq—For undergrad cr: nurs sr or RN; for grad cr: nurs grad student or #)  
Exploration of the concept of spirituality as integral to the whole person. Discussion of spiritual nursing care interventions.

**Nurs 5803. Transcultural Nursing: Theories and Issues.** (2 cr. Prereq—Cultural anth course or #)

Study of cultural factors that influence theories, issues, and nursing care practices in diverse cultures and subcultures. Emphasis on nursing within international systems of health care and nursing practices related to various health-illness systems in this country and worldwide.

**Nurs 5804. Therapeutic Healing Touch: Research and Practice.** (2 cr; S-N only. Prereq—[Upper div or grad]

student in [health sciences or health care])  
Therapeutic/Healing Touch as energetic based,

biofield healing modality. Art/science of this modality. Research literature related to Therapeutic Touch/Healing Touch. Explanations for effects. Practice of Therapeutic Touch, intervention techniques.

**Nurs 5805. The 'M' technique.** (1 cr; S-N only.

Prereq—Undergrad nursing student or grad student in health sciences or health professional)  
Scientific/theoretical foundations/practice of 'm' technique, a touch therapy for promoting relaxation by topically administering essential oils. Appropriate applications. Demonstration/practice of technique. Interdisciplinary course.

**Nurs 5806. Theoretical Foundations and Experiential Learning in Complementary/Alternative Therapies.** (2-3 cr. Prereq—#)

Overview of complementary therapies. Demonstration of selected therapies. Theoretical/scientific knowledge supporting use of therapies.

**Nurs 5807. Stories of Illness.** (3 cr)

Subjective experiences of various physical/mental illnesses. Social context of illness, society's responses to illness. Ethical implications for patients/practitioners. Uses fiction, art, film, music, first-person accounts of illness, and anthropological, sociological, and historical literature.

**Nurs 5808. American Indian Health and Health Care.**

(2 cr. Prereq—Upper div or grad student or #)  
Examines health of native nations in Minnesota within historical/cultural contexts. Epidemiology of major health conditions, health services, traditional Indian medicine, health beliefs. Opportunities for contact with Native American community.

**Nurs 5809. Seminars in Critical Care.** (2 cr)

Analyzes current research/developments in treatments, care delivery, and ethical issues affecting critically ill patients and their families. Students participate with team of multidisciplinary faculty from Center for Critical Care in critiquing/presenting literature and discussing applications to clinical practice.

**Nurs 5830. Advanced Clinical Nursing.** (1-6 cr.

Prereq—Graduate nurs major or #)  
Independent study or faculty seminar on special clinical topic.

**Nurs 8100. The Discipline of Nursing.** (3 cr.

Prereq—Grad nurs major or #)  
Knowledge structures used in nursing; theories, models, and conceptual frameworks. Articulation and evaluation of personal conceptual framework for advanced nursing practice.

**Nurs 8110. Developing Nursing Knowledge.** (2 cr;

S-N only. Prereq—PhD student)  
Philosophical perspectives, research methodologies for developing nursing knowledge.

**Nurs 8112. Theoretical Foundations of the Discipline.**

(3 cr. Prereq—8100 or equiv, knowledge of phil of sci)  
Paradigms in nursing and related methods of inquiry, knowledge structures, and projection of needs for further knowledge development and testing.

**Nurs 8113. Theory Development in Nursing.** (3 cr;

S-N only. Prereq—8100 or equiv, 8112 or #)  
Strategies for theory development; synthesis of theoretical formulations in nursing using selected inductive and deductive theory development strategies.

**Nurs 8120. Phenomenon of Health.** (3 cr. Prereq—Grad

nurs major, #)  
Prevailing and emerging views of health from differing belief systems and methods of inquiry. Philosophical, theoretical, and methodological implications for development of a nursing paradigm based on evolving perspectives of "humanness."

**Nurs 8121. Theoretical Foundations of Health-**

**Related Behaviors.** (2 cr. Prereq—Research course, grad nurs major)  
Research and theory related to development and modification of health behaviors and human responses to events disruptive to health; formulation of research hypotheses and selection of appropriate methodologies for studying hypotheses.

**Nurs 8122. Stress, Coping, and Health.** (2 cr. Prereq—Research course, grad nurs major, #) Stress and coping theories and related research; adequacy and efficacy of stress-management interventions/programs; directions for future research.

**Nurs 8123. Complementary Therapies: Theory and Research.** (2 cr. Prereq—Research course) Scientific basis of selected complementary therapies such as therapeutic touch, imagery, music, and massage; hypotheses related to selected interventions; appropriate methodologies.

**Nurs 8124. Family Health Theory.** (3 cr. Prereq—8100, #) Emerging theory in family nursing science, related theories, and research on family systems for structuring a systemic framework to examine clinical problems related to family healthcare. Applies family health theories to selected phenomena of interest in healthcare.

**Nurs 8140. Moral and Ethical Positions in Nursing.** (3 cr. Prereq—Grad nurs major or #) Synthesis of ethical positions, from nursing perspective, on health-related issues at individual, group, population, and policy levels. Normative ethics, theoretical basis for positions taken, and contextual implications for subsequent action.

**Nurs 8150. Moral and Ethical Development in Nursing Science.** (3 cr. Prereq—Grad nurs major, 8140 or #) Interactions among research and theory in moral judgment and behavior, applied ethics, and nursing.

**Nurs 8170. Research in Nursing.** (3 cr. Prereq—18170 or inferential stat course taken within two yrs) Research process/methods appropriate for problems relevant to nursing. Critique of research studies, proposal development.

**Nurs 8171. Qualitative Research in Nursing and Healthcare.** (3-4 cr. Prereq—8170, 8100 or equiv grad theory and research courses or #) Characteristics of key qualitative research methods and nature of knowledge generated. Relevance to healthcare and development of nursing discipline; issues related to entry into the field, data collection, and analysis.

**Nurs 8173. Principles and Methods of Implementing Research.** (3 cr. Prereq—8114 or other 8xxx grad research methods course, 2 grad stat courses) Integrates scientific, statistical, and practical aspects of research. Inter-relationships among design, sample selections, subject access, human subjects requirements, instrument selection and evaluation, data management, analyses plans, grant writing, and research career issues. Field experiences required.

**Nurs 8175. Advanced Nursing Research.** (3 cr. Prereq—8170 or equiv, advanced inferential and nonparametric stat, comp sci course) Interrelationships among types of knowledge and phenomenon, methods of scientific inquiry, generation of research questions, accepted conventions of stating and studying relationships; questions examined by reviewing writings of selected authors.

**Nurs 8176. Research on Decision Making in Health Care.** (3 cr. Prereq—One graduate-level research course, #) Conceptual models/studies on decision making about health care. Formulating research proposals to investigate health care decisions by health care professionals, health care policy makers, patients/clients, or families.

**Nurs 8177. Advanced Nursing Research Practicum.** (1-4 cr; S-N only. Prereq—Nurs PhD student, #) Students collaborate as a team in research experience providing opportunities to synthesize knowledge in an area of study and to design and/or implement research.

**Nurs 8178. Methods for the Study of Family Health Phenomena.** (3 cr. Prereq—8124, 8100 or equiv or #) Conceptual and methodological approaches in study of family health phenomena from nursing perspective. Research designs formulated to study questions in this area.

**Nurs 8193. Special Topics in Nursing Research.** (1-6 cr. Prereq—#) Seminar and/or individual study of research design, methodologies, or instruments.

**Nurs 8194. Problems in Nursing.** (1-6 cr; S-N only. Prereq—Grad nurs major, #) Individual study of a nursing problem or phenomenon. For Plan B projects, student must register S/N.

**Nurs 8240. Advanced Practice Nursing: Roles and Issues.** (2 cr. Prereq—Admission to advanced practice area of study or #) Current most relevant professional/health care issues affecting diverse advanced practice nursing roles. Role theory, practice models, interdisciplinary team function, reimbursement, certification, scope of advanced nursing practice.

**Nurs 8241. Health Care Leadership for a Changing World.** (2 cr. Prereq—AHC grad student or #) Application of leadership theory/research to strengthen students' capacity to facilitate change in health care delivery system.

**Nurs 8242. Population Focused Health Care Delivery Systems.** (2 cr. Prereq—Grad nurs student or #) Health care organizations/delivery systems, their relation to health of diverse populations. Models of population focused care, use of research to improve health care delivery, effect of economic/social factors on health/health services.

**Nurs 8300. Cancer Principles and Practice.** (3 cr. Prereq—Grad nurs major or #) Synthesis of personal and societal risk factors in carcinogenesis. Analysis of strategies to prevent cancer and reduce morbidity. Models of acute, chronic, and late effects of treatment. Comparative analysis of ethical, legal, and socioculture issues in cancer care.

**Nurs 8301. Oncology Clinical I.** (3 cr. Prereq—18300, grad nurs major, Minnesota RN licensure) Synthesis and clinical application of knowledge of cancer risk factors and advanced practice interventions to modify cancer risk behaviors of individuals, families, and communities. Use of research and clinical models to analyze, manage, and evaluate responses to cancer and treatment.

**Nurs 8302. Advanced Practice Nursing for Acute Health Needs I.** (3 cr. Prereq—5200, 5222, 8100, advanced pharmacology, [pathophysiology or immunobiology], inferential statistics) Evaluation of theories/models/research in symptom management. Application of therapy/research supporting clinical decision making with adults experiencing alterations in exchange, sensory, and mobility phenomena. Emphasizes client outcomes related to advanced practice nursing interventions.

**Nurs 8303. Research-based Clinical Reasoning and Management in Acute Care I.** (4 cr. Prereq—5200, [5222 or pathophysiology or immunobiology], 8100, advanced pharmacology, inferential statistics) Synthesis/utilization of knowledge/research in care of adults with acute/critical illness. Advanced clinical decision making. Management of responses to acute cardiac, renal, and sensory alterations.

**Nurs 8304. Advanced Practice Nursing for Acute Health Needs II.** (3 cr. Prereq—5200, 8100, [8170 or advanced physiology], 8302, [pathophysiology or immunobiology], advanced pharmacology) Evaluation of theories/models/research in management of acute symptoms. Application of theory/research to support clinical decision making for adults experiencing alterations in metabolic, alimentary, and regulatory phenomena. Emphasizes client outcomes related to advanced practice nursing outcomes.

**Nurs 8305. Research-based Clinical Reasoning and Management in Acute Care II.** (4 cr. Prereq—5200, 5222, 8100, 8170, 8303, [advanced pharmacology or pathophysiology or immunobiology]) Synthesis/utilization of knowledge/research in care of adults with acute/critical illness. Advanced clinical decision making. Management of responses to acute alterations in metabolic, alimentary, and pulmonary functions.

**Nurs 8306. Psychological and Immunological Responses in Cancer and Acute Care.** (3 cr. Prereq—Grad nurs major or #) Research-based evaluation and management of hematological and immunological responses to cancer and acute life-threatening illness. Exploration of theories and models used to explain and predict psychological adaptation in clients and their family members.

**Nurs 8307. Oncology Clinical II.** (3 cr. Prereq—8306 or 18306, grad nurs major, Minnesota RN licensure) Synthesis of research and integration of knowledge in clinical management of complex physical and psychosocial care in cancer. Application of advanced practice and theoretical models to guide decision making and coping responses in clients and their families.

**Nurs 8309. Research-based Clinical Reasoning and Management in Acute Care III.** (4 cr. Prereq—5200, [5222 or pathophysiology or immunobiology], 8100, 8140, 8170, 8240, 8303, 8305, advanced pharmacology) Synthesis/utilization of knowledge/research in care of adults with acute/critical illness. Advanced clinical decision making. Management of responses to acute alterations in immunological, hematological, and psychological functions.

**Nurs 8311. Specialized Focus in Research-based Clinical Reasoning and Management in Acute Care.** (3-4 cr. Prereq—5200, 5222, 8100, 8140, 8170, 8240, 8303, 8305, 8309, advanced pharmacology, [pathophysiology or immunobiology]) Synthesis/utilization of knowledge/research in care of adults with acute/critical illness. Participation (in a clinical area of interest) in advanced decision making and in management of clients requiring restorative care.

**Nurs 8314. Intervention Models for Adults and Elders With Chronic Health Conditions.** (3 cr. Prereq—5222, 5800, 8100, 8140, 8170) Development of theory-/research-based nursing intervention models for adults/elders with chronic health conditions. Students implement/evaluate intervention models in an advanced practice role with chronically ill adults/elders.

**Nurs 8315. Advanced Practice Nursing for Adults.** (4 cr. Prereq—5222, 5800, 8100, 8140, 8170) Development of clinical expertise in provision of advanced nursing care to adults with acute health problems needing restorative care. Students utilize theory/research to manage/evaluate acute health problems in a selected adult specialty area.

**Nurs 8316. Implementing Advanced Practice Roles in Adult Nursing.** (5 cr. Prereq—5222, 5800, 8100, 8140, 8170, 8314, 8315) Experiences in clinical nurse specialist roles of case management, teaching, consultation, and collaboration. Students utilize theory/research to provide advanced nursing care to adults within selected specialty area.

**Nurs 8320. Multidisciplinary Seminar on Social Perspectives of Aging.** (3 cr. Prereq—#) Literature/policy on key social aspects of aging, emphasizing service, policy, and ethical implications; generation of research questions.

**Nurs 8321. Advanced Nursing Care of the Elderly I.** (6 cr; A-F only. Prereq—Grad nurs major, core courses, #) Exploration of functional patterns of health, and evaluation of theories/research as related to physiological, psychological, and sociological aspects of aging. Comprehensive assessment and research-based advanced nursing interventions to promote, maintain, and restore health of the elderly.

**Nurs 8322. Primary Health Care for Elders.** (6 cr; A-F only. Prereq—8321) Focuses on data-based primary care management of common acute and chronic conditions of the elderly and on physiological, psychosocial, and pharmacological interventions. Age-related, cultural, family and community variations will be incorporated into the analysis, implementation, and evaluation of interventions.

**Nurs 8323. Advanced Nursing Care of the Elderly (II): For Nurse Practitioners.** (5-6 cr; A-F only. Prereq-8322, 8xxx advanced gerontological nurs course, grad nurs major, #)

Synthesis and application of theory and research to effectively implement advanced gerontological nursing practice. Focuses on comprehensive primary care management across settings, evaluation of care, role analysis, and impact of contextual factors on health care services for the elderly.

**Nurs 8324. Advanced Nursing Care of the Elderly II: For Clinical Nurse Specialists.** (6 cr; A-F only.

Prereq-Grad nurs major, #)  
Synthesis and application of theory and research to effectively implement as an advanced gerontological nurse. Comprehensive client care management across settings, evaluation of care, role implementation, and influences of contextual factors on health care services for the elderly.

**Nurs 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**Nurs 8340. Advanced Practice Psychiatric/Mental Health Nursing with Individuals and Their Families.** (7 cr. Prereq-5200, 5223, 5225, 8100, 8121, 8140, 8170)

Evaluation of theory and research; their application to advanced clinical management of biological, psychological, and social responses of individuals and families to psychiatric illness. Developing clinical expertise in assessment, diagnosis, treatment planning, and management of individuals and their families.

**Nurs 8341. Advanced Practice Psychiatric/Mental Health Nursing in Groups and Community.** (7 cr.

Prereq-5340, 8340, 18240, 18242)  
Application of theory and research to advanced practice psychiatric/mental health nursing with groups and community systems, including populations at risk. Clinical practicum provides experiences for developing advanced practice roles in variety of healthcare settings.

**Nurs 8360. Advanced Clinical Nursing.** (1-6 cr.

Prereq-Grad nurs major, #)  
Independent study or faculty seminar on special clinical topic when interest exists.

**Nurs 8361. Special Topics in Nursing.** (1-4 cr.

Prereq-Grad nurs major, #)  
Students select and study a topic of interest.

**Nurs 8402. Primary Care: Assessment and Management of Health for Advanced Practice Nurses.** (2-4 cr; A-F only. Prereq-5200, 5222, 5224, 8242)

Data-based assessment/management of preventive health services and common acute/chronic conditions of primary care populations. Emphasizes clinical reasoning and independent/collaborative practice health care plans.

**Nurs 8403. Primary Care Practice for Family Nurse Practitioners: Assessment and Management of Health.** (4 cr; S-N only. Prereq-5200, 5222, 8402)

Application of advanced practice comprehensive health histories and physical assessments in formulating client centered databases. Development/implementation of care plans. Follow-up evaluation of primary care delivered to families across life span.

**Nurs 8404. Family Practice Practicum I.** (2 cr; A-F only. Prereq-5200, 5222, 5224, 8402, 8601)

Comprehensive advanced nursing assessment for acute/chronic health conditions of primary care population across life span. Synthesis/application of nursing theory/research in implementing/evaluating safe/effective nursing interventions to promote health and prevent illness.

**Nurs 8405. Family Practice Practicum II.** (2 cr; A-F only. Prereq-5200, 5222, 5224, 8402, 8601)

Synthesis of advanced practice nursing theory in data collection and in assessment of client in his/her environment. Implementation/evaluation of interventions for disease management in primary care setting. Nursing theory/research used in developing nursing practice models for health promotion, disease prevention, and intervention.

**Nurs 8406. Health Care of Children for the Family Nurse Practitioner.** (3 cr; A-F only. Prereq-#)

Application of midrange theories, models, concepts applicable to promotion, maintenance, restoration of health of infants, children, adolescents within context of their families/communities. Current research evaluated/used for designing age-specific interventions for children and their families.

**Nurs 8407. Health Care of Children Practicum for the Family Nurse Practitioner.** (2 cr; A-F only. Prereq-5200, 5222, 5224, 8242, 8402)

Synthesis of research-based nursing assessment/intervention of minor acute/chronic health conditions in primary care population across life span. Application of nursing theory, research from related disciplines, in evaluating/implementing interventions. Clinical practicum in pediatric primary care. Focuses on assessment, primary health care, of well children from birth to adolescence.

**Nurs 8420. Childbearing-Childrearing Family Nursing.** (4 cr. Prereq-8100, 8150, grad nurs major or #)

Maintenance, promotion, and restoration of health for clients in the childbearing-childrearing family. Theories and concepts related to parents, children, and families. Practicum includes conferences, written assignments, and use of grounded theory methods of investigation.

**Nurs 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**Nurs 8450. Primary Care: Health Assessment and Care of Well Children.** (3 cr. Prereq-5200, 5222, 18451)

Study of age-specific and family-centered assessment, prevention, and health promotion nursing interventions for infants through adolescents. Emphasis on theories and concepts related to comprehensive health supervision. Stresses the use of critical thinking for clinical decision making to implement and evaluate advanced practice nursing interventions.

**Nurs 8451. Primary Care Practicum: Health Assessment and Care of Well Children.** (3 cr. Prereq-5200, #)

Focus on age-specific, family-centered nursing assessment and interventions to promote wellness of children, infants through adolescence. Emphasis on compiling and evaluating advanced nursing interventions for disease prevention and health promotion of children and families. Practicum includes exposure to models of primary prevention.

**Nurs 8452. Primary Care: Common Acute Health Conditions Affecting Children.** (2 cr. Prereq-8501, 8451, 18453, #)

Research-based evaluation and management of common acute conditions affecting children from infancy through adolescence. Exploration of theories and models used to explain and predict physiologic and psychologic adaptation of children and their families.

**Nurs 8453. Primary Care Practicum: Common Acute and Chronic Health Conditions Affecting Children.** (3 cr. Prereq-8411, 8442, 18452, #)

Focus on age-specific, family-centered nursing assessment and intervention of minor acute and chronic conditions of children within family context. Emphasis on nursing intervention strategies include diagnostics, therapeutics, education, and follow-up evaluation of outcomes.

**Nurs 8454. Primary Care Practicum: Synthesis of Advanced Nursing Practice for the Child, Family, Community.** (4 cr. Prereq-8452, 8453)

Research-based knowledge synthesis to effectively intervene with common pediatric physical and psychosocial alternations in health. Role implementation issues and development of an effective theory-based nursing practice model for care of individuals, families, and communities.

**Nurs 8455. Health Care for Children and Youth With Special Health-Care Needs.** (2 cr. Prereq-8454)

Primary care of children and youth with special healthcare needs, emphasizing growth and

development, pathophysiology, specific conditions, and holistic, family-centered, community-based, culturally competent, and coordinated approach to assessment and intervention.

**Nurs 8456. Health Care for Children and Youth With Special Health-Care Needs Practicum.** (3 cr. Prereq-8454, 8455, #)

Research-based evaluation and management of psychologic and physiologic responses to chronic illness. Developing theory-based holistic, family-centered, community-based, culturally competent, coordinated nursing interventions. Clinical seminars incorporate advanced practice nursing models of care and interdisciplinary collaboration strategies.

**Nurs 8457. Assessment and Intervention Models in Families of Children With Special Health-Care Needs.** (4 cr. Prereq-8124 or equiv, 8100, 8456, #)

In-depth, systemic, and theory-based study of family health assessment methods and intervention models. Practicum to assess, intervene, and evaluate intervention models related to patterns of functioning in families of children with complex health-care needs.

**Nurs 8501. Reproductive Health Care for Women.** (3-8 cr. Prereq-5200, #)

Theory, current research underlying clinical practice in assessing/managing issues related to women's reproductive/sexual health throughout life cycle.

**Nurs 8502. Reproductive Health Care for Women at Risk.** (2-6 cr. Prereq-1, 8503 or 8520)

Theoretical and research basis for advanced practice nursing care of women and infants at risk for medical and/or psychosocial problems. Selected high-risk perinatal and complicated gynecological and neonatal conditions.

**Nurs 8503. Nurse-Midwifery Care of the Childbearing Family.** (4-10 cr; A-F only. Prereq-8501, #)

Theoretical/research-based nurse-midwifery intrapartum care, management, support of women and their families. Labor, birth, immediate postpartum period, and newborn care. Development/implementation of nurse-midwifery care. Draws from research that provides basis for practice.

**Nurs 8504. Nurse Midwifery and Women's Health Care Nurse Practitioner Primary Care Practicum.** (2-3 cr; S-N only. Prereq-5200, 5222, 8402)

Application of advanced practice comprehensive health histories and physical assessments in formulating client centered databases. Development/implementation of care plans. Follow-up evaluation of primary care delivered to adult populations. Focuses on women.

**Nurs 8520. Advanced Concepts in Women's Health for the Nurse Practitioner.** (3-8 cr; A-F only. Prereq-1, 8501, #)

Theoretical and research basis for women's healthcare nurse practitioner practice building on foundations of gynecological and antepartum care. Preparation of childbearing family for birth and selected complex health concerns for women.

**Nurs 8600. Advanced Public Health Nursing.** (2 cr. Prereq-Grad nursing major)

Conceptual frameworks for advanced public health nursing practice. Analysis of population-focused nursing research and of public health nursing management strategies.

**Nurs 8601. Interventions for Health of Populations.** (3 cr. Prereq-8040 or PubH 5733)

Synthesis of behavior formation/change, public health, and nursing models, theories, and research for critiquing and designing population-focused interventions. Developing, implementing, evaluating, and proposal writing for culturally competent public health interventions in community-based settings.

**Nurs 8602. Public Health Nursing Intervention Practicum.** (3 cr; S-N only. Prereq-8242, 8601)

Applying principles, theory, and research about epidemiology/public health/public health nursing interventions to population-focused health issues. Collaborating with community-based preceptors to achieve public health objectives.

**Nurs 8603. Public Health Nursing Leadership Practicum.** (3 cr; S-N only. Prereq–8100, 8170, 8241, 8242, 8600)

Synthesis of leadership and advanced public health nursing theories and research; their applicability within public health nursing leadership situations.

**Nurs 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq–Max 18 cr per sem/summer; doc student who has not passed prelim oral)

**Nurs 8701. Nursing and Health-Care Systems Administration I.** (4 cr; A-F only. Prereq–#)

Intensive study of nursing and healthcare administration and leadership. Application of nursing, organization, care delivery, and population health improvement theories to health systems administrative practice. Planning, organizing care systems, assembling, and developing material and human resources.

**Nurs 8702. Nursing and Health-Care Systems Administration II.** (4 cr; A-F only. Prereq–8701, #)

Intensive development of competencies associated with skilled administration of healthcare services. Application of organization, nursing, political, and economic theories in operationalizing and evaluating administrative and leadership practice of nurses in healthcare delivery systems.

**Nurs 8720. Teaching and Learning Nursing.** (3 cr. Prereq–5204, 8100, 8140, learning theory course)

Theories of curriculum, teaching, learning, nursing used to develop conceptual framework for teaching nursing. Framework is used as model for teaching students in simulated classroom situations.

**Nurs 8721. The Nurse Educator in Higher Education.** (4 cr. Prereq–[8241, 8242, 8720, educational measurement course, grad nursing major] or #)

Teaching practicum: comprehensive implementation/evaluation of effectiveness of personal teaching models in classroom/clinical settings in an academic environment. Roles/responsibilities of faculty. Issues affecting curriculum design/development.

**Nurs 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq–Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Nurs 8800. Methods for the Study of Family Health Phenomena.** (2 cr. Prereq–8124, 8175 or equiv or #)

Exploration of conceptual and methodological approaches in study of family health phenomena from a nursing perspective. Formulation of research design to study questions in family health.

**Nurs 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer; 24 cr required)

## Nutrition (Nutr)

*College of Agricultural, Food and Environmental Sciences and College of Human Ecology*

**Nutr 8333. FTE: Master's.** (1 cr; NGA. Prereq–Master's student, adviser and DGS consent)

**Nutr 8444. FTE: Doctoral.** (1 cr; NGA. Prereq–Doctoral student, adviser and DGS consent)

**Nutr 8610. Nutrition Graduate Seminar.** (1 cr; S-N only. Prereq–Nutr grad student, #)

Presentation of thesis (M.S. or Ph.D.) or plan B project work in public seminar.

**Nutr 8612. Advances in Nutrition: Diet and Chronic Disease.** (2 cr [max 4 cr])

Recent research on relationship of diet to development/treatment of chronic diseases, including cancer, diabetes, and osteoporosis. Clinical, animal, and cell culture studies examined epidemiologically.

**Nutr 8613. Advances in Nutrition: Lipoproteins, Cholesterol, and Atherosclerosis.** (2 cr. Prereq–Grad student in nutr or related field)

Lipoprotein biochemistry and physiology, environmental and genetic factors influencing

cholesterol metabolism, efficacy of diet therapy and lipid lowering in heart disease prevention, use of drugs in atherosclerosis, putative role of lipoprotein oxidation in atherosclerosis. Human studies and animal models in atherosclerosis research.

**Nutr 8614. Advances in Nutrition: Advanced Energy Balance.** (2 cr. Prereq–Grad student in nutr or related field)

Recent literature on energy balance and body composition in animals and humans.

**Nutr 8615. Advances in Nutrition: Exercise Metabolism.** (2 cr. Prereq–Grad student in nutr or related field.)

Review of research on effects of diet on exercise metabolism.

**Nutr 8616. Advances in Nutrition: Free Radicals, Trace Elements, and Other Micronutrients.** (2 cr. Prereq–Grad student in nutr or related field)

Free radical chemistry, cellular biology, and micronutrient nutrition considered in roles of pro-oxidants and antioxidants in human diseases and aging. Current understanding of biological action of free radicals and role of micronutrients in antioxidant protection in humans and animals.

**Nutr 8617. Chemical Carcinogenesis and Chemoprevention.** (3 cr; A-F only. Prereq–[[BioC 3001, BioC 3021, BioC 4331] or equiv], [Chem 2302 or equiv])

Fundamental background in chemical carcinogenesis, carcinogen activation/detoxification, carcinogen-DNA adduct formation, cellular oncogenesis, cancer chemoprevention, nutrition/cancer. Topics integrated/interrelated.

**Nutr 8618. Neuroregulation of Energy Metabolism.** (2 cr; A-F only. Prereq–[FScN 5621, FScN 5623] or #)

Advanced topics on neural regulation of food intake and energy expenditure. Neurotransmitters, including NPY, opioids, urocortin, melanocortins, oxytocin, and vasopressin. Genetics of obesity. Behavioral aspects of feeding. Energy balance. Macronutrient specific appetite. Energy expenditure. Uncoupling proteins. Vagal feeding regulation. Drug therapy for obesity. Eating disorders. Students read/discuss key research papers.

**Nutr 8620. Advances in Nutrition.** (2-3 cr [max 6 cr]. Prereq–#)

Recent research or special topics (e.g., obesity, vitamin biochemistry, nutrition education).

**Nutr 8621. Presentation Skills.** (1 cr; S-N only. Prereq–Δ)

Orientation to nutrition graduate program. Presenting scientific seminars, using electronic presentation programs/equipment.

**Nutr 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq–Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Nutr 8695. Independent Study: Nutrition.** (1-4 cr [max 6 cr]. Prereq–#)

Written report for master's plan B project.

**Nutr 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq–Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Nutr 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer; 24 cr required)

**Nutr 8900. Advances in Nutrition: Advanced Lifestyle Nutrition.** (2 cr. \$PubH 8900. Prereq–Nutr grad major or Pub hltl nutr or Epi MPH or Epi or Food sci grad major)

Evaluation and discussion of research and research issues in nutrition during various stages of the life cycle. Methodological issues of applied human nutrition investigation, current status of knowledge, and implication of research results to public health policies, programs, and future research.

## Occupational Therapy (OT)

*Department of Physical Medicine and Rehabilitation  
Medical School*

**OT 8333. FTE: Master's.** (1 cr; NGA. Prereq–Master's student, adviser and DGS consent)

**OT 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq–Max 18 cr per semester or summer; 10 cr total required [Plan A only])

## Operations and Management Science (OMS)

*Department of Operations and Management Science  
Curtis L. Carlson School of Management*

**OMS 5170. Simulation Modeling and Analysis.** (4 cr; A-F only. Prereq–MBA 6120 or BA 1550 or #)

Techniques and application of computer simulation modeling and analysis. Includes animations of existing or proposed real-world facilities and processes. Experiments in simulation programming language and environment. Simulation models and animations demonstrating actual operation of models. Planning, analysis, and interpretation of simulation experiment results.

**OMS 8651. Experimental Design.** (3 cr; A-F only. Prereq–MBA 6120 or equiv or business admin PhD student or #; offered alt yrs)

Analysis of variance for one-way, two-way, and multi-way data. Basic concepts of statistical design and analysis of results. Randomized block, Latin square, cross-over, factorial designs, confounding, estimation and comparison of effects, response surfaces, and applications to management.

**OMS 8652. Regression Analysis.** (3 cr; A-F only. Prereq–MBA 6120 or equiv, business admin PhD student or #; offered alt yrs)

Regression and correlation models, inferences in simple and multiple regression, multicollinearity, indicator variables, variable selection techniques, treatment of assumption violations, applications to management problems, basic concepts of experimental design.

**OMS 8661. Linear Programming.** (3 cr; A-F only. Prereq–Business admin PhD student or #)

Revised simplex, primal-dual, and large-scale methods, including decomposition and partitioning and methods for bounded variables.

**OMS 8671. Simulation Analysis.** (3 cr; A-F only. Prereq–Business admin PhD student or #; offered alt yrs)

A treatment of underlying probabilistic and statistical aspects of computer simulation. Random number generators, variate and process generation, statistical analysis of simulation output, ranking and selection of simulation models, and variance reduction techniques.

**OMS 8672. Stochastic Modeling and Analysis.** (3 cr; A-F only. Prereq–Business admin PhD student or #; offered alt yrs)

Probabilistic modeling of dynamic processes, including Markov chains; Poisson, renewal, continuous-time Markov processes, and queuing models. Statistical estimation of selected models; applications to managerial problems, such as brand shift, industrial migration, manufacturing, and computer/communications networks.

**OMS 8681. Queuing Theory: A Computational Approach.** (3 cr; A-F only. Prereq–8672, business admin PhD student or #)

Theory of Stochastic Service Systems (theory of queues) from an algorithmic point of view. Prepares

students to model and analyze complex stochastic service systems via classical methods and algorithmic methods and approximations.

**OMS 8711. Research in Operations Strategy.** (3 cr; A-F only. Prereq—Business admin PhD student or #; offered alt yrs)

Operations performance; competitive advantage; focused factory, product, and process innovation; and operations strategy implementation. Research results and methods.

**OMS 8721. Management of Technological Operations.** (3 cr; A-F only. Prereq—Business admin PhD student or #; offered alt yrs)

Theories and models used to address problems of managing technological operations and operations in manufacturing and service firms. Technology strategy, economic/organizational perspectives on technology, productivity analysis, technology evaluation, project selection and evaluation, learning, etc.

**OMS 8735. Operations Forecasting and Inventory Research.** (3 cr; A-F only. Prereq—Business admin PhD student or #; offered alt yrs)

Research on forecasting, inventory control, materials requirements planning, just-in-time manufacturing, aggregate planning, scheduling, routing, sequencing, and dispatching in manufacturing and service industries. Research papers and methods are discussed.

**OMS 8745. Research on Quality Management.** (3 cr; A-F only. Prereq—Business admin PhD student or #; offered alt yrs)

Research literature, methods, and results. Research on quality strategy, economics of quality, statistical process control, vendor management, off-line quality, and quality practice.

**OMS 8892. Readings in Operations and Management Science.** (1-8 cr [max 16 cr]. Prereq—Business admin PhD student or #)

Readings useful to student's individual program and objectives that are not available in regular courses.

**OMS 8894. Graduate Research in Operations and Management Science.** (1-8 cr [max 16 cr]. Prereq—Business admin PhD student or #)

Individual research on an approved topic appropriate to student's program and objectives.

## Oral Biology (OBio)

*Department of Oral Sciences  
School of Dentistry*

**OBio 5001. Methods in Research and Writing.** (2 cr) Skills necessary to begin a research project, including literature review, hypothesis formation, research design, and writing. Each student develops a research protocol.

**OBio 8011. Oral Biology.** (2 cr; A-F only. Prereq—Dental specialist or oral research trainee)

Salivary secretions, composition and function; orofacial development, anatomy and genetics; oral aspects of inflammation, wound healing, and immunology; plaque formation, composition, metabolism, and clinical control; biochemistry of connective and mineralized tissues; neurobiology and pathophysiology of orofacial pain and sensations.

**OBio 8021. Oral Microbiology.** (2 cr. Prereq—Dental specialist or oral research trainee or #)

Role of indigenous human oral microflora in health and disease. Colonization of oral cavity and role of specific pathogens in development of dental caries and periodontal diseases. Infections of dental pulp and periapical tissues, oral manifestations of viral and fungal infections, and microbial considerations in specialty areas of dental practice.

**OBio 8022. Oral Neuroscience.** (2 cr. Prereq—Dental specialist or oral research trainee or #)

Background lectures and student presentations on current research topics to evaluate questions in general

motor and sensory function related to oral and nasal structures. Taste, smell, and other chemical senses as they relate to those structures.

**OBio 8023. Physical Biology of the Oral Cavity.** (2 cr; A-F only. Prereq—Dental specialist or oral research trainee or #)

Structure and function of load-bearing components of human masticatory system from biophysical point of view. Mandibular form and movement; infrastructure of hard tissues as related to occlusal wear and masticatory efficiency; role of saliva and salivary pellicle in reduction of interocclusal friction; and computer simulation of jaw mechanics.

**OBio 8024. Genetics and Human Disease.** (1 cr. Prereq—Dental specialist or oral research trainee or #) Principles of medical genetics with emphasis on oral diseases. Twins, chromosomes, recombinant DNA, major gene traits, genes in populations, chromosomal abnormalities, complex traits, facial clefts, dental caries, periodontal diseases.

**OBio 8025. Topics in Cariology.** (2 cr; A-F only.

Prereq—Dental specialist or oral research trainee or #) Lectures, assigned readings, and discussions of basic epidemiological, biological, and chemical aspects of dental caries. Etiology, epidemiology, and pathogenesis of dental caries, and influence of dietary, salivary, plaque, and microbial factors on the caries process.

**OBio 8026. Salivary Glands, Secretions, and the**

**Secretory Immune System.** (2 cr; A-F only. Prereq—Dental specialist or oral research trainee or #) Salivary gland structure and development; mechanisms and control of macromolecule and electrolyte secretion; protein structure and function, interactions with bacteria, salivary pellicle, clinical studies, salivary gland disease. Secretory IgA origin, structure, and synthesis; sIgA induction and biological activity; role of sIgA in oral health.

**OBio 8027. Structural and Biological Aspects of Dental Biomaterials.** (1 cr. Prereq—Dental specialist or oral research trainee or #)

Relates composition and structure of dental biomaterials to their behavior in a biological environment. Fundamental questions: What is the effect of a material on the oral environment? What is the cause and mechanism of such effects? What materials can be used that have beneficial effects? Dental implantology and guided tissue regeneration.

**OBio 8028. Molecular Basis of Cellular and Microbial Adhesion.** (2 cr; A-F only. Prereq—Dental specialist or oral research trainee or #)

Biochemical basis of adhesion phenomena, focusing on cells of immune system, development of organs and tissue formation, and bacterial colonization of the human.

**OBio 8030. Seminar.** (1 cr [max 10 cr]; S-N only.

Prereq—Dental specialist or oral research trainee or #) Faculty and student discussion of current topics in oral biology.

**OBio 8093. Tutorial in Oral Biology.** (1-2 cr; S-N only. Prereq—#)

Semester-long apprenticeship with faculty members to familiarize students with faculty research interests. Individual study of selected topics.

**OBio 8094. Directed Research.** (1-10 cr; S-N only. Prereq—#)

**OBio 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**OBio 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**OBio 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**OBio 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**OBio 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

## Otolaryngology (Otol)

*Department of Otolaryngology  
Medical School*

**Otol 5101. Introduction to the Basic Sciences in Otolaryngology I: Ear.** (2 cr. Prereq—Otolaryngology major or #)

Multidisciplinary introduction to the basic sciences of the ear. Acoustics and psychoacoustics, temporal bone anatomy, external and middle ear mechanisms, cochlear physiology, auditory neurophysiology, ear embryology, ear biochemistry, immunology, fine structures, vestibular mechanisms and measurement. S-N grading option for nonmajors only.

**Otol 5102. Introduction to the Basic Sciences in Otolaryngology II: Head and Neck.** (2 cr. Prereq—Otol major or #)

Multidisciplinary introduction to the basic sciences of the head and neck. Laryngeal anatomy and physiology, nasal anatomy and physiology, immune biology, embryology of head and neck. S-N grading option for nonmajors only.

**Otol 5993. Directed Studies.** (1-12 cr [max 12 cr]. Prereq—#)

Directed readings and preparation of reports on selected topics.

**Otol 8230. Clinical Otorhinolaryngology.** (4 cr; A-F only. Prereq—Grad otol major)

Diagnostic and management instruction and experience in all phases of clinical otorhinolaryngology. Both inpatient and outpatient services are provided at Fairview-University Medical Center, St. Paul Ramsey Medical Center, Veterans Administration Medical Center, and Hennepin County Medical Center. Clinical practica and weekly special group conferences.

**Otol 8231. Surgery of the Ear, Nose, and Throat.** (3 cr; A-F only. Prereq—Grad otol major)

Surgical training and experience with broad scope of surgical problems encountered in otorhinolaryngology provided at Fairview-University Medical Center, St. Paul Ramsey Medical Center, Veterans Administration Medical Center, and Hennepin County Medical Center. Clinical practica and weekly special group conferences.

**Otol 8232. Maxillofacial Surgery.** (1 cr; A-F only. Prereq—Grad otol major)

Basic science and management principles of maxillofacial diseases. Problems of maxillofacial trauma. Experience with these problems in the hospitals of the training program, especially the county hospitals.

**Otol 8233. Plastic and Reconstructive Surgery: Head and Neck.** (1 cr; A-F only. Prereq—Otol major)

Otolaryngologic cosmetic surgery emphasizing rhinoplasty and otoplasty.

**Otol 8234. Anatomy of the Head and Neck and Temporal Bone Dissection.** (2 cr. Prereq—Grad otol major or #)

Head and neck anatomy studied from cadaver through programmed learning. Temporal bones dissected to learn anatomy and to practice otologic surgical procedures. S/N for nonmajors only.

**Otol 8235. Roentgenology of the Head and Neck.** (1 cr [max 12 cr]; A-F only. Prereq—Grad otol major) Principles and procedures in roentgenology for otolaryngologic and head and neck problems.

**Otol 8236. Pharmacology in Otolaryngology.** (1 cr [max 12 cr]; A-F only. Prereq—Grad otol major)

Principles of pharmacology as they relate to otolaryngology.

**Otol 8237. Endoscopy.** (1 cr [max 12 cr]; A-F only. Prereq—Grad otol major)

Didactic and practical instruction in laryngoscopy, esophagoscopy, bronchoscopy, and mediastinoscopy. General management principles emphasized.

**Otol 8238. Pathology of the Ear, Nose, and Throat.**

(1 cr [max 12 cr]; A-F only. Prereq—Grad otol major) Gross pathology and histopathology of diseases of the ear, nose, throat, and related regions.

**Otol 8239. Otoneurology.** (1-2 cr [max 12 cr].

Prereq—Grad otol major or #) Instruction and experience in diagnosis and management of otoneurologic problems, including training in electronystagmographic analysis of vestibular function.

**Otol 8240. Allergy.** (1 cr [max 12 cr]; A-F only.

Prereq—Grad otol major) Concepts and management of otolaryngologic allergy.

**Otol 8241. Cancer of the Head and Neck.** (1 cr [max 12 cr]; A-F only. Prereq—Grad otol major)

Clinical head and neck oncology; etiology, treatment (both surgical and nonsurgical), and other principles of management.

**Otol 8242. Audiology and Speech Pathology.** (2 cr.

Prereq—Grad otol major or #) Clinical audiology and speech-language pathology, including diagnosis and treatment of conductive, sensorineural, and central hearing loss; voice disorders; swallowing disorders; velopharyngeal insufficiency related to cleft lip/palate and craniofacial anomalies; alaryngeal speech; and speech disorders related to head and neck cancer.

**Otol 8243. Introduction to Research Methodology.**

(1 cr. Prereq—Grad otol major or #) Statistical methods, experimental design, and execution of otolaryngologic research. Ethics of research with human and animal subjects.

**Otol 8244. Seminar: Current Literature.** (1 cr.

Prereq—Grad otol major or #) Presentation and discussion of selected articles. Required for all otolaryngology graduate students.

**Otol 8247. Anatomy and Physiology of Hearing and Balance.** (3 cr. Prereq—#)

Structure and function of auditory and vestibular systems. Network analysis of middle and inner ear mechanics, hair cell biophysics, auditory nerve and CNS electrophysiology, information processing, neural mechanisms subserving balance and gaze, cellular morphology, and computer models.

**Otol 8248. Directed Readings in Auditory Physiology.**

(1-2 cr. Prereq—#) Current research on biophysics and physiology of auditory system; topics selected for each student. Written reviews prepared and discussed.

**Otol 8249. Current Topics in Cochlear Anatomy.** (1 cr.

Prereq—#) Review of current research papers concerning cochlear anatomy and pathology.

**Otol 8250. Advanced Biochemistry of the Auditory System.** (1 cr. Prereq—MdBc 6100, MdBc 6101 or equiv or #)

Review of recent progress in biochemical aspects of auditory end organs.

**Otol 8262. Advanced Clinical Audiology.** (2 cr [max 2 cr]. Prereq—Grad otol major, 8242 or #)

Comprehensive reading and practicum in auditory evaluation of patients. Assumes basic knowledge of clinical audiology. Each session devoted to aspect of auditory evaluation or aural rehabilitation, including behavioral audiometry, electrophysiologic evaluation, hearing aid selection, and cochlear implants.

**Otol 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**Otol 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**Otol 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Otol 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Otol 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

## Pharmaceutics (Phm)

### Department of Pharmaceutics

#### College of Pharmacy

**Phm 8100. Seminar: Pharmaceutics.** (1 cr [max 4 cr]; S-N only. Prereq—Grad Phm major)

**Phm 8110. Readings in Pharmaceutics.** (1 cr [max 4 cr]; S-N only. Prereq—Grad Phm major) Current literature.

**Phm 8150. Pharmacokinetics Research Seminar.** (1 cr [max 12 cr]; S-N only. Prereq—Grad Phm major) Current concepts and literature review.

**Phm 8295. Research Problems in Pharmaceutics.** (1 cr [max 20 cr]; S-N only. Prereq—#) Experimental investigation of problems in pharmaceutics.

**Phm 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**Phm 8411. Stabilization of Pharmaceuticals.** (3 cr. Prereq—Physical and organic chem survey courses) Application of physicochemical principles (e.g., chemical kinetics) to elucidate and minimize stability problems in pharmaceutical systems.

**Phm 8421. Advanced Pharmacokinetics.** (4 cr; A-F only. Prereq—#) Topics in kinetics of drug absorption, distribution, metabolism, and excretion.

**Phm 8441. Solid-State Properties of Drugs.** (2 cr; A-F only. Prereq—Physical chem survey course or #) Physical and physicochemical properties of drugs in solid state as related to drug delivery.

**Phm 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**Phm 8451. Industrial Pharmacy.** (2 cr. Prereq—#) Design, manufacture, and evaluation of modern pharmaceutical dosage forms and delivery. Preformulation studies; oral liquid and solid pharmaceutical dosage forms and optimization. Pulmonary, transdermal, and parenteral deliveries, including veterinary drug delivery systems.

**Phm 8461. Solubility Behavior of Drugs and Other Organic Compounds.** (3 cr; A-F only. Prereq—Physical chem survey course or #) Thermodynamics and kinetics of solubility and partitioning. Intermolecular interactions in pure state and in solution. Measurement and prediction of solubility and partitioning behavior. Functional group contributions. Molecular complexation and ion-pairing in solution.

**Phm 8471. Biological Approaches to Drug Targeting and Mechanisms of Drug Transport.** (4 cr; A-F only. Prereq—Survey courses in biochem, physical chem, cell biol, differential equations) Correlation of drug absorption with physiology and properties of drugs. Concept of drug targeting. Characteristics of site-specific drug delivery systems. Therapeutic applications and critical evaluation of major drug carrier systems.

**Phm 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Phm 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Phm 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

**Phm 8900. Special Topics in Pharmaceutics.** (1-4 cr [max 5 cr]; A-F only)

## Pharmacology (Phcl)

### Department of Pharmacology

#### Medical School

**Phcl 5100. Pharmacology for Pre-Nursing Students.** (3 cr; A-F only. Prereq—[Biochemistry, human physiology] or #) Drug principles, mechanisms of action.

**Phcl 5101. Pharmacology for Pharmacy Students.** (3 cr; A-F only. Prereq—Regis 2nd yr pharmacy student or #) Action/fate of drugs. Lectures, lab.

**Phcl 5102. Pharmacology for Pharmacy Students.** (2 cr; A-F only. Prereq—5101 or #) Action/fate of drugs.

**Phcl 5103. Pharmacology for Dental Students.** (3 cr. Prereq—Regis dental student or #) Pharmacological principles/actions of drugs.

**Phcl 5109. Problems in Pharmacology.** (1-18 cr. Prereq—Upper div or grad student or #) Research projects and special problems by arrangement.

**Phcl 5110. Introduction to Pharmacology.** (2 cr [max 2 cr]; A-F only. Prereq—Grad student or #) Basic principles of Pharmacology. Focuses on molecular mechanisms of drug action.

**Phcl 5111. Pharmacogenomics.** (3 cr; A-F only. Prereq—Grad student or #) Human genetic variation, its implications. Functional genomics, pharmacogenomics, toxicogenomics, proteomics. Interactive, discussion-based course.

**Phcl 5210. Pharmacology.** (1 cr; A-F only. Prereq—Grad student or #) Principles of pharmacology. Meets with 6110.

**Phcl 5211. Pharmacology.** (2 cr; A-F only. Prereq—5210 or #) Continuation of 5210. Meets with 6111. Lectures on the major classes of drugs.

**Phcl 5212. Pharmacology.** (3 cr; A-F only. Prereq—5211 or #) Continuation of 5211. Meets with 6112.

**Phcl 5462. Neuroscience Principles of Drug Abuse.** (2 cr. Prereq—#) Current research on drugs of abuse, their mechanisms of action, characteristics shared by various agents, and neural systems affected by them. Offered biennially, spring semester of even-numbered years.

**Phcl 8110. Advanced Pharmacology I.** (3 cr; A-F only. Prereq—Biochem and physiology background, 6110 or #6111 or #) Supplement to Phcl 6110 and 6111. Contemporary research concepts and experimental approaches in the different areas of investigative pharmacology. Mechanisms of action of drugs on systems (whole animal), organ, and cellular levels.

**Phcl 8111. Advanced Pharmacology II.** (3 cr; A-F only. Prereq—Biochem and physiology background, 6111 or #6112 or #) Supplement to Phcl 6111 and 6112. Contemporary research concepts and experimental approaches in the different areas of investigative pharmacology. Mechanisms of action of drugs on cellular and molecular levels.

**Phcl 8200. Seminar: Selected Topics in Pharmacology.** (1 cr [max 8 cr]. Prereq—6112 or #) Student-presented seminars.



**Phcl 8207. Seminar: Psychopharmacology.** (1 cr. Prereq-#)

For graduate students and postdoctorals interested in studies and research associated with psychotropic drugs and chemicals. Neurochemistry, pharmacology, and behavior as antecedent or consequential variables. Some seminars devoted to biomedical ethics.

**Phcl 8208. Neuropsychopharmacology.** (3 cr; A-F only. Prereq-[5212, 6112, Psy 5021, Psy 5061] or #)

Methodologies to study relationships between drugs and biochemical, behavioral, and neurophysiological consequences. Functional biogenic amine, peptidergic, other pathways. How manipulations alter neuronal function or behavior. Feedback mechanisms, induction, inhibition. Reinforcement of, tolerance to, or dependence on drugs of abuse: stimulants, hallucinogens, depressants, opiates. Student presentations. Offered alternate years.

**Phcl 8217. Problems in Investigative Pharmacology.** (1 cr; S-N only. Prereq-#)

Presentation and discussion of contemporary research problems, investigative approaches, and methodologies in experimental pharmacology. Related to cardiovascular, renal, endocrine, and autonomic pharmacology; neuropharmacology; psychopharmacology; chemotherapy; toxicology; and molecular pharmacology.

**Phcl 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**Phcl 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**Phcl 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Phcl 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Phcl 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

## Philosophy (Phil)

### Department of Philosophy College of Liberal Arts

**Phil 5201. Symbolic Logic I.** (4 cr. Prereq-1001 or #) Study of syntax and semantics of sentential and first-order logic. Symbolization of natural-language sentences and arguments. Development of deductive systems for first-order logic. Metatheoretic proofs and methods, including proof by mathematical induction and proof of consistency and completeness.

**Phil 5202. Symbolic Logic II.** (4 cr. Prereq-5201 or #) Elements of set theory, including the concepts of enumerability and nonenumerability. Turing machines and recursive functions; the results of Church, Godel, and Tarski and the philosophical significance of those results.

**Phil 5211. Modal Logic.** (3 cr. Prereq-5201 or #) Axiomatic and semantic treatment of propositional and predicate modal logics; problems of interpreting modal languages.

**Phil 5221. Philosophy of Logic.** (3 cr. Prereq-5202 or #) Attempts to answer, "What is logic?" Scope of logic. Disputes about alternative logics. Theories concerning logical truth (e.g., conventionalism: view that logical truths are contingent).

**Phil 5222. Philosophy of Mathematics.** (3 cr. Prereq-5202 or 5xxx math course) Major philosophical questions arising in connection with mathematics: What is mathematics about? How do we know the mathematics we do? What is the relation between mathematics and the natural sciences. Selected readings of leading contributors such as Frege, Dedekind, Russell, Hilbert, Brunner, Godel, Quine.

**Phil 5325. Biomedical Ethics.** (3 cr. Prereq-# for undergrads) A survey of major topics and issues in biomedical ethics including patients' rights and duties, informed consent, confidentiality, ethical issues in medical research, the initiation and termination of medical treatment, euthanasia, abortion, and the allocation of medical resources.

**Phil 5415. Philosophy of Law.** (3 cr. Prereq-1003 or 1004 or 3302 or social science major or #) Analytical accounts of law and legal obligation.

**Phil 5606. Philosophy of Quantum Mechanics.** (3 cr) Problems of interpretation in ordinary (nonrelativistic) quantum mechanics. Two-slit experiment, Schrodinger cat paradox (measurement problem), Einstein-Podolsky-Rosen paradox. Leading approaches to interpretation (Copenhagen, hidden variables, universal wave function) and their connections with philosophical issues.

**Phil 5760. Selected Topics in Philosophy.** (3 cr [max 9 cr]. Prereq-3xxx-5xxx course in phil or #) Philosophical problems of contemporary interest. Topics specified in *Class Schedule*.

**Phil 5993. Directed Studies.** (1-3 cr [max 6 cr]. Prereq-#,  $\Delta$ ,  $\square$ ) Guided individual reading or study.

**Phil 8010. Workshop in History of Philosophy.** (1 cr [max 4 cr]. Prereq-14xxx hist of phil course, #) Topics vary by offering.

**Phil 8080. Seminar: History of Ancient and Medieval Philosophy.** (3 cr [max 6 cr]. Prereq-#) Topics vary by offering.

**Phil 8081. Seminar: History of Philosophy—Ancient Philosophers.** (3 cr. Prereq-#) Major developments in ancient Greek philosophic thought; methods and role of history of philosophy in discipline of philosophy.

**Phil 8085. Seminar: History of Philosophy—Modern Philosophers.** (3 cr. Prereq-#) Major developments in modern philosophic thought; methods and role of history of philosophy in discipline of philosophy.

**Phil 8090. Seminar: History of Modern Philosophy.** (3 cr [max 6 cr]. Prereq-#) Topics vary by offering.

**Phil 8100. Workshop in Epistemology and Metaphysics.** (1 cr [max 4 cr]. Prereq-14xxx [epistemology or metaphysics] course, #) Topics vary by offering.

**Phil 8110. Seminar: Metaphysics.** (3 cr [max 6 cr]. Prereq-4101 or #) Topics vary by offering.

**Phil 8130. Seminar: Epistemology.** (3 cr [max 6 cr]. Prereq-4105 or #) Problems in the theory of knowledge. Topics specified in *Class Schedule*.

**Phil 8131. Epistemology Survey.** (3 cr) Survey, against background of traditional issues, of contemporary developments in theory of knowledge.

**Phil 8180. Seminar: Philosophy of Language.** (3 cr [max 6 cr]. Prereq-4231 or #) Topics vary by offering.

**Phil 8182. Formal Semantics of Natural Language.** (3 cr; A-F only. Prereq-Phil 5201 or #) Truth-conditional model-theoretic semantics applied to treatment of opacity, intensionality, quantification, and related phenomena in natural language.

**Phil 8200. Workshop in Logic and Philosophy of Mathematics.** (1 cr [max 4 cr]. Prereq-[14xxx logic or 4xxx phil of math], #) Topics vary by offering.

**Phil 8210. Seminar: Logical Theory.** (3 cr [max 6 cr]. Prereq-[5201, 5202] or #) Topics vary by offering.

**Phil 8220. Seminar: Philosophy of Mathematics.** (3 cr [max 6 cr]. Prereq-5202 or [4xxx or 5xxx] math course or #) Topics such as significance of limitative metatheorems (Goedel, et al), assessment of major foundational programs (set theoretic, modern Hilbertian, constructivist), modal/structuralist alternatives to standard platonism.

**Phil 8300. Workshop in Moral and Political Philosophy.** (1 cr [max 4 cr]. Prereq-[14xxx moral phil or 4xxx pol phil], #) Topics vary by offering.

**Phil 8310. Seminar: Moral Philosophy.** (3 cr [max 9 cr]. Prereq-4320 or 4330 or 4340 or #) Systematic study of concepts and problems relating to ethical discourse.

**Phil 8320. Seminar on Medical Ethics.** (3 cr [max 6 cr]. Prereq-[4xxx or 5xxx] ethics course or #) Patients' rights/duties, informed consent, confidentiality, ethical issues in medical research, initiation/termination of medical treatment, euthanasia, abortion, maternal/fetal conflicts, allocation of medical resources.

**Phil 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**Phil 8410. Seminar: Philosophy of Law.** (3 cr [max 6 cr]. Prereq-5415 or #) Primarily for law students and advanced political science, history, or sociology majors or minors.

**Phil 8420. Seminar: Political Philosophy.** (3 cr [max 6 cr]. Prereq-4321 or 4414 or #) Topics vary by offering.

**Phil 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**Phil 8500. Workshop in Aesthetics.** (1 cr [max 4 cr]. Prereq-14xxx aesthetics course, #) Topics vary by offering.

**Phil 8510. Seminar: Aesthetics Studies.** (3 cr [max 6 cr]) Topics vary by offering.

**Phil 8550. Seminar: Philosophy of Religion.** (3 cr [max 6 cr]. Prereq-4521 or #) Topics vary by offering.

**Phil 8600. Workshop in the Philosophy of Science.** (1 cr [max 4 cr]. Prereq-14xxx phil of sci course, #) Topics vary by offering.

**Phil 8601. Seminar: Scientific Inquiry.** (3 cr. Prereq-#) Philosophical theories of the nature of scientific methods for evaluating scientific hypotheses, of role of experimentation in science, and of how hypotheses come to be accepted within a scientific community.

**Phil 8602. Seminar: Scientific Representation and Explanation.** (3 cr. Prereq-#) Contemporary issues concerning representation and explanation of scientific facts.

**Phil 8605. Seminar: History of the Philosophy of Science.** (3 cr. Prereq-#) Historical development of logical empiricism from its European origins in first half of 20th century to its emergence as nearly universal account of science in post-war Anglo-American philosophy.

**Phil 8606. Seminar: Philosophy of Medicine and the Biomedical Sciences.** (3 cr. Prereq-#) Aims and goals of medicine; concepts of health, illness, and disease; nature of reasoning in clinical medicine; theoretical evolution in medicine; and role of values in practice of medicine and healthcare.

**Phil 8610. Seminar: Philosophy of the Physical Sciences.** (3 cr [max 6 cr]. Prereq-#) Topics specified in *Class Schedule*.

**Phil 8620. Seminar: Philosophy of the Biological Sciences.** (3 cr [max 6 cr]. Prereq-#) Topics vary by offering.

**Phil 8640. Seminar: Philosophy of the Cognitive Sciences.** (3 cr [max 6 cr]. Prereq-#)  
Philosophical framework for analyzing cognitive sciences. Recent developments in metaphysics/epistemology. Nature of scientific theories, methodologies of cognitive sciences, relations among cognitive sciences. Relation of cognitive science to epistemology and to various philosophical problems. Topics vary by offering.

**Phil 8660. Seminar: Social and Cultural Studies of Science.** (3 cr [max 6 cr]. Prereq-#)  
Review of recent work; analysis of theoretical and methodological differences among practitioners; selected responses from historians and philosophers of science.

**Phil 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Phil 8670. Seminar: Philosophy of Science.** (3 cr [max 6 cr]. Prereq-#)  
Topics vary by offering.

**Phil 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Phil 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

**Phil 8993. Directed Study.** (1-3 cr [max 6 cr]. Prereq-#)

**Phil 8994. Directed Research.** (1-3 cr [max 6 cr]. Prereq-#)

## Physical Medicine and Rehabilitation (PMed)

### Department of Physical Medicine and Rehabilitation Medical School

**PMed 5121. Issues in Mental Health.** (1 cr; S-N only. Prereq-One course gen psych, one course abnorm psych)  
Psychiatric/neuropsychological assessment/treatment. Issues related to medical/community management and to roles of OT/PT with respect to clients with mental health needs. Interaction between physical/mental health and disability.

**PMed 5122. Descriptive Neurology.** (1 cr [max 2 cr]; A-F only. Prereq-OT or PT or #)  
Relates neuroanatomical/neurophysiological principles to neurological conditions commonly seen in occupational/physical therapy practice.

**PMed 5135. Advanced Biomechanics I: Kinematics.** (2 cr; A-F only. Prereq-#)  
How to describe/measure movement. Emphasizes three-dimensional techniques. Lecture, laboratory, seminar discussion of basic and applied biomechanics, pathokinesiology, and rehabilitation literature. Classes held with 8135 registrants. Assignments vary for those registered at different levels.

**PMed 5161. Theory of Physical Medicine and Rehabilitation Applied to Medical Sciences.** (2 cr [max 2 cr]; A-F only. Prereq-OT student or #)  
Diagnostic procedures. Medical, surgical, and rehabilitation management of patient problems in orthopedics, surgery, pediatrics, dermatology, medicine, cancer, and speech. Correlation to current practice. Presentation of patients.

**PMed 5182. Functional Neuroanatomy and Neurophysiology.** (4 cr; A-F only. Prereq-Registered occupational therapy student or #)  
Neuroanatomic structures as functional systems, basic neurophysiologic concepts. Emphasizes applications for understanding/treating physical dysfunctions.

**PMed 5215. Clinical Practice of Physical Therapy I.** (1 cr; S-N only. Prereq-Regis PT student)

First of three-course sequence. Emphasizes sensitivity to needs of patients, families, and health-care coworkers. Patient handling techniques, communication skills, awareness of cultural differences, psychological aspect of disability, and use of community resources.

**PMed 5216. Clinical Practice of Physical Therapy II.** (1 cr; S-N only. Prereq-Registered 2nd yr PT student)  
Second of a three-course sequence. Emphasizes sensitivity to needs of patients, families, and health-care coworkers. Patient-handling techniques, communication skills, awareness of cultural differences, psychological aspect of disability, use of community resources.

**PMed 5217. Clinical Practice of Physical Therapy III.** (1 cr; S-N only. Prereq-Registered 2nd-year PT student)  
Third of three-course sequence. Sensitivity to needs of patients, families, and health-care coworkers. Patient handling techniques, communication skills, awareness of cultural differences, psychological aspects of disability, use of community resources. Offered summer session.

**PMed 5223. Electrotherapy and Electrophysiological Testing.** (2 cr; A-F only. Prereq-Regis PT student)  
Theory and technique of movement analysis and treatment using electrophysiological testing and therapeutic devices.

**PMed 5231. Clinical Biomechanics.** (5 cr; A-F only. Prereq-Registered PT student, intro calculus, intro physics)  
Forces/structures internal/external to body responsible for normal/abnormal human movement. Analysis techniques, independent assignments. Muscle function, palpation, posture. Gait of normal individuals, analysis to detect deviation from norm.

**PMed 5255. Clinical Internship I.** (3 cr; S-N only. Prereq-Regis PT student)  
Five-week, full-time internship. Select and perform physical therapy evaluation techniques, interpret results, define rationale for physical therapy service, develop a care plan, implement treatment program, and communicate patient/client care process as a physical therapy professional.

**PMed 5260. Professional Issues in Physical Therapy.** (3 cr; A-F only. Prereq-Regis PT student)  
Current professional issues, dilemmas, and trends in health care. Evaluation and treatment skills in physical therapy specialty areas.

**PMed 5282. Therapeutic Exercise II.** (3 cr; A-F only. Prereq-Registered PT student)  
Principles of neurophysiology, neurology, motor control, and motor learning as basis for therapeutic intervention in motor dysfunction.

**PMed 5283. Musculoskeletal I.** (4 cr; A-F only. Prereq-Regis PT student)  
First of two-course sequence. Problem-solving approach to evaluating, treating, and preventing selected musculoskeletal conditions across the life span. Chart review, history taking, strength testing, functional testing, gait and posture examination, special orthopedic tests. Therapeutic exercises, orthopedic ambulation, joint mobilization, splinting, patient education.

**PMed 5284. Musculoskeletal II.** (4 cr; A-F only. Prereq-Regis PT student)  
Problem-solving approach to evaluating, treating, and preventing selected musculoskeletal conditions across life span. Chart review, history taking, strength testing, functional testing, gait/posture examination, special orthopedic tests. Therapeutic exercises, orthopedic ambulation, joint mobilization, splinting, patient education. Second of two-course sequence.

**PMed 5287. Neurorehabilitation I.** (4 cr; A-F only. Prereq-Regis PT student)  
Assessment and rehabilitation of patients with neurological conditions (e.g., cerebral vascular disease traumatic brain injury, multiple sclerosis, Parkinson's disease, amyotrophic lateral sclerosis). Using treatment procedures, orthotics, and equipment to improve function and prevent, stabilize, or decrease impairments.

**PMed 5288. Neurorehabilitation II.** (4 cr; A-F only. Prereq-Registered PT student)  
Pediatric assessment/rehabilitation for neurological, orthopedic, cardiac, prematurity, transplant, and behavioral conditions. Preparation for adult assessment/treatment with neurological, general medical, and vascular disease. Students use etiologic knowledge to assess patients in clinic and establish treatment plans and goals.

**PMed 5293. Research Design in Physical Therapy.** (3 cr; A-F only. Prereq-Registered 2nd yr PT student)  
Predictive research, elementary statistical concepts, analysis of scientific literature. Tools to design experiments and analyze data acquired from student group projects. Design/statistical formats: risk analysis, multivariate regression analysis, designs of reliability studies, traditional group designs. Students give preliminary presentation of analysis to their peers.

**PMed 5294. Independent Study in Rehabilitation Science.** (1-3 cr [max 3 cr])  
Independent exploration into topics related to rehabilitation science.

**PMed 5295. Clinical Education.** (12 cr; S-N only. Prereq-Registered 3rd yr PT student)  
Students must demonstrate proficiency in communication, team participation, and evaluation/treatment; predict outcomes; and manage a variety of patient diagnoses/problems consistently with good/safe judgment.

**PMed 5300. Concepts for Occupational Therapy Practice.** (4 cr; A-F only. Prereq-Regis OT student or #)  
Critical thinking, ethics, professional resources/organizations, patient-therapist relationship. Level I fieldwork experience.

**PMed 5313. Therapeutic Occupation.** (4 cr; A-F only. Prereq-Regis OT student or #)  
Occupational therapy philosophy, history, and frames of reference. Activity analysis applied to purposeful, therapeutic activities for individuals and groups.

**PMed 5341. Introduction: Evaluation and Intervention I.** (4 cr; A-F only. Prereq-5393 or #)  
Assessment concepts/techniques. Application to patient populations with both mental health/physical disabilities. Treatment planning/documentation.

**PMed 5342. Compensatory Rehabilitation: Evaluation and Intervention II.** (4 cr; A-F only. Prereq-5300, 5313 or #)  
Assessment of daily living performance areas; adaptation techniques to compensate for performance deficits. Level I fieldwork experience.

**PMed 5343. Specialty Topics: Evaluation and Intervention III.** (4 cr; A-F only. Prereq-5342 or #)  
Applies critical thinking model to assessment/intervention of selected patient populations with mental/physical problems requiring specialized approaches. Focus on habilitation/rehabilitation of populations with multiple performance component deficits. Fieldwork.

**PMed 5344. Neurorehabilitation: Evaluation and Intervention IV.** (5 cr; A-F only. Prereq-5343 or #)  
Assessment/intervention related to perception, cognition, reflexes, sensory integration, and motor control. Application to individuals with multiple performance component deficits.

**PMed 5360. Dynamics of Group Models.** (2 cr; A-F only. Prereq-5313 or #)  
Application of group/team dynamics in diverse professional settings.

**PMed 5370. Theory of Occupation.** (1 cr; A-F only. Prereq-Regis OT student or #)  
Occupational therapy frames of reference, role of activity, and historical development of profession.

**PMed 5375. Community Resources and Health-Care Issues.** (2 cr; A-F only. Prereq-[5300, 5342] or #)  
Analysis of community health-care systems, including cultural/family influences on individual health and decision making. Students identify current trends in health care and determine responses to them at social, political, or legislative level.

**PMed 5376. Adult Education and Planning.** (1 cr; A-F only. Prereq–5313 or #)  
Skills needed to plan, implement, and evaluate adult educational programs/materials for patient/family education, peer/professional education, and education of others in order to carry out therapeutic interventions. Student teaching unit, community based activity.

**PMed 5380. Management of Occupational Therapy Services.** (3 cr; A-F only. Prereq–[5360, 5375, 5376] or #)  
Administration/management of occupational therapy services within managed care environment. Issues in Medicare, HMOs, TQM, consultation, human resources, promotion of profession. Emphasizes program development in current organizational structures.

**PMed 5391. Occupation across the Life Span.** (3 cr; A-F only. Prereq–[5375, 5376] or #)  
The well elderly, school therapy, work-related injuries/industrial rehabilitation. Fieldwork.

**PMed 5392. Research in Occupational Therapy.** (3 cr; A-F only. Prereq–5313 or #)  
Analysis of scientific literature, development of research proposals.

**PMed 5393. Functional Anatomy and Kinesiology.** (4 cr; A-F only. Prereq–Regis OT student or #)  
Gross human anatomy emphasizing skeletal, muscular, circulatory, and peripheral nervous systems of the extremities and trunk. Includes cadaver lab prosections. Analyzing functional human movement from a biomechanical perspective.

**PMed 5394. Orthotics.** (3 cr; A-F only. Prereq–5341 or #)  
Analysis, design, and construction of orthotic devices.

**PMed 5395. Independent Study in Occupational Therapy.** (1-4 cr [max 16 cr]. Prereq–Regis OT student or #)

**PMed 5814. Age, Exercise, and Rehabilitation.** (2 cr)

**PMed 5841. Rehabilitation Science Instrumentation and Methodology.** (4 cr; A-F only. Prereq–Phys 1031, Phys 1032 or equiv, #)  
Theory and application of kinesiological EMG and other common instruments used to measure human motion.

**PMed 8100. Rehabilitation Science Seminar.** (1 cr [max 6 cr]; A-F only)  
Critically reading/discussing rehabilitation science literature. Identifying important researchable questions, methods to answer them. Speaking/writing persuasively on scientific topics.

**PMed 8103. Physical Therapy Clinic.** (1-4 cr; A-F only. Prereq–Physical therapist)  
Adult and pediatric rehabilitation.

**PMed 8130. Current Literature Seminar.** (1 cr; A-F only. Prereq–Grad PT major or #)  
Critical review of the literature to evaluate efficacy of selected physical therapy interventions.

**PMed 8135. Advanced Kinesiology.** (2 cr; A-F only. Prereq–#)  
How to describe movement. How to measure movement. Emphasizes three-dimensional techniques. Basic/applied biomechanics, pathokinesiology, rehabilitation literature. Lecture, laboratory exposure, seminar discussion.

**PMed 8170. Special Topics in Physical Therapy.** (1 cr; A-F only. Prereq–Grad PT major)  
Topics vary by semester. Papers required.

**PMed 8185. Problems in Physical Therapy.** (1-3 cr. Prereq–5293 or 8192 or #)  
Research practicum on selected topic designed to make students familiar with systematic literature search, critical analysis of scientific literature, specific measurement systems, data collection and data reduction methods of on-going or new research projects, preparing and defending research reports.

**PMed 8188. Teaching Practicum.** (1-5 cr; A-F only. Prereq–#)  
Supervised practical experience in classroom/laboratory teaching.

**PMed 8192. Research Design in Physical Therapy.** (3 cr; A-F only. Prereq–Grad PT major)  
Critical appraisal of current medical literature. Fundamentals of research design, data analysis, and medical writing.

**PMed 8193. Research Problems in Physical Therapy.** (1-4 cr [max 4 cr]; A-F only. Prereq–Grad PT major or #)  
Designing a research project to answer scientific question in physical therapy, collecting data, analyzing data, interpreting results, and defending the work to an examining committee.

**PMed 8200. Physical Medicine and Rehabilitation Service.** (1-15 cr. Prereq–Enrolled in PMed residency training program)

**PMed 8207. Basic and Applied Psychiatry.** (1 cr. Prereq–Enrolled in PMed residency training program)

**PMed 8210. Research in Physical Medicine.** (1-15 cr. Prereq–Enrolled in PMed residency training program)

**PMed 8212. Electromyography.** (1-15 cr. Prereq–Enrolled in PMed residency training program)

**PMed 8214. Readings in Electromyography.** (1-3 cr. Prereq–Enrolled in PMed residency training program)

**PMed 8220. Seminar: Physical Medicine and Rehabilitation.** (1-15 cr. Prereq–Enrolled in PMed residency training program)

**PMed 8282. Problems in Human Movement.** (4 cr; A-F only. Prereq–Registered PhD grad student in [rehabilitation science or field related to rehabilitation], #)  
Mechanisms of pathology/recovery associated with neurologically based problems in human movement (e.g., paralysis, spasticity, tremor).

**PMed 8300. Research Seminar in Occupational Therapy.** (1 cr; S-N only. Prereq–5392 or #)  
Critical review of research literature in occupational therapy. Issues related to ethical/successful conduct/publication of research. Development of Plan B project outline.

**PMed 8310. Research Problems in Occupational Therapy.** (3-6 cr [max 6 cr]; S-N only. Prereq–[5392, Plan B OT student] or #)  
Individual, concentrated study of a problem in occupational therapy. Completion of Plan B project.

**PMed 8320. Fieldwork Education in Occupational Therapy I.** (6 cr; S-N only. Prereq–5343, 5344, 5380 or #)  
Supervised clinical practice in affiliated hospitals and community agencies. Students apply critical thinking through supervised application of theory and skills.

**PMed 8321. Fieldwork Education in Occupational Therapy II.** (6 cr; S-N only. Prereq–5343, 5344, 5380 or #)  
Supervised clinical practice in affiliated hospitals and community agencies. Students apply critical thinking through supervised application of theory and skills.

**PMed 8322. Fieldwork Education in Occupational Therapy III: Optional.** (1-6 cr; S-N only. Prereq–5343, 5344 or #)  
Optional fieldwork experience involving supervised practice in clinic or community agency with specialty focus. Sample topics: hand therapy, school therapy, clinical research. Students apply critical thinking through supervised application of theory and skills.

## Physical Therapy (PT)

*Department of Physical Medicine and Rehabilitation  
Medical School*

**PT 8131. Research Seminar I.** (1 cr; A-F only. Prereq–Grad PT major)  
Scientific thinking in physical therapy. Preparation to execute research project or literature review. Analysis of current literature. Basic features of research design. Elements of evaluating treatment efficacy. Students interact with their research adviser and with research faculty in various specialties.

**PT 8132. Research Seminar in Physical Therapy II.** (1 cr; A-F only. Prereq–8131, Grad PT major)  
Scientific thinking in physical therapy. Preparation to execute research project or literature review. Analysis of current literature. Basic features of research design. Elements of evaluating treatment efficacy. Students interact with their research adviser and with research faculty in various specialties.

**PT 8193. Research Problems in Physical Therapy.** (1-7 cr [max 7 cr]; A-F only. Prereq–Grad PT major)  
Process of developing/completing a scholarly research project or literature review related to rehabilitation science. Type of research experience is determined by adviser.

**PT 8333. FTE: Master's.** (1 cr; NGA. Prereq–Master's student, adviser and DGS consent)

**PT 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq–Max 18 cr per semester or summer; 10 cr total required [Plan A only])

## Physics (Phys)

*School of Physics and Astronomy  
Institute of Technology*

**Phys 5001. Quantum Mechanics I.** (4 cr. Prereq–4101 or equiv or #)  
Schrodinger equation: bound state and scattering problems in one dimension. Spherically symmetric problems in three dimensions, angular momentum, and the hydrogen atom. Approximation methods for stationary states. Time-dependent perturbation theory. Operators and state vectors: general formalism of quantum theory.

**Phys 5002. Quantum Mechanics II.** (4 cr. Prereq–5001 or equiv)  
Symmetry in quantum mechanics, space-time symmetries and the rotation group. Clebsch-Gordan coefficients and the Wigner-Eckart theorem. Scattering theory. Method of second quantization with elementary applications. Relativistic wave equations including Dirac equation.

**Phys 5011. Classical Physics I.** (4 cr. Prereq–4001 or equiv or #)  
Classical mechanics: Lagrangian/Hamiltonian mechanics, orbital dynamics, rigid body motion, special relativity.

**Phys 5012. Classical Physics II.** (4 cr. Prereq–5011 or #)  
Classical electromagnetism: electrostatics, magnetostatics, Maxwell's equations, electromagnetic waves, radiation, interaction of charged particles with matter.

**Phys 5022. Relativity, Cosmology, and the Universe.** (4 cr. \$Ast 5022. Prereq–2601 or #)  
Large-scale structure and history of universe. Introduction to Newtonian and relativistic world models. Physics of early universe. Cosmological tests. Formation of galaxies.

**Phys 5041. Analytical and Numerical Methods of Physics I.** (4 cr. Prereq–Grad or #)  
Survey of mathematical techniques, both analytic and numerical, needed for physics. Application to physical problems.

**Phys 5042. Analytical and Numerical Methods of Physics II.** (4 cr. Prereq–5041 or #)  
Survey of mathematical techniques, both analytic and numerical, needed for physics. Application to physical problems.

**Phys 5071. Physics for High School Teachers: Experimental Foundations and Historical Perspectives.** (3 cr. Prereq–Gen physics, #; no cr for physics grad or grad physics minor)  
In-depth examination of a conceptual theme in physics, its experimental foundations and historical perspectives. Kinematics and dynamics from Aristotle through Einstein; nature of charge and light; energy and thermodynamics; electricity, magnetism, and quantized fields; structure of matter.

**Phys 5081. Introduction to Biopolymer Physics.** (3 cr)  
Biological physics and soft condensed matter physics. Emphasizes physical ideas involved in experimental/theoretical understanding of biological/synthetic macromolecules/materials.

**Phys 5201. Thermal and Statistical Physics.** (3 cr; A-F only. \$4201. Prereq-2601 or equiv; primarily for grad students)  
Principles of thermodynamics and statistical mechanics. Selected applications such as kinetic theory, transport theory, and phase transitions.

**Phys 5401. Physiological Physics.** (4 cr. Prereq-1301 or 1401)  
Musculoskeletal system, circulatory system/membrane transport, biological control systems, propagation/action potential in nervous system, biomagnetism, electromagnetism at cellular level.

**Phys 5402. Radiological Physics.** (4 cr. Prereq-1302 or 1402)  
Signal analysis, medical imaging, medical x-rays, tomography, radiation therapy, nuclear medicine, MRI, and similar topics.

**Phys 5701. Solid-State Physics for Engineers and Scientists.** (4 cr. Prereq-Grad or advanced undergrad in physics or engineering or the sciences)  
Crystal structure and binding; diffraction; phonons; thermal and dielectric properties of insulators; free electron model; band structure; semiconductors.

**Phys 5702. Solid State Physics for Engineers and Scientists.** (4 cr. Prereq-5701 or #)  
Diamagnetism and paramagnetism; ferromagnetism and antiferromagnetism; optical phenomena; lasers; superconductivity; surface properties; ferroelectricity.

**Phys 5950. Colloquium Seminar.** (1 cr. Prereq-Grad or advanced undergrad in physics,  $\Delta$ )

**Phys 5980. Introduction to Research Seminar.** (1 cr [max 3 cr]; S-N only. Prereq-Grad or upper div phys major)  
Introduction to the research activities of the School of Physics and Astronomy.

**Phys 5993. Directed Studies.** (1-5 cr [max 15 cr]. Prereq-#,  $\Delta$ )  
Independent, directed study in physics in areas arranged by the student and a faculty member.

**Phys 5994. Directed Research.** (1-5 cr [max 15 cr]. Prereq-Jr,  $\Delta$ )  
Problems, experimental or theoretical, of special interest to students. Written reports.

**Phys 8001. Advanced Quantum Mechanics.** (3 cr. Prereq-Phys 5002 or #)  
Topics in non-relativistic quantum mechanics; second quantization. Introduction to Diagrammatic and Green's function techniques and to relativistic wave equations. Application of relativistic perturbation theory to particle interactions with electromagnetic field. Invariant interactions of elementary particles.

**Phys 8011. Quantum Field Theory I.** (3 cr. Prereq-8001 or #)  
Second quantization of relativistic wave equations; canonical quantization of the free scalar and Dirac fields. Fields in interaction: interaction picture. Quantum electrodynamics: quantization of the electromagnetic field, propagators and Feynman rules, tree-level processes. Higher-order processes and renormalization.

**Phys 8012. Quantum Field Theory II.** (3 cr. Prereq-8011 or #)  
Aspects of general theory of quantized fields, including space-time and discrete transformation properties, the CPT theorem, and the spin-statistics connection. Introduction to functional and path-integral methods. Renormalization group and asymptotic freedom. Semi-classical methods and instantons in gauge theories.

**Phys 8013. Special Topics in Quantum Field Theory.** (3 cr. Prereq-8012 or #)  
Includes non-perturbative methods in quantum field theory, supersymmetry, two-dimensional quantum field theories and their applications, lattice simulations of quantum fields, topological quantum field theories, quantum field theory methods applied to condensed matter physics, and string theory.

**Phys 8100. Seminar: Problems of Physics Teaching and Higher Education.** (1 cr [max 3 cr]. Prereq-#)  
Lectures and informal discussions of courses and curricula, techniques, and materials important in undergraduate physics instruction; relation to general problems of higher education.

**Phys 8301. Symmetry and Its Application to Physical Problems.** (3 cr. Prereq-5002 or #)  
Fundamental invariance principles obeyed by laws of physics. Group theory as tool for using symmetry and invariance to help understand behavior of physical systems. Applications made to atomic, molecular, nuclear, condensed-matter, and elementary particle physics.

**Phys 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**Phys 8401. Atomic and Molecular Structure.** (3 cr. Prereq-5002 or #)  
Understanding behavior of atoms and molecules in terms of basic interactions between electrons and nuclei and electromagnetic radiation. Applications made to condensed-matter physics, astrophysics, biophysics, and physical chemistry.

**Phys 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**Phys 8500. Plan B Project.** (4 cr. Prereq-#; may be taken once to satisfy Plan B master's project requirement; no cr toward PhD)  
Project topic arranged between student and instructor. Written report required.

**Phys 8501. General Relativity and Cosmology I.** (3 cr. Prereq-5012 or #)  
Tensor analysis and differential geometry. Special relativity leading to formulation of principles of general relativity and Einstein's equations. Tests of general relativity and thorough discussion of various black hole solutions, including Schwarzschild, Reissner-Nordstrom, and Kerr solutions.

**Phys 8502. General Relativity and Cosmology II.** (3 cr. Prereq-8501 or #)  
Gravitational radiation. Applications of general relativity to stellar structure of white dwarfs and neutron stars, action principle, and symmetric spaces. Big-bang cosmology, strongly emphasizing particle physics.

**Phys 8600. Seminar: Space Physics.** (1 cr [max 6 cr]; S-N only. Prereq-#)  
Current topics in space physics and plasma physics.

**Phys 8601. Plasma Physics I.** (3 cr. Prereq-4621, 5012 or #)  
Theory of plasma waves and instabilities in plasmas, magnetohydrodynamics, nonlinear waves in plasmas, wave propagation in inhomogeneous plasmas.

**Phys 8602. Plasma Physics II.** (3 cr. Prereq-8601 or #)  
Theory of plasma waves and instabilities, collisions, radiation, transport, nonlinear wave-particle and wave-wave interactions, instabilities in inhomogeneous plasmas.

**Phys 8611. Cosmic Ray and Space Physics.** (3 cr. Prereq-5012 or #)  
Properties of energetic particles in heliosphere and in astrophysical environments; solar physics, including radiation and magnetic effects; solar wind and magnetospheric physics; physics of radiation belts.

**Phys 8650. Advanced Topics in Space and Plasma Physics.** (3 cr [max 9 cr]. Prereq-8602 or 8611 or #)  
Topics in plasma waves and instabilities, solar physics, cosmic ray physics, atmospheric physics or planetary physics.

**Phys 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Phys 8700. Seminar: Condensed Matter Physics.** (1 cr [max 6 cr]; S-N only. Prereq-#)  
Current research.

**Phys 8701. Statistical Mechanics and Transport Theory I.** (3 cr. Prereq-5002 or #)  
Equilibrium properties of macroscopic classical and quantum systems. Phase transitions and Renormalization Group. Transport theory. Applications to soft condensed matter systems.

**Phys 8702. Statistical Mechanics and Transport Theory II.** (3 cr. Prereq-8701 or #)  
Equilibrium properties of macroscopic classical and quantum systems. Phase transitions and Renormalization Group. Transport theory. Applications to soft condensed matter systems.

**Phys 8711. Solid-State Physics I.** (3 cr. Prereq-4211, 5002 or #)  
Fundamental properties of solids. Electronic structure and transport in metals and semiconductors. Properties of disordered materials.

**Phys 8712. Solid-State Physics II.** (3 cr. Prereq-8711 or #)  
Fundamental properties of solids. Electronic structure and transport in metals and semiconductors. Properties of disordered materials.

**Phys 8750. Advanced Topics in Condensed Matter Physics.** (3 cr [max 9 cr]. Prereq-8712 or #)  
Sample research topics: magnetism, superconductivity, low temperature physics, superfluid helium.

**Phys 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Phys 8800. Seminar: Nuclear Physics.** (1 cr [max 6 cr]; S-N only. Prereq-#)  
Current research topics.

**Phys 8801. Nuclear Physics I.** (3 cr. Prereq-5001 or 45001)  
Properties of nuclei based on hadronic and quark-gluon degrees of freedom. Relativistic field theory at finite temperature and density applied to many-body problems, especially nuclear matter and quark-gluon plasma. Applications to lepton and hadron scattering, nucleus-nucleus collisions, astrophysics and cosmology.

**Phys 8802. Nuclear Physics II.** (3 cr. Prereq-8801 or #)  
Properties of nuclei based on hadronic and quark-gluon degrees of freedom. Relativistic field theory at finite temperatures and density applied to many-body problems, especially nuclear matter and quark-gluon plasma. Applications to lepton and hadron scattering, nucleus-nucleus collisions, astrophysics and cosmology.

**Phys 8850. Advanced Topics in Nuclear Physics.** (3 cr [max 9 cr]. Prereq-8802 or #)  
Research topics.

**Phys 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

**Phys 8900. Seminar: Elementary Particle Physics.** (1 cr [max 6 cr]. Prereq-#)  
Elementary particle physics, high energy physics, particle astrophysics and cosmology.

**Phys 8901. Elementary Particle Physics I.** (3 cr. Prereq-8001 or #)  
Types of fundamental interactions. Exact and approximate symmetries and conservation laws. Gauge quanta: gluons, photons, W and Z bosons, gravitons. Fundamental fermions: leptons and quarks. Isotopic and flavor SU(3) symmetries of strong interaction. Heavy hadrons. Amplitudes and probabilities. Quantum chromodynamics.

**Phys 8902. Elementary Particle Physics II.** (3 cr. Prereq-8901 or #)  
Deep inelastic scattering. Weak interactions of leptons. Semileptonic and nonleptonic weak processes with hadrons. Oscillations of neutral Kaons. Violation of CP symmetry in Kaons. Neutrino masses and oscillations. Standard model of the electroweak interaction. Grand unification. Unitarity of the S matrix. Properties of soft pions.

**Phys 8950. Advanced Topics in Elementary Particle Physics.** (3 cr [max 9 cr]. Prereq-8902 or #)  
Research topics.

**Phys 8994. Research in Physics.** (1-12 cr [max 24 cr]. Prereq-#)  
Research under faculty direction.

## Physiology (Phsl)

*Department of Physiology  
Medical School*

**Phsl 5061. Principles of Physiology for Biomedical Engineering.** (4 cr. Prereq-Biomedical engineering grad, one yr college chem and physics and math through integral calculus)  
Human physiology with emphasis on quantitative aspects. Organ systems (circulation, respiration, renal, gastrointestinal, endocrine, muscle, central and peripheral nervous systems), cellular transport processes, and scaling in biology.

**Phsl 5094. Research in Physiology.** (1-5 cr [max 20 cr]. Prereq-#)  
Independent lab research project in physiology, supervised by physiology faculty.

**Phsl 5095. Problems in Physiology.** (1-5 cr [max 20 cr]. Prereq-#)  
Individualized study in physiology. Students address selected problem through library or lab research, supervised by physiology faculty.

**Phsl 5101. Human Physiology.** (5 cr. Prereq-Grad student in biomedical sciences)  
Survey of human physiology. Muscle, cardiovascular, respiratory, gastrointestinal, renal physiology. Integrative, systems approach. Emphasizes normal function.

**Phsl 5201. Computational Neuroscience I: Membranes and Channels.** (3 cr. Prereq-Calculus through differential equations)  
Neural excitation (ion channels, excitation models, effects of neural morphology) using UNIX workstations to simulate empirical results. Includes the Hodgkin-Huxley model, nonlinear dynamic systems analysis, voltage and ligand gated ion channels, ion transport theories, and impulse initiation and propagation.

**Phsl 5202. Computational Neuroscience II: Neural Systems and Information Processing.** (3 cr. Prereq-Understanding of UNIX, Phsl/NSc 5201 or equiv)  
Quantitative examination of information processing by networks based on experimental data and theoretical models. Neural codes, neural network models and information processing, neural control systems, computational maps.

**Phsl 5444. Muscle.** (3 cr. \$BioC 5444, \$MDBC 5444 \$VPB 5444. Prereq-3061 or 3071 or 5061 or BioC 3021 or BioC 4331 or #)  
Muscle membranes: structures, mechanisms, and physiological roles of channels/pumps. Muscle contraction: force generation by actin/myosin.

**Phsl 5510. Advanced Cardiac Physiology and Anatomy.** (2-3 cr. Prereq-#)  
Fundamental concepts, advanced topics related to clinical/biomedical cardiac physiology. Lectures, laboratories, workshops, anatomical dissections. Intense, one week course.

**Phsl 5511. Advanced Neuromuscular Junction Physiology.** (2-3 cr. Prereq-#)  
Fundamental concepts and advanced topics related to clinical/biomedical aspects of neuromuscular junction physiology. Lectures, laboratories, workshops, anatomical dissections. Intense, one week course.

**Phsl 5520. Advanced Pulmonary Mechanics: Physiology and Pathophysiology.** (2-3 cr. Prereq-#)  
Fundamental concepts and advanced topics related to mechanical aspects of pulmonary function (e.g., elastic recoil, airway resistance). Lectures, laboratories, demonstrations. Intense, one week course.

**Phsl 5530. Pharmacokinetics: Introduction and Physiological Background.** (1-2 cr. Prereq-Two semesters of calculus, #)  
Topics in pharmacokinetics. Non-compartmental calculations of clearance and volume of distribution. Compartmental modeling. Deconvolution approaches. Physiologically-based pharmacokinetic modeling. Course is designed around the pharmacokinetic program PKQuest.

**Phsl 5701. Physiology Laboratory.** (1-2 cr [max 2 cr]; A-F only. Prereq-#)  
Experiments in physiology. Emphasizes quantitative aspects, including analysis of organ systems.

**Phsl 8294. Research in Physiology.** (1-18 cr. Prereq-Grad cellular and integrative phsl major, #)  
Directed laboratory research.

**Phsl 8310. Advanced Topics in Cellular Physiology.** (1 cr [max 4 cr]. Prereq-#)  
Discussion of primary research publications. Topics vary by semester.

**Phsl 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**Phsl 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**Phsl 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Phsl 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Phsl 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

## Plant Biology (PBio)

*Department of Plant Biology  
College of Biological Sciences*

**PBio 5109. Current Questions in Fungal Biology.** (2 cr; A-F only. Prereq-Biol 4003 or GCB 3022)  
Diversity of fungi and their interactions with other organisms. Pathogenic and mutualistic interactions with animals and plants. Use of fungal systems for drug discovery and understanding pathogenicity, signal transduction, morphogenesis, and evolution.

**PBio 5301. Plant Genomics.** (3 cr. Prereq-[Intro course in genetics, intro course in biochemistry] or #)  
Introduction to genomics. Emphasizes plants and relevant model organisms. DNA marker/sequencing technology, comparative genomics, whole genome sequencing, DNA chips/microarrays, EST libraries and SAGE analysis, gene-knockout systems, genome databases, sequence comparison/clustering algorithms, visualization tools.

**PBio 5412. Plant Physiology.** (3 cr. Prereq-Biol 2022 or Biol 3002 or Biol 3007, Biol/BioC 3021 or BioC 4331)  
Physiological and biochemical bases of plant systems with emphasis on higher plants.

**PBio 5414. Plant Cell and Molecular Biology.** (3 cr. Prereq-Biol 2022 or Biol 3007 or Biol 3002, Biol/BioC 3021 or Biol 4003 or GCB 3022)  
Aspects of recombinant DNA technology and other technologies in cell and molecular biology. Appropriate for those without extensive background in these areas but who wish to understand the potential uses of current cell and molecular technologies in the plant sciences.

**PBio 5416. Plant Morphology, Development, and Evolution.** (4 cr. Prereq-Biol 2022 or Biol 3002 or Biol 3007)  
Evolutionary history of land plants. Morphological changes in vegetative and reproductive structures. Morphology of green algal ancestors, nonvascular land plants, and spore bearing and seed bearing vascular plants are analyzed in an evolutionary framework.

**PBio 5640. Discussions in Plant Molecular Biology.** (2 cr [max 4 cr]. \$PBio 5414. Prereq-Biol 3002, Biol 4003, GCB 5034 or GCB 5034)  
Selected topics in plant molecular biology for students with a strong interest in the subject. Classical and recent papers that have led to current understanding of transposable elements, genomic structure and function, mechanisms of hormone action and gene regulation.

**PBio 5960. Special Topics.** (1-3 cr [max 6 cr]. Prereq-Biol 2022 or Biol 3002 or Biol 3007)  
In-depth treatment of specialized topics in plant biology.

**PBio 8081. Current Topics in Plant Biology: Molecular Biology-Physiology-Cell Biology.** (1 cr; S-N only)  
Background information and review of selected current literature. For first-year students in plant biological sciences and other biological science graduate programs.

**PBio 8082. Current Topics in Plant Biology: Structure-Evolution-Ecology.** (1 cr; S-N only)  
Background information and review of selected current literature. For first-year students in plant biological sciences and other biological science graduate programs.

**PBio 8123. Research Ethics in the Plant and Environmental Sciences.** (0.5 cr; S-N only. Prereq-Grad student in [applied plant sciences or plant pathology or plant biological sciences or soil science])  
History/values relating to research/scholarship. Social responsibility/reporting misconduct. Authorship plagiarism. Peer review. Copyright/intellectual property. Conflicts of interest. Research data management. Fiscal responsibility/management. Environmental health/safety. Research involving humans/animals. Mentorship presentations by faculty and invited speakers. Meets first seven weeks of spring semester.

**PBio 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**PBio 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**PBio 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Doctoral student who has not passed prelim oral)

**PBio 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA)

**PBio 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA)

**PBio 8900. Seminar.** (1 cr [max 4 cr]; S-N only)  
Current scientific research.

**PBio 8910. Journal Club.** (1 cr [max 4 cr]; S-N only)  
Critical evaluation of selected current literature.

**PBio 8993. Directed Studies.** (1-5 cr [max 15 cr]. Prereq-PBio grad student or #)

**PBio 8994. Research.** (1-5 cr [max 10 cr]; S-N only. Prereq-PBio grad student or #)  
Independent research determined by student's interests, in consultation with faculty mentor.

## Plant Pathology (PIPa)

### Department of Plant Pathology

### College of Agricultural, Food and Environmental Sciences

**PIPa 5003. Diseases of Forest and Shade Trees.** (3 cr)  
Diseases of trees in urban and forested areas. Biology, ecology, and control of tree diseases. Identifying disease agents, integrated control procedures. Laboratory.

**PIPa 5090. Issues in Plant Pathology.** (2-4 cr)  
See *Class Schedule* or department for current offerings.

**PIPa 5102. Epidemiology and Genetics of Host-Parasite Interactions.** (3 cr; A-F only. Prereq-[5201 or equiv], GCD 3022)

Concepts/methodology in study of plant disease epidemics, host plant resistance, and host-parasite genetics. Disease assessment, epidemic progress models, environmental influences, crop loss assessment, disease forecasting, ecology of host-parasite. Environmentally sound management strategies. Use of resistance for disease control.

**PIPa 5103. Physiological and Molecular Plant-Microbe Interactions.** (3 cr)  
Genetics, physiology, molecular biology of plant-microbe interactions. Communication between plant/microbes, signal transduction, control of gene expression, symbiosis/parasitism, plant host response mechanisms, plant disease physiology.

**PIPa 5201. Biology of Plant Diseases.** (4 cr. Prereq-Biol 1009 or equiv)

Principles and concepts of plant disease caused by selected viruses, bacteria, fungi, nematodes, and environmental factors. Pathogen biology, interaction of pathogens and the environment; epidemiology and control measures appropriate to plant disease.

**PIPa 5202. Field Plant Pathology.** (2 cr. Prereq-#)  
Characteristics of a variety of plant diseases. Field trips to observe symptoms and effects of diseases, and to learn about prevention and control of diseases in field, forest, golf course, greenhouse, nursery, orchard, and urban environments.

**PIPa 5203. Biology and Ecology of Fungi.** (3 cr. Prereq-Biol 1009 or equiv)  
Major groups of fungi, their roles in ecosystems and human society, environmental and nutritional needs, and modes of dissemination and survival. Representative species of fungi observed and manipulated.

**PIPa 5204. Plant Disease Management.** (3 cr; A-F only. Prereq-3001 or 3002)  
Principles of crop/pathogen biology, epidemiology, crop ecology, crop management practices that influence occurrence of plant disease. Interaction of crop management practices with plant disease. Strategies for controlling plant disease through management practices illustrated by examples from agronomic, horticultural, forest crops.

**PIPa 5300. Current Topics in Molecular Plant Pathology.** (1 cr [max 2 cr]; A-F only. Prereq-[BioC 4125, course in [plant pathology or microbiology], course in genetics, [lab in [molecular biology, biotechnology] or equivalent]] or #)  
Interactive class. Students read, discuss, and critique publications in molecular plant pathology. Each week, students focus on one article and examine it from different dimensions (underlying principles, experimental strategies, data analysis, impact on the broader discipline).

**PIPa 5301. Plant Genomics.** (3 cr. Prereq-Intro course in genetics or #)  
Introduction to genomics. Emphasizes plants and relevant model organisms. DNA marker/sequencing technology, comparative genomics, whole genome sequencing, DNA chips/microarrays, EST libraries and SAGE analysis, gene-knockout systems, genome databases, sequence comparison/clustering algorithms, visualization tools.

**PIPa 5302. Genomics of Plant-Associated Microbes.** (3 cr; A-F only. Prereq-[BioC 4125, course in [plant pathology or microbiology], course in genetics, [lab in [molecular biology, biotechnology] or equiv]] or #)  
Genomics research for plant-associated microbes. Journal articles, discussions, case studies. Identification/characterization of genes in plant-microbe interactions. Analysis of plant pathogens, research methodologies. Linkage/gene/physical mapping, candidate genes, sequencing, gene silencing, knock-out, ESTs, microarrays, bioinformatics. Online training modules, field trips, guest lectures, individual/group projects.

**PIPa 5999. Special Workshop in Plant Pathology.** (1-4 cr)  
Workshops on a variety of topics in plant pathology offered at locations other than the Twin Cities campus. See *Class Schedule* or department for current offerings.

**PIPa 8005. Supervised Classroom or Extension Teaching Experience.** (2 cr; S-N only. Prereq-#)  
Teaching experience in one of the following departments: Biosystems and Agricultural Engineering; Agronomy and Plant Genetics; Horticultural Science; Soil, Water, and Climate; or Plant Pathology. Discussions about effective teaching to strengthen skills and develop a personal teaching philosophy.

**PIPa 8090. Advanced Procedures and Research in Plant Pathology.** (1-8 cr)  
Special assignment in lab and field problems in pathological research.

**PIPa 8101. Causal Organisms of Plant Disease.** (4 cr. Prereq-5201 or equiv)  
Laboratory-based intensive examination of bacteria, viruses, and nematodes as causal agents of plant disease.

**PIPa 8102. Epidemiology and Genetics of Host-Parasite Interactions.** (3 cr; A-F only. Prereq-5201, GCD 3022)  
Disease assessment, analysis in time/space, models for epidemic progress, environmental influences, crop loss assessment, disease forecasting, ecology of host-parasite interactions. Mendelian, populational, and molecular genetic aspects of host-parasite interactions. Modes of variability in pathogen populations, strategies for disease resistance.

**PIPa 8103. Plant-Microbe Interactions.** (3 cr. Prereq-Intro course in biochem or plant physiology or equiv)  
Genetics, physiology, and molecular biology of plant-microbe interactions. Communication between plants/microbes. Signal transduction, control of gene expression, symbiosis/parasitism, plant host response mechanisms, plant disease physiology.

**PIPa 8123. Research Ethics in Plant and Environmental Sciences.** (0.5 cr; S-N only. Prereq-Enrolled in a plant/environmental grad research prog)  
History/values relating to research/scholarship. Social responsibility, reporting misconduct. Authorship. Plagiarism. Peer review. Copyright, intellectual property. Conflicts of interest. Research data management. Fiscal responsibility/management. Environmental health/safety. Research involving humans/animals. Mentorship. Presentations by faculty, invited speakers. Meets during first seven weeks of spring semester.

**PIPa 8200. Seminar.** (1-2 cr; A-F only)  
Critical review and presentation of current problems and progress in plant pathology.

**PIPa 8302. Genomics of Plant-associated Microbes.** (3 cr; A-F only. Prereq-[BioC 4125, course in [plant pathology or microbiology], course in genetics, [lab in molecular biology/biotechnology or equiv]] or #)  
Identification/characterization of genes involved in plant-microbe interactions. Genome analysis of plant pathogens. Innovative research methodologies. Linkage/gene/physical mapping. Identification of candidate genes. Genome sequencing, gene silencing, knock-out, ESTs/microarrays, bioinformatics. Online training modules. Field trips. Guest lectures. Individual/group projects. Journal articles, case studies.

**PIPa 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**PIPa 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**PIPa 8500. Perspectives in Plant Pathology.** (2 cr [max 4 cr]; S-N only. Prereq-#)  
Integrative overview of the field. For Ph.D. students nearing end of formal classroom experience.

**PIPa 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**PIPa 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**PIPa 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

## Polish (Plsh)

### Institute of Linguistics, ESL, and Slavic Languages and Literatures

### College of Liberal Arts

**Plsh 5900. Topics.** (1-4 cr)  
Topics specified in *Class Schedule*.

**Plsh 5993. Directed Readings.** (1-3 cr)  
Guided individual reading or study in Polish language, literature, and culture.

## Political Science (Pol)

### Department of Political Science

### College of Liberal Arts

**Pol 5210. Topics in Political Theory.** (3 cr [max 9 cr]; A-F only. \$4210. Prereq-13210, Δ, grad)

**Pol 5251. Greeks, Romans, and Christians: Ancient and Medieval Political Thought.** (4 cr. \$3251)  
Politics and ethics in Greece, Rome, Christendom: Thucydides, Socrates, Plato, Aristotle, Cicero, Augustine, Aquinas, Marsilius.

**Pol 5252. Renaissance, Reformation, and Revolution: Early Modern Political Thought.** (4 cr. \$3252)  
Thinkers, themes, and discourses from the Renaissance to the French Revolution. Renaissance Humanists; Machiavelli; More; Reformation; Luther; Calvin; Natural Law; Grotius; Divine Right; Common Law; Bacon; English Revolutionaries; Hobbes; Locke; Astell; Enlightenment; Rousseau; French Revolutionaries; Hume; Burke; Wollstonecraft.

**Pol 5253. Modernity and its Discontents: Late Modern Political Thought.** (4 cr. \$3253)  
Theoretical responses to and rival interpretations of Western economy, society, politics, and democratic culture in the modern age; theories of history; class struggle; end of metaphysics and death of God; technology and bureaucracy; psychology of culture in Hegel, Marx, Tocqueville, Mill, Nietzsche, Weber, Freud.

**Pol 5275. Contemporary Political Thought.** (3 cr. \$4275. Prereq-Grad student; 1201 recommended)  
20th-century crisis of Western humanism in major works of contemporary political thought from World War II to present. Force and freedom. Ideology and truth. Authority and resistance. Thinkers may include Arendt, Camus, Beauvoir, Fanon, Foucault, Habermas, Rawls, Sartre, Said. Ideas may include communitarianism, feminism, postcolonialism, postmodernism, socialism.

**Pol 5280. Topics in Political Theory.** (3-4 cr [max 8 cr]. \$4280. Prereq-Grad student)  
Topics in historical, analytical, or normative political theory. Topics vary, see *Class Schedule*.

**Pol 5303. American Democracy in Crisis.** (3-4 cr. \$4303. Prereq-[1001 or equiv], [non-pol sci grad major or #]) Compares performance of American political system with promises of democracy. Interpretations of democratic government and American national governing process.

**Pol 5306. Presidential Leadership and American Democracy.** (3-4 cr. \$4306. Prereq-[1001 or equiv], [non-pol sci grad major or #]) Examines whether president's political and constitutional powers are sufficient to satisfy citizens' high expectations and whether president should be expected to dominate American politics.

**Pol 5308. Congressional Politics and Institutions.** (3-4 cr. \$4308. Prereq-[1001 or 1002], non-pol sci grad major or #) Origin/development of U.S. congressional institutions, parties, committees, leaders, lobbying/elections, and relations between Congress/executive branch. Relationship of campaigning/governing, nature of representation, biases of institutional arrangements.

**Pol 5309. Justice in America.** (3 cr. \$4309. Prereq-[1001 or 1002], [non-pol sci grad major or equiv or #]) American judiciary, selection of judges, how/why these individuals/institutions behave the way they do. What influences judicial decisions. What impact decisions have. Why people comply with them.

**Pol 5310. Topics in American Politics.** (3 cr. \$4310. Prereq-1001 or equiv or grad student or #) See *Class Schedule* for description.

**Pol 5315W. State Governments: Laboratories of Democracy.** (4 cr. \$4315W. Prereq-[1001 or equiv], non-pol sci grad major or #) Political behavior, governmental institutions, and public policies in American states. Comparison among states, between state and national government. Emphasizes Minnesota.

**Pol 5322. Rethinking the Welfare State.** (3-4 cr. \$4322. Prereq-Grad student) Competing arguments about welfare states in advanced industrial countries. Whether welfare states result from sectional interests, class relations, or citizenship rights. Compares American social policy with policies in other western countries.

**Pol 5327. Politics of American Cities and Suburbs.** (3 cr. \$4327. Prereq-[1001 or 1002], [non-pol sci grad major or equiv] or #) Development/role of American local government. Forms and structures. Relationships with states and federal government. Local politics and patterns of power/influence.

**Pol 5331. Thinking Strategically in Domestic Politics.** (3-4 cr. \$4331. Prereq-Grad student) Applications of rational-choice and game theories to important features of domestic politics in the United States and elsewhere.

**Pol 5410. Topics in Comparative Politics.** (3 cr. \$4410. Prereq-Grad student) Topics of current analytical or policy importance. Topics vary, see *Class Schedule*.

**Pol 5441. Environmental Policy.** (3 cr. \$3441. Prereq-Non-pol sci grad student or #) How American political system deals with environmental issues. How third world countries deal with environmental protection/economic growth. How international community deals with global environmental problems.

**Pol 5461W. European Government and Politics.** (4 cr. \$4461W. Prereq-1054 or 3051 or non-pol sci grad student or #) European political institutions in their social settings. Power and responsibility. Governmental stability. Political decision making. Government and economic order.

**Pol 5467. Politics and Market in Contemporary Japan.** (3-4 cr. \$4467, \$EAS 4467. Prereq-1054 or 3051 or non-pol sci grad student or #) How Japan combined rapid economic development and social stability in postwar period. Strengths/weaknesses of Japanese model of capitalism, particularly in today's new "globalized" world.

**Pol 5471. After Communism: Russia and the Commonwealth of Independent States.** (3-4 cr. \$4471. Prereq-1054 or 3051 or non-pol sci grad student or #) Politics of newly independent states of former Soviet Union, particularly Russia. Political transformation, sources of political stability/instability, economic reform, problems of multinational state.

**Pol 5473. Chinese Politics.** (3 cr. \$4473, \$EAS 4473. Prereq-Grad student) Fundamental conflicts in Chinese society. Democracy movement, human rights, class divisions, gender struggles, environmental issues, capitalist vs socialist development strategies. Secondary topics include Chinese foreign relations and domestic/foreign political issues in Taiwan.

**Pol 5477. Struggles and Issues in the Middle East.** (4 cr. \$4477. Prereq-1054 or 3051 or non-pol sci grad student or #) Turkey, Iran, Israel, and selected Arab states. Domestic politics of religious/secular, ethnic, economic, environmental, and other policy/identity issues. Regional politics of water access, Israeli/Palestinian/Arab world relationships, oil and Persian/Arabian Gulf, human rights.

**Pol 5478. Contemporary Politics in Africa and the Colonial Legacy.** (4 cr. \$4478. Prereq-1054 or 3051 or non-pol sci grad student or #) How current politics in mainly, though not exclusively, sub-Saharan Africa have been shaped by pre-colonial/colonial processes. Reality of independence, recurrent political/economic crises. Global context and prospects for effective democracy.

**Pol 5479. Latin American Politics.** (3 cr. \$4479, \$LAS 4479. Prereq-1054 or 3051 or non-pol sci grad student or #) Overview of Latin American politics and political economy. Authoritarianism, human rights, redemocratization. Development and economic policy. Social movements. Ethnicity and race. Religion. Revolution. U.S.-Latin American relations.

**Pol 5481. Governments and Markets.** (3-4 cr. \$4481. Prereq-1054 or 3051 or non-pol sci grad student or #) Connection between democracy and markets. Focuses on countries in North America, Europe.

**Pol 5483. Grassroots Politics.** (3-4 cr. \$4483. Prereq-Grad student) Politics of daily life, powerlessness, workplace politics, everyday resistance, local organizing, protest, rebellion, and social movements.

**Pol 5485. Human Rights and Democracy in the World.** (3 cr. \$4485. Prereq-[At least one 1xxx or 3xxx course in pol sci, non-pol sci major] or #) History of ideas about human rights and democracy. Economic, political, psychological, and ideological explanations for repression.

**Pol 5487. Struggle for Democratization and Citizenship.** (4 cr. \$4487. Prereq-Non-pol sci grad student) History of democratic movement from its earliest moments in history to present. Attempts to draw balance sheet. Emphasizes how disenfranchised fought to become included.

**Pol 5501. Supreme Court and Constitutional Interpretation.** (3 cr. \$4501. Prereq-1001 or 1002 or equiv or non-pol sci grad student or #) Historical/analytical approaches to Court's landmark decisions. Theory/techniques of judicial review. Court's authority related to wider political/social context of American government.

**Pol 5523. Politics of Regulatory Process.** (3 cr. \$4523. Prereq-[1001 or 1002 or equiv or #], [4309 or 4501 or sr or non-pol sci grad student]) Operations of regulatory agencies in political/legal environment. Principles of federal administrative law, informal procedures, interest group activity. Philosophy of regulation. Politics/processes of deregulation.

**Pol 5525. Federal Indian Policy.** (3 cr; A-F only. \$4525, \$Amln 4525. Prereq-Grad student) Formulation, implementation, evolution, comparison of Indian policy from pre-colonial times to self-governance of new millennium. Theoretical approaches to federal Indian policy. Major federal Indian policies. Views/attitudes of policy-makers, reactions of indigenous nations to policies. Effect of bodies of literature on policies.

**Pol 5561. Comparative Legal Systems.** (3 cr. \$4561. Prereq-Jr or sr or non-pol sci grad student) Survey of principal legal systems of Western world. Role of legal system in relation to various political/economic systems. Contrast between common law and civil law traditions.

**Pol 5737. American Political Parties.** (3-4 cr. \$4737. Prereq-[1001 or equiv], grad student] or #) American two-party system. Party influence in legislatures/executives. Decline of parties, their future.

**Pol 5766. American Political Culture and Values.** (3-4 cr. \$4766. Prereq-1001 or equiv or non-pol sci grad student or #) Individualism, freedom, equality. Dominant beliefs about democratic principles, materialism, capitalism, citizenship, patriotism/heroism.

**Pol 5767. Public Opinion and Voting Behavior.** (3 cr. \$4767. Prereq-[1001 or equiv], grad student] or #) Major factors influencing electoral decisions. Political attitude formation/change. Data analysis lab required.

**Pol 5810. Topics in International Politics and Foreign Policy.** (3-4 cr [max 8 cr]. \$4810. Prereq-Grad student) Selected issues in contemporary international relations. Topics vary, see *Class Schedule*.

**Pol 5832. Defending America: U.S. Security Policy.** (3-4 cr. \$4832. Prereq-Grad student) History of U.S. security doctrine. Major issues in present U.S. security policy (e.g., future of NATO, nuclear strategy in absence of a clear enemy, nuclear/chemical international arms control). Political/bureaucratic process of making U.S. defense policy.

**Pol 5833. The United States in the Global Economy.** (3-4 cr. \$4833. Prereq-Grad student; 3835 recommended) Domestic/international politics of United States. Foreign economic policy (trade, aid, investment, monetary, migration policies). Effects of policies and international economic relations on U.S. economy/politics.

**Pol 5836. Making Foreign Policy: Perceptions and Decisions.** (3-4 cr. \$4836. Prereq-Non-pol sci grad student) Foreign policy decision making beyond the "to serve the national interest" cliché. Culture, political psychology, organizational theory, democratic theory, bureaucratic politics, game theory, and political economy. Decision making in cross-cultural settings.

**Pol 5872. Global Environmental Politics.** (3 cr. \$3872. Prereq-Non-pol sci grads only) Emergence of the environment as a key aspect of the global political agenda. Non-governmental and governmental international organizations. Politics of protection of the atmosphere, rain forests, seas and other selected issues. International security and the environment.

**Pol 5881. International Law.** (3 cr. \$4881. Prereq-3835 or non-pol sci grad student or #) How international law matters for world politics. War crimes, human rights. Law of the sea and of the environment. International crime. Lectures, discussions, simulations of cases.

**Pol 5883. Global Governance.** (3 cr. \$4883. Prereq—3835 or non-pol sci grad student or #)  
Rise/role of inter-governmental organizations such as United Nations, non-governmental organizations. Peacekeeping, trade, development, human rights, security and arms control, self-determination, refugees, health, environment. Seminar discussions, class simulations.

**Pol 5885. International Conflict and Security.** (3-4 cr. \$5885. Prereq—Grad student)  
Alternative theories of sources of militarized international conflict. Theories applied to past conflicts. Theories' relevance to present.

**Pol 5887. Thinking Strategically in International Politics.** (3 cr; A-F only. \$4887. Prereq—Grad student)  
Applications of game theory to international politics. Conflict/cooperation, global environmental commons, deterrence/reputation.

**Pol 5889. Governments and Global Trade and Money.** (3-4 cr. Prereq—3835 or non-pol sci grad or #)  
Study the politics of international trade and monetary affairs including north-south and east-west relations

**Pol 5970. Individual Reading and Research.** (1-4 cr [max 1 cr]. Prereq—#, Δ, □)  
Guided individual reading or study.

**Pol 8101. Introduction to Political Science.** (3 cr; A-F only. Prereq—Grad pol sci major or #)  
History, scope, and methods of political science as a discipline; current subfields; major research programs (including statism, pluralism, institutionalism, realism, behavioralism, rational choice, and critical theory); problems of theory, interpretation, concept-formation, comparison, measurement and experimentation; designs for research.

**Pol 8104. Professional Development I.** (1 cr [max 2 cr]; S-N only. Prereq—Pol student, ABD status)  
Research ethics. Completion of dissertation prospecti or early dissertation chapters.

**Pol 8105. Professional Development II.** (1 cr [max 2 cr]; S-N only. Prereq—Pol student, ABD status)  
Research ethics. Skills for teaching undergraduate courses in political science. Completion of dissertation prospecti or early chapters.

**Pol 8122. Positive Theory.** (3 cr. Prereq—Grad pol sci major or #)  
Survey of positive political theory and rational-choice models. Information and transaction costs; institutions; models of elections, voting, coalitions.

**Pol 8123. Introduction to Quantitative Political Research.** (3 cr; A-F only. Prereq—Pol sci grad student or #)  
Principles of regression analysis, use of regression model in political science.

**Pol 8124. Game Theory.** (3 cr. Prereq—[8122, pol-sci grad student] or #)  
Application of noncooperative game theory in political science. Equilibrium concepts, bargaining, repeated games, games of incomplete information, signaling games, reputation, learning in games.

**Pol 8125. Dynamic Analysis.** (3 cr. Prereq—Pol sci grad student or #)  
Time series method, its application in political science.

**Pol 8126. Qualitative Methods.** (3 cr. Prereq—Grad pol sci major or #)  
Broad introduction to qualitative methods in social science. Practical, hands-on training through fieldwork projects devised and carried out during the semester. Interviewing, participant observation, narrative interpretation, ethical problems, and issues of gender and race in fieldwork.

**Pol 8131. Advanced Methods and Models.** (3 cr. Prereq—Grad pol sci major, 6 cr 81xx seminars or #)  
Intersection of statistical methodology and deductive modeling; issues in merging inductive and deductive research. Sample topics: parties and elections, probabilistic voting, strategic modeling of international relations.

**Pol 8160. Topics in Models and Methods.** (3 cr [max 12 cr]. Prereq—Grad pol sci major or #)  
Seminars on selected topics.

**Pol 8201. Understanding Political Theory.** (3 cr. Prereq—Grad pol sci major or Δ)  
Key concepts and major approaches.

**Pol 8215. Philosophy of Political Inquiry.** (3 cr. Prereq—Grad pol sci major or #)  
Major schools in philosophy of science as applied to political inquiry: pragmatism, positivism, hermeneutics, critical rationalism, critical theory, realism. Themes of political inquiry: explanation, interpretation, theory, criticism. Political issues raised by philosophy of science: liberalism, democracy, control, multiculturalism.

**Pol 8225. American Political Thought.** (3 cr. Prereq—Grad pol sci major or #)  
Colonial era to present: Puritans, American Revolution, Constitution, rise of individualism, pro- and anti-slavery arguments, civil war and reconstruction, industrialism, westward expansion, Native Americans, immigration, populism, socialism, social Darwinism, growth of corporations and unions; Great Depression; growth of American power at home and abroad.

**Pol 8235. Democratic Theory.** (3 cr. Prereq—Grad pol sci major or #)  
Competing models of democracy: classical, republican, liberal, radical, Marxist, neo-Marxist, pragmatist, populist, pluralist, postmodern, participatory. Domestic and international struggles over meaning of "democracy"; social science models of and findings on democracy.

**Pol 8251. Ancient and Medieval Political Thought.** (3 cr. Prereq—Grad pol sci major or #)  
Politics and ethics in Greece, Rome, Christendom: Thucydides, Socrates, Plato, Aristotle, Cicero, Augustine, Aquinas, Marsilius.

**Pol 8252. Early Modern Political Thought.** (3 cr. Prereq—Grad pol sci major or #)  
Theorists and texts from Renaissance to French Revolution. Selectively includes Machiavelli, More, Calvin, Luther, Grotius, Bodin, Hobbes, Winstanley, Harrington, Locke, Montesquieu, Rousseau, Hume, Smith, Burke, and Wollstonecraft; key debates over liberty, law, power, and knowledge.

**Pol 8253. Late Modern Political Thought.** (3 cr. Prereq—Grad pol sci major or #)  
Theoretical responses to and rival interpretations of Western economy, society, politics, and democratic culture in the modern age; theories of history; class struggle; the end of metaphysics and the death of God; technology and bureaucracy; psychology of culture, in Hegel, Marx, Tocqueville, Mill, Nietzsche, Weber, Freud.

**Pol 8260. Topics in Political Theory.** (3 cr [max 6 cr]. Prereq—Grad pol sci major or #)  
Readings and research in special topics or problems.

**Pol 8275. Contemporary Political Thought.** (3 cr. Prereq—Grad pol sci major or #)  
From approximately World War II to the present. Survey of range of texts or intensive focus on such authors as Adorno, Arendt, Derrida, Foucault, Habermas, Horkheimer, Rawls, Said. Sample topics: feminism, postmodernism, communitarianism, Frankfurt School, postcolonialism.

**Pol 8301. American Politics.** (3 cr. Prereq—Grad pol sci major or #)  
Seminar on main themes of theory and research in American politics, institutions, law, and policy. Major works on individual, mass, elite, and institutional behavior and their relationship to each other. Foundation for advanced seminars in American politics.

**Pol 8302. Public Opinion and Political Participation.** (3 cr. Prereq—Grad pol sci major or #)  
Major theoretical perspectives and research on political participation, voting behavior, and public opinion. Voter turnout, importance of party identification, effects of campaigns, long-term change in public opinion, and designing and conducting research.

**Pol 8303. Political Parties.** (3 cr. Prereq—Grad pol sci major or #)  
Party systems and subsystems; party organizational characteristics, goals, and incentives; distribution of power and authority within the party; chief party functions; party as an organizer of governmental power; determinants of party structure and role.

**Pol 8305. Interest Groups and Social Movements.** (3 cr. Prereq—Grad pol sci major or #)  
Theoretical/empirical work on role of interest groups and social/political movements in American politics and policy-making processes. Theories of interest group and social/political movement formation, maintenance, and decline. How interest groups and social/political movements attempt to influence public policy. Impact/effectiveness groups/movements as agents of democratic representation, particularly for marginalized groups.

**Pol 8307. Proseminar in Political Psychology I.** (1 cr; S-N only. Prereq—Grad pol sci major or pol psych minor or #)  
Readings, discussion, and guest speakers. Topics vary by semester.

**Pol 8308. Proseminar in Political Psychology II.** (1 cr; S-N only. Prereq—Grad pol sci major or pol psych minor or #)  
Readings, discussion, and guest speakers. Topics vary by semester.

**Pol 8311. Political Psychology and Socialization.** (3 cr; A-F only. Prereq—Grad pol sci major or pol psych minor or #)  
Introduction to political psychology. Personality and politics; political cognition, emotion, and political behavior; political expertise; media and politics; aggression, authoritarianism, and political behavior; altruism and politics.

**Pol 8312. Legislative Process.** (3 cr. Prereq—Grad pol sci major or #)  
Introduction to study of legislative politics; theories of legislative institutions and individual behavior; congressional elections; congressional committees, parties, and leaders.

**Pol 8313. Executive Process.** (3 cr. Prereq—Grad pol sci major or #)  
Tension between leadership and democracy in context of American presidency in terms of President's relationship with federal bureaucracy, Congress, and making of diplomatic and military policy.

**Pol 8314. Judicial Process.** (3 cr. Prereq—Grad pol sci major or #)  
Judicial systems and roles; selection of judges; organizing and supporting litigation; influences on judicial decisions; impact and enforcement of judicial decisions; courts and other institutions of government.

**Pol 8320. Social Psychology of Prejudice and Intergroup Relations.** (3 cr; A-F only)  
Approaches, findings, and controversies in research on social psychology of prejudice, racial attitudes, and intergroup relations. Focuses on approaches based in social psychology and on related work from political science and sociology.

**Pol 8321. Urban Politics.** (3 cr; A-F only. Prereq—Grad pol sci major or #)  
Selection of local leadership; relationship of political system to governmental forms and social institutions; role and impact of political institutions; policymaking at local level; studies in policy problems; the emerging metropolis.

**Pol 8325. State Politics and Intergovernmental Relations.** (3 cr. Prereq—Grad pol sci major or #)  
Theoretical approaches to comparative study of state politics; study of political culture and behavior, governmental institutions, and public policy at state level; federalism.

**Pol 8331. Constitutional Law.** (3 cr. Prereq—Grad pol sci major or #)  
Overview of substantive and theoretical debates in American constitutional law; role of law and constitutional interpretation in shaping American political institutions and American politics.

**Pol 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**Pol 8335. Public Policy.** (3 cr. Prereq—Grad pol sci major or #)

Theoretical approaches: incrementalism, innovation and policy learning, comparative policy outputs, policy process models, interest groups, and selected areas of public policy.

**Pol 8337. Welfare State Theories and American Social Policy.** (3 cr. Prereq—Grad pol sci major or #)

Rival theoretical explanations for cause and nature of welfare state development in context of four American social policies: social security, welfare, education, and healthcare.

**Pol 8360. Topics in American Politics.** (1-3 cr [max 3 cr]. Prereq—Pol-sci graduate student or #)

Readings/research in special topics or problems.

**Pol 8401. International Relations.** (3 cr. Prereq—Pol-sci graduate student or Δ)

Basic theories/approaches to study of international politics. Surveys representative work/central issues of scholarship.

**Pol 8402. Conflict Dynamics and Security.** (3 cr. Prereq—Grad pol sci major or #)

Introduction to contending theories of international conflict and national security.

**Pol 8403. International Norms and Institutions.** (3 cr. Prereq—Grad pol sci major or #)

Origins, roles, and effectiveness of international norms and institutions; theoretical explanations and debates. Institution of sovereignty; rational choice versus constructivist perspectives; role of international law, international organizations, and non-governmental organizations; and international society and transnational cultural norms.

**Pol 8404. International Hierarchy.** (3 cr. Prereq—Grad pol sci major or #)

Asymmetric structures and processes of international relations; systemic conditions and implications of informal empire and structures of hegemony; cultural productions of difference and inequality.

**Pol 8405. International Political Economy.** (3 cr; A-F only. Prereq—Grad pol sci major or #)

Theoretical and policy issues in international economic relations. Different approaches for understanding outcomes in international economy. Trade, finance, labor markets, creation and maintenance of international regimes, and “globalization” of economic liberalism.

**Pol 8406. Politics of International Finance.** (3 cr. Prereq—Grad pol sci major or #)

Relationship between workings of the international political system and that of international markets for currency and capital.

**Pol 8407. Morality in World Politics.** (3 cr. Prereq—Grad pol sci major or #)

Approaches to normative theorizing and empirical research on moral norms in world politics. Theoretical topics: realism, communitarianism, consequentialism, constructivism, postmodernism, cultural relativism. Substantive issue areas: famine and foreign aid, just war theory, nuclear weapons, moral implications of technology, case study on war (Gulf War).

**Pol 8408. International Relations of the Environment.** (3 cr. Prereq—Grad pol sci major or #)

Theory and practice of international environmental politics. Emergence of environment as major issue of international relations. Diversities of agendas and politics. Imperatives, templates, resistance in global efforts to forge an applied politics of environmental sustainability. Selected cases.

**Pol 8411. Political Psychology and Foreign Policy.** (3 cr. Prereq—Grad pol sci major or #)

Foreign policy theories about decision makers and audiences. Impact of human nature, formal institutions, cultural and cross-cultural settings, and kinds of issues on foreign policy choice, control, and justification.

**Pol 8412. American Foreign Policy.** (3 cr. Prereq—8410 or #)

U.S. policy toward foreign states and peoples: heritage, motivations, policy processes, what the public generally knows and wants, specific policies. Rise of intermestic issues and decline of enemy-focused internationalism; implications for process and content of U.S. foreign policy.

**Pol 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**Pol 8460. Topics in International Relations.** (3 cr [max 6 cr]. Prereq—Grad pol sci major or #)

Readings and research in advanced topics or problems. Recent topics: global environmental issues, morality in world politics, and norms and institutions in world politics.

**Pol 8601. Introduction to Comparative Politics.** (3 cr. Prereq—Grad pol sci major)

Main theoretical approaches and issues: comparative method, the state and class; political culture; development, democratization, rational choice, social movements.

**Pol 8603. European Government and Politics.** (3 cr; A-F only. Prereq—Grad pol sci major or #)

Main theories and approaches used to interpret European politics. Many of these theories have broad relevance for comparative politics, for example, theories about the state, cleavages and coalitional bases, parties and social movements, and constitutional structures and institutions have broad relevance for the field of comparative politics.

**Pol 8605. Government and Politics in Africa.** (3 cr; A-F only. Prereq—Grad pol sci major or #)

Theoretical and methodological approaches to study of African politics, focusing on pre-colonial and colonial legacies for post-colonial reality. Local politics, social construction of identities, political economy of peasantry and working class, political development and decay, social movements, and prospects for democracy.

**Pol 8608. Government and Politics of Russia and the Commonwealth of Independent States.** (3 cr; A-F only. Prereq—Grad pol sci major or #)

Framework for understanding politics of change underway in the former Soviet Union. Roots of current transformation, including causes and legacy of the Russian revolution and creation of the Soviet Union. Issues in current transformation, including nationalism, economic reform, and democratization. Prior knowledge of basic Soviet politics is assumed.

**Pol 8611. Chinese Politics.** (3 cr. Prereq—Grad pol sci major or #)

Major issues since 1949: democratization, dissent, violence, gender, capitalist and socialist development strategies, inequality, effect of culture on politics, status of Taiwan. Current scholarly debates on Chinese politics. Professional methods for research on contemporary China.

**Pol 8615. The Political Economy of Contemporary Japan.** (3 cr. Prereq—Grad pol sci major or #)

Major political and economic issues confronting the Japanese system; situation of Japanese case within comparative politics literature concerning role of the state in formulating economic and social policy making. Review of literature. Deregulation in key industries, welfare reform, tax reforms.

**Pol 8619. Latin American Politics.** (3 cr. Prereq—Grad pol sci major or #)

Major bodies of theory on development, democracy and redemocratization, social movements, civil society, the state, and transnational linkages.

**Pol 8633. Comparative Sociopolitical Change.** (3 cr. Prereq—Grad pol sci major or #)

Critical evaluation of literature and theoretical perspectives; comparative examination of social and political change and interrelationship between both processes; structure/agency nexus.

**Pol 8637. Comparative Political Economy.** (3 cr. Prereq—Grad pol sci major or #)

Connections between democracy and markets, emphasizing experiences of countries in North America and Europe.

**Pol 8641. Comparative Mass Political Behavior.** (3 cr; A-F only. Prereq—Grad pol sci major or #)

Examined from a cross-national perspective. Development of political participation, mobilization and its effects, development of political cleavages and political parties as vehicles of conflict, modes of political behavior under varied systems of representation and varied party systems.

**Pol 8643. Comparative Political Institutions.** (3 cr; A-F only. Prereq—Pol sci grad student or #)

Structure/operation of various political institutions in different settings. Theoretical approaches, comparative frameworks. Introduction to literature on political institutions. Preparation for comparative research on political institutions.

**Pol 8660. Topics in Comparative Politics.** (1-3 cr [max 6 cr]. Prereq—Grad pol sci major or #)

Readings in advanced topics or problems; supervised research and research training.

**Pol 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Pol 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Pol 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

**Pol 8990. Directed Readings and Research in Political Science.** (1-7 cr [max 7 cr]. Prereq—16 cr 8xxx pol sci courses, #, Δ)

## Portuguese (Port)

*Department of Spanish and Portuguese Studies  
College of Liberal Arts*

**Port 5520. Portuguese Literary and Cultural Studies.** (3 cr [max 9 cr]. Prereq—#)

Study of origins and development of modern Portuguese nation (late 15th to 20th century) using literature, cultural and literary criticism, history, sociology) and various media (film, art, music, Internet). Main cultural problematics pertaining to Portugal as well as fundamental literary texts.

**Port 5530. Brazilian Literary and Cultural Studies.** (3 cr [max 9 cr]. Prereq—#)

Study of origins and development of modern Brazilian nation (late 16th to 20th century) using literature, cultural and literary criticism, history, sociology) and various media (film, art, music, Internet). Main cultural problematics pertaining to Brazil as well as fundamental literary texts.

**Port 5540. Literatures and Cultures of Lusophone Africa.** (3 cr [max 9 cr]. Prereq—#)

Origins/development of Lusophone Africa (Angola, Mozambique, Cape-Verde, Guinea-Bissau, São Tomé, Príncipe) using literature, cultural/literary criticism, history, sociology, and various media (film, art, music, Internet).

**Port 5910. Topics in Lusophone Cultures.** (3 cr [max 9 cr]. Prereq—#)

Cultural manifestations in Portuguese-speaking world (Portugal, Brazil, Lusophone Africa): literature, history, film, intellectual thought, critical theory, popular culture. Topics include: Portuguese colonialism; postcolonial nation in Lusophone world; Lusophone women writers; Luso-Brazilian (post)modernity.

**Port 5920. Figures in Lusophone Literatures.** (3 cr [max 9 cr]. Prereq-#)  
One Portuguese, Brazilian, or other major Portuguese-speaking writer or group of writers whose work has had impact on thought, literature, or social problems (e.g., Machado de Assis, Fernando Pessoa, Clarice Lispector). Figures specified in *Class Schedule*.

**Port 5930. Topics in Brazilian Literature.** (3 cr [max 9 cr]. Prereq-#)  
Major issues of Brazilian literature; focuses on important authors, movements, currents, genres. Problems, socioeconomic questions, literary techniques related to Brazilian themes. Topics specified in *Class Schedule*.

**Port 5970. Directed Readings.** (3 cr [max 9 cr]. Prereq-MA or PhD candidate, #, Δ, □)  
Lusophone studies (Portuguese-speaking Africa, Brazil, Portugal). Areas not covered in other courses. Students submit reading plans for particular topics, figures, periods, or issues.

**Port 5990. Directed Research.** (1-4 cr [max 9 cr]. Prereq-#, Δ, □)  
Graduate-level research in literatures and cultures of the Portuguese-speaking world. Topics vary.

**Port 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**Port 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Port 8920. Seminar: Lusophone Literatures and Cultures.** (3 cr [max 9 cr])  
Problems pertaining to Portuguese, Brazilian, and/or Lusophone African cultures and literatures. Topics specified in *Class Schedule*.

## Psychology (Psy)

Department of Psychology  
College of Liberal Arts

**Psy 5012. Learning and Cognition in Animals.** (4 cr. Prereq-3011 or grad student or #)  
Review/evaluation of key questions, methods, theories, and data about forms of learning and elementary cognitive processes. Emphasizes animal models. Implications for human learning/behavior.

**Psy 5014. Psychology of Human Learning and Memory.** (3 cr. Prereq-3011 or 3051, except honors, grad students)  
Survey of basic methods and findings of research on human learning, memory, and cognition. Emphasis on major factors influencing human encoding or acquisition of information and skill, retention, and retrieval. Theoretical perspectives on underlying processes of encoding, retention, and retrieval.

**Psy 5015. Cognition, Computation, and Brain.** (3 cr. Prereq-3051 except honors, grad students)  
Human cognitive abilities (perception, memory, attention) from different perspectives (e.g., cognitive psychological approach, cognitive neuroscience approach).

**Psy 5031W. Perception.** (3 cr. Prereq-3031 or 3051 or #)  
Cognitive, computational, and neuroscience perspectives on visual perception. Topics include color vision, pattern vision, image formation in the eye, object recognition, reading, and impaired vision.

**Psy 5034. Psychobiology of Vision.** (3 cr. Prereq-3031 or #)  
Analysis of the properties and biological bases of visual perception in humans and animals. Emphasis on color vision, visual sensitivity and adaptation, nerve cells and circuits in the eye, structure and function of the visual brain.

**Psy 5036W. Computational Vision.** (3 cr. Prereq-[[3031 or 3051], Math 1272] or #)  
Applications of psychology, neuroscience, computer science to design principles underlying visual perception, visual cognition, action. Compares

biological/physical processing of images with respect to image formation, perceptual organization, object perception, recognition, navigation, motor control.

**Psy 5037. Psychology of Hearing.** (3 cr. Prereq-3031 or #)  
Biological and physical aspects of hearing, auditory psychophysics, theories and models of hearing, perception of complex sounds including music and speech, clinical, and other applications.

**Psy 5038W. Introduction to Neural Networks.** (3 cr. Prereq-[[3061 or NSc 3102], Math 2243] or #)  
Parallel distributed processing models in neural/cognitive science. Linear models, Hebbian rules, self-organization, non-linear networks, optimization, representation of information. Applications to sensory processing, perception, learning, memory.

**Psy 5051W. Psychology of Human-Machine Interaction.** (3 cr. Prereq-3031 or 3051 or #)  
Psychological perspectives on human-machine interaction and factors that limit performance. Cognitive and perceptual aspects of computer, use, telepresence, and design and evaluation of sensory aids.

**Psy 5054. Psychology of Language.** (3 cr. Prereq-3005W or honors or grad student or #)  
Theories/experimental evidence in past/present conceptions of psychology of language.

**Psy 5061. Neurobiology of Behavior.** (3 cr. \$3061. Prereq-3005W or Biol 1009 or #)  
Physiological/neuroanatomical mechanisms underlying behavior of animals, including humans. Neural basis of learning/memory, sleep, wakefulness, and attention processes. Effects of drugs on behavior.

**Psy 5062. Cognitive Neuropsychology.** (3 cr. Prereq-3031 or 3051)  
Consequences of different types of brain damage on human perception/cognition. Neural mechanisms of normal perceptual/cognitive functions. Vision/attention disorders, split brain, language deficits, memory disorders, central planning deficits. Emphasizes function/phenomenology. Minimal amount of brain anatomy.

**Psy 5064. Brain and Emotion.** (3 cr; A-F only. Prereq-3061 or 5061 or #)  
Introduction to affective neuroscience. Focuses on how brain promotes emotional behavior in animals/humans. Biological theories of emotion reviewed in historical, current theoretical contexts. Research related to specific "basic" emotions, including brain substrates for fear, sadness, pleasure, attachment. Implications for understanding emotional development, vulnerability to psychiatric disorders.

**Psy 5101. Personality Psychology.** (3 cr. \$3101. Prereq-3005W, [honors or grad student])  
Theories and major issues/findings on personality functioning, personality structure, and personality assessment. Historically important and currently influential perspectives.

**Psy 5135. Psychology of Individual Differences.** (3 cr. \$3135. Prereq-[[3005W or equiv], 5862] or #)  
Differential methods in study of human behavior. Overview of nature of psychological traits. Influence of age, sex, heredity, and environment in individual/group differences in ability, personality, interests, and social attitudes.

**Psy 5137. Introduction to Behavioral Genetics.** (3 cr. Prereq-3005W or equiv or #)  
Genetic methods for studying human/animal behavior. Emphasizes nature/origin of individual differences in behavior. Twin and adoption methods. Cytogenetics, molecular genetics, linkage/association studies.

**Psy 5138. Psychology of Aging.** (3 cr. Prereq-3005W or equiv)  
Theories/findings concerning age-related changes in mental health, personality, cognitive functioning, productivity are reviewed/interpreted within context of multiple biological, social, and psychological changes that accompany age.

**Psy 5202. Attitudes and Social Behavior.** (3 cr. Prereq-3201 or #)  
Theory/research in social psychology, other fields in psychology of attitudes, beliefs, values. These fields' relationship to social behavior. Principles/theories of persuasion.

**Psy 5204. Psychology of Interpersonal Relationships.** (3 cr; A-F only. Prereq-3201 or honors or grad student or #)  
Introduction to interpersonal relationship theory/research findings. Emphasizes conceptual/methodological issues.

**Psy 5205. Applied Social Psychology.** (3 cr. Prereq-3201 or grad student or #)  
Applications of social psychology research/theory to domains such as physical/mental health, education, the media, desegregation, the legal system, energy conservation, public policy.

**Psy 5206. Social Psychology and Health Behavior.** (3 cr; A-F only. Prereq-3201 or grad student or #)  
Survey of social psychological theory/research pertaining to processes by which people develop beliefs about health/illness. Relationship between these beliefs, adoption of health-relevant behavior. Effect of psychological factors on physical health.

**Psy 5207. Personality and Social Behavior.** (3 cr; A-F only. Prereq-3101 or 3201 or honors or grad student or #)  
Conceptual/methodological strategies for scientific study of individuals and their social worlds. Applications of theory/research to issues of self, identity, and social interaction.

**Psy 5501. Vocational and Occupational Health Psychology.** (3 cr. Prereq-3005 or #)  
Survey of history, concepts, theories, methods, and findings of vocational/occupational health psychology. Burnout, personality, violence, stressors/stress-relations, counter productive behaviors, coping in workplace. Vocational development/assessment, career decision-making/counseling, person-environment fit.

**Psy 5604H. Abnormal Psychology.** (3 cr. \$3604. Prereq-Honors or grad student or #)  
Comprehensive review of psychopathological disorders. Etiology, diagnostic criteria, clinical research findings.

**Psy 5606. Clinical Psychophysiology.** (3 cr. Prereq-3005 or equiv, 3061 or 5061, 3604 or 5604 or #)  
How psychophysiological methods such as autonomic and central nervous system recording are used in the study of major psychopathological disorders.

**Psy 5701. Organizational Staffing and Decision Making.** (3 cr. Prereq-[[3005W or 4801 or equiv], 3711] or #)  
Application of psychological research/theory to issues in personnel recruitment/selection and to measurement of job performance. Applying principles of individual differences, psychological measurement to decision making in organizations (recruitment, selection, performance appraisal).

**Psy 5702. Psychological Foundations of Individual Behavior in Organizations.** (3 cr. Prereq-[[3005W or 4801 or equiv], 3711] or #)  
Theory/research on human behavior/performance in organizations. Organizational socialization processes across career span, leadership styles/processes, work team structures/characteristics. Problem-solving, decision-making processes. Group dynamics, inter-group relations.

**Psy 5705. Psychology of Work Motivation.** (3 cr. Prereq-4801 or equiv, 3711 or #)  
Motivation issues related to the behavior and performance of individuals in organizational settings. Contemporary work motivation theories and practices that relate person factors and environmental factors to skill acquisition, job performance, organizational citizenship behavior, and job satisfaction.

**Psy 5707. Personnel Psychology.** (4 cr. \$5701, \$5703. Prereq-[3005W or equiv], 3711) or #)  
Application of psychological research/theory to organizational staffing, evaluation, and training. Principles of individual differences and psychological measurement applied to decision making, staffing, and instruction in organizations. Job analysis, recruitment, screening, selection, performance appraisals, criterion measurement, organizational training, learning, aptitude treatment interactions.

**Psy 5708. Organizational Psychology.** (4 cr. \$5702, \$5705. Prereq-[3005W or equiv], 3711) or #)  
Psychological causes of behavior in work organizations. Consequences for individual fulfillment and organizational effectiveness. Individual differences, social perception, motivation, stress, job design, leadership, job satisfaction, teamwork, organizational culture.

**Psy 5862. Psychological Measurement: Theory and Methods.** (3 cr. Prereq-4801 or equiv)  
Types of measurements (tests, scales, inventories) and their construction. Theory/measurement of reliability/validity.

**Psy 5865. Advanced Psychological and Educational Measurement.** (4 cr. Prereq-5862 or #)  
Topics in test theory. Classical reliability/validity theory/methods, generalizability theory. Linking, scaling, equating. Item response theory, methods for dichotomous/polytomous responses. Comparisons between classical, item response theory methods in instrument construction.

**Psy 5960. Topics in Psychology.** (1-4 cr [max 8 cr]. Prereq-1001, [jr or sr or grad student])  
Special course or seminar. Topics listed in psychology office.

**Psy 8004. Philosophical Psychology.** (2 cr; S-N only. Prereq-Logic or phil course, psych or phil PhD student or #)  
Selected philosophical and methodological problems.

**Psy 8010. Advanced Topics in Learning.** (2 cr; S-N only. Prereq-5012 or #)  
Contemporary topics in learning and behavior theory.

**Psy 8020. Seminar in Conditioning and Learning.** (2 cr; S-N only. Prereq-5012 or grad psych major or #)  
Review and discussion of ongoing research and perspectives on future research.

**Psy 8026. Neuro-Immune Interactions.** (3-23 cr. \$NSc 8026. Prereq-MicB 4131 or equiv, NSc 5111 or equiv)  
Regulatory systems (neuroendocrine, cytokine, and autonomic nervous systems) linking brain and immune systems in brain-immune axis. Functional effects of bidirectional brain-immune regulation.

**Psy 8031. Seminar: Visual Perception.** (1-2 cr [max 3 cr]. Prereq-#)  
Cognitive, psychological, neurophysiological determinants of visual perception. Current research.

**Psy 8036. Topics in Computational Vision.** (3 cr [max 12 cr]. Prereq-5031 or 5036 or equiv or #)  
Recent research in visual psychophysics, visual neuroscience, and computer vision.

**Psy 8037. Psychophysics and Audition.** (3 cr. Prereq-#)  
Modern/classical psychophysics. Psychophysical/physiological correlates of audition. Theories of hearing.

**Psy 8055. Seminar: Cognitive Neuroscience.** (1-4 cr. Prereq-5015 or #)  
Recent advances in analysis of neural bases of cognitive functions.

**Psy 8056. Seminar: Psychology of Language.** (3 cr; A-F only. Prereq-Grad psych major or #)  
Selected topics in psycholinguistics.

**Psy 8060. Seminar: Neural Substrates of Mental Processes.** (3 cr [max 12 cr]. Prereq-5012 or 5061 or 5062 or 5064 or NSci 5661 or 8010 or CPsy 8301 or NSci 8401 or #)  
Neurobiological substrates of psychological processes such as memory, attention, and emotion. Neurobiological substrates of mental dysfunction.

**Psy 8070. Seminar: Psychopharmacology.** (1-3 cr [max 12 cr]. Prereq-#)  
Basic issues, contemporary research. Lectures, student presentations.

**Psy 8107. Personality, Culture, and Society.** (3 cr; A-F only. Prereq-[5101, 5604] or equiv or #)  
Methodological issues and status of current research in intersection of personality, social, and cultural psychology.

**Psy 8108. Theories of Personality and Intervention.** (3 cr)  
Historical perspective on relationship between theories of personality and formulations of etiology/course of types of psychopathology. Treatment techniques ensuing from different theoretical perspectives. Psychoanalytic thought, works of Carl Rogers, existentialism, Gestalt therapists.

**Psy 8111. Psychopathology I.** (4 cr; A-F only. Prereq-Psychology grad student or #)  
Descriptive psychopathology. Theory/research. Evaluation of current experimentation in various behavior disorders.

**Psy 8112. Psychopathology II.** (3 cr; A-F only. Prereq-[8111, psych grad student] or #)  
Descriptive psychopathology. Theory/research. Evaluation of current experimentation in various behavior disorders.

**Psy 8201. Social Cognition.** (3 cr; A-F only. Prereq-Psych PhD candidate)  
Theory and research in stereotyping, social inference, and person memory.

**Psy 8202. Close Relationships.** (3 cr; A-F only. Prereq-5204 or #)  
Recent theory and research.

**Psy 8203. Impression Management.** (3 cr. Prereq-Grad psych major, #; 8208 recommended)  
Classic and contemporary theory and research concerning interpersonal strategies of impression management and interplay between private and public self.

**Psy 8204. Social Psychology of Prejudice and Intergroup Relations.** (3 cr)  
Approaches, findings, and controversies in research on social psychology of prejudice, racial attitudes, and intergroup relations. Focuses on approaches based in social psychology and on related work from political science and sociology.

**Psy 8205. Proseminar: Research in Social Psychology.** (2 cr [max 8 cr]; A-F only. Prereq-Psych PhD student)  
Contemporary theoretical positions and related research.

**Psy 8206. Proseminar: Research in Social Psychology.** (2 cr [max 6 cr]; A-F only. Prereq-Psych PhD student, 8205)  
Contemporary theoretical positions and related research.

**Psy 8208. Social Psychology: The Self.** (3 cr; A-F only. Prereq-Psych background especially in personality and soc psych)  
Social psychological theory and research concerning the self and social behavior.

**Psy 8209. Research Methods in Social Psychology.** (3 cr; A-F only. Prereq-Grad psych major)  
Experimental and quasi-experimental methods suitable for research in social psychology. Statistical, interpretive, operational, and ethical issues.

**Psy 8211. Proseminar in Political Psychology I.** (1 cr; S-N only. Prereq-Grad pol psych minor)  
Readings, discussion, and guest speakers. Topics vary each semester.

**Psy 8212. Proseminar in Political Psychology II.** (1 cr; S-N only. Prereq-Grad pol psych minor)  
Readings, discussion, and guest speakers. Topics vary each semester.

**Psy 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**Psy 8410. Perspectives in Learning, Perception, and Cognition.** (1 cr [max 12 cr]. Prereq-#)  
Lectures and discussions in cognitive sciences by local and visiting faculty.

**Psy 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**Psy 8501. Counseling Psychology: History and Theories.** (3 cr. Prereq-Counseling psych grad student or #)  
Introduction to history of counseling psychology and to primary theoretical orientations used by counseling psychologists. For each theory: basic principles, application to counseling practice, and research support.

**Psy 8502. Assessment in Counseling Psychology.** (3 cr. Prereq-Counseling psych grad student or #)  
Principles and practice. Emphasizes psychometric assessment. History, foundations in measurement, basic methods, survey of instruments, test interpretation evaluation, ethics.

**Psy 8503. Interviewing and Intervention.** (3 cr. Prereq-8501, 8502 or #)  
Skills-based course: conceptualization of counseling process, stages of counseling, development of counseling skills, and strategies for behavior change.

**Psy 8510. Counseling Psychology Beginning Practicum: General.** (1-6 cr; S-N only. Prereq-Counseling psych grad student, 8501, 8502, 8503 or equiv, #)  
Beginning applied experiences in counseling psychology settings.

**Psy 8511. Counseling Psychology Beginning Practicum: General.** (1-6 cr [max 18 cr]; S-N only. Prereq-[8501, 8502, 8503] or equiv), counseling psych grad student, #)  
Beginning applied experiences in counseling psychology settings.

**Psy 8512. Counseling Psychology Beginning Practicum: General.** (1-6 cr [max 18 cr]; S-N only. Prereq-Counseling psych grad student, 8501, 8502, 8503 or equiv, #)  
Beginning applied experiences in counseling psychology settings.

**Psy 8514. University Counseling Practicum I.** (4-6 cr; S-N only. Prereq-Counseling psych grad student, 8501, 8502, 8503 or equiv, #)  
Integrates science with supervised practice in University Counseling and Consulting Services (UCCS) involving career, academic, and personal counseling clientele.

**Psy 8515. University Counseling Practicum II.** (4-6 cr; S-N only. Prereq-Counseling psych grad student, 8501, 8502, 8503 or equiv, 8514, #)  
Integrates science with supervised practice in University Counseling and Consulting Services (UCCS) involving career, academic, and personal counseling clientele.

**Psy 8541. Seminar: Multicultural Issues in Counseling Psychology.** (3 cr; A-F only. Prereq-Counseling psych grad student or #)  
Theory, research, and practice of multiculturally competent counseling in diverse settings/communities. Emphasizes self-awareness, knowledge, and skills. Discussion, lecture, readings, lab, guest lectures.

**Psy 8542. Ethics in Psychology.** (3 cr; S-N only. Prereq-Counseling or clinical psych grad student or #)  
Ethical principles and codes of conduct for psychologists. Ethical dilemmas faced by researchers, practitioners, and teachers.

**Psy 8544. Vocational and Occupational Health Psychology Research.** (3 cr; A-F only. Prereq-[8501, 8502, 8503] or equiv), counseling psych grad student, #)  
Research problems specific to special populations, vocational research, assessment/testing, findings in these areas useful to counseling psychology practice.

**Psy 8545. Counseling Psychology Process and Outcome Research.** (3 cr; A-F only. Prereq—[[8501, 8502, 8503] or equiv], counseling psych grad student, #) Introduction to methods/content domains. Research design, methodological issues, analogue research, process/outcome research.

**Psy 8550. Assessment: WAIS-III.** (3 cr; S-N only. Prereq—Counseling psych grad student, #) Skills acquisition for administering, scoring, summarizing results of Wechsler Adult Intelligence Scale—Revised (WAIS-R).

**Psy 8554. Career and Occupational Health Psychology Assessment.** (3 cr; A-F only. Prereq—Counseling psych grad student, #) History of vocational interest inventories/measures related to career development, and of assessments used in occupational health psychology. Scale construction methodology. Research applications. Interpretation/use of instruments.

**Psy 8560. Counseling Psychology Advanced Practicum I: General.** (1-6 cr; S-N only. Prereq—[[[8501, 8502, 8503] or equiv], [[8510, 8511] or [8514, 8515] or equiv]], counseling psych grad student) or #) Applied practice experience in counseling psychology settings and seminars. May include guest speakers, readings, and student presentations.

**Psy 8561. Counseling Psychology Advanced Practicum II: General.** (1-6 cr; S-N only. Prereq—Counseling psych grad student, 8501-8502-8503 or equiv, 8510-8511 or 8514-8515 or equiv, #) Applied practice experience in counseling psychology settings and seminar that may include guest speakers, readings, and student presentations on topics relevant to clients and settings of practice experiences.

**Psy 8562. Counseling Psychology Advanced Practicum III: General.** (1-6 cr; S-N only. Prereq—Counseling psych grad student, 8501-8502-8503 or equiv, 8510-8511 or 8514-8515 or equiv, #) Applied practice experience in counseling psychology settings and seminar that may include guest speakers, readings, and students presentations on topics relevant to clients and settings of practice experiences.

**Psy 8565. Counseling Psychology Advanced Practicum I: Vocational Assessment Clinic.** (1-6 cr; S-N only. Prereq—[[[8501, 8502, 8503] or equiv], [[8514, 8515] or equiv], counseling psych grad student) or #) Applied practice experience in vocational assessment clinic of Department of Psychology. Career/vocational testing, assessment, decision making.

**Psy 8566. Counseling Psychology Advanced Practicum II: Vocational Assessment Clinic.** (1-6 cr; S-N only. Prereq—8501, 8502, [8503 or equiv], 8514, [8515 or equiv], counseling psych grad student, #) Applied practice experience in Vocational Assessment Clinic of Department of Psychology. Career/vocational testing, assessment, decision making.

**Psy 8567. Counseling Psychology Advanced Practicum III: Vocational Assessment Clinic.** (1-6 cr; S-N only. Prereq—Counseling psych grad student, 8501, 8502, 8503 or equiv, 8514, 8515 or equiv, #) Applied practice experience in Vocational Assessment Clinic of Department of Psychology. Career and vocational testing, assessment, and decision making.

**Psy 8570. Counseling Psychology Internship I.** (1-12 cr [max 36 cr]; S-N only. Prereq—Counseling psych PhD candidate, #) First part of counseling psychology internship.

**Psy 8571. Counseling Psychology Internship II.** (1-12 cr [max 36 cr]; S-N only. Prereq—Counseling psych PhD candidate, #) Second part of counseling psychology internship.

**Psy 8572. Counseling Psychology Internship III.** (1-12 cr [max 36 cr]; S-N only. Prereq—Counseling psych PhD candidate, #) Third part of counseling psychology internship.

**Psy 8611. Assessment I.** (5 cr; A-F only. Prereq—Clinical psych grad student) Theory and practice in clinical application of assessment techniques and interviewing. Lab: observations, administration, scoring, interpretation.

**Psy 8612. Assessment II.** (5 cr; A-F only. Prereq—8611, clinical psych grad student) Theory and practice in clinical application of assessment techniques and interviewing. Lab: observations, administration, scoring, interpretation.

**Psy 8620. Clinical Psychology Practicum.** (1-6 cr [max 36 cr]; S-N only. Prereq—Clinical psych grad student) Field experience in professional work in clinical settings.

**Psy 8621. Clinical Intervention I.** (1-3 cr; A-F only. Prereq—Clinical psych grad student) Professional methods in clinical psychology. Individual and group treatment techniques. Lectures and demonstrations of contemporary theories of methods of intervention with adults and children.

**Psy 8622. Treatment I.** (3 cr; A-F only. Prereq—8621, clinical psych grad student) Theories of intervention, applications of clinical methods.

**Psy 8640. Research Seminar.** (2 cr; S-N only. Prereq—Clinical psych grad student) Current topics for first-year clinical psychology graduate students.

**Psy 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Psy 8701. Seminar in Industrial and Organizational Psychology I.** (3 cr; A-F only. Prereq—#) Application of research and theory in psychological measurement and individual differences to problems in job analysis, personnel selection and classification, and individual training.

**Psy 8702. Seminar in Industrial and Organizational Psychology II.** (3 cr; A-F only. Prereq—#) Determinants of behavior, performance, job satisfaction that can be influenced after an individual enters an organization. Application of research/theory in motivation, social psychology, human factors to enhancement of job performance/satisfaction.

**Psy 8703. Seminar in Industrial and Organizational Psychology III.** (3 cr; A-F only. Prereq—#) Developing issues and trends in current research, research methodological advances, and implementation practices. Recent important and controversial developments.

**Psy 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Psy 8814. Analysis of Psychological Data.** (4 cr. Prereq—Undergrad course in statistics, grad student in [psychology or child psychology], #) Data-analytic procedures used in psychological research. Types of variables used in psychological research. Data collection designs, their limitations. Procedures for analyzing experimental/non-experimental data, both univariate and multivariate. Emphasizes selection of data-analytic procedures. Procedures and their assumptions. Computation using statistical software. Limitations, interpretation. Lecture, lab.

**Psy 8815. Analysis of Psychological Data.** (4 cr. Prereq—Undergrad course in statistics, grad student in [psychology or child psychology], #) Data-analytic procedures used in psychological research. Types of variables used in psychological research. Data collection designs, their limitations. Procedures for analyzing experimental/non-experimental data, both univariate and multivariate. Emphasizes selection of data-analytic procedures. Procedures and their assumptions. Computation using statistical software. Limitations, interpretation. Lecture, lab.

**Psy 8881. Seminar: Psychometric Methods.** (1 cr. Prereq—#) Reviews and individual research on current topics in psychological measurement, statistics.

**Psy 8882. Seminar: Psychometric Methods.** (1 cr. Prereq—5862, 5865, #) Reviews. Individual research on topics in psychological measurement, statistics.

**Psy 8884. Factor Analysis and Latent Variable Models.** (3 cr. Prereq—Stat 5302, PubH 5450, PubH 5452, #) Common factor model, major methods of estimation. Analytic rotation algorithms, number of factors problem, evaluation of model fit. Recent developments in restricted factor analysis.

**Psy 8886. Hierarchical Models.** (3 cr. Prereq—#) Methods for repeated measures and longitudinal data. Linear mixed-effects model. Treatment of missing data and unbalanced designs. Extensions to conditionally linear/nonlinear models. Exercises with software such as HLM and SAS PROC MIXED.

**Psy 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

**Psy 8935. Readings in Behavioral Genetics and Individual Differences Psychology.** (1 cr [max 10 cr]; S-N only. Prereq—5135, 5137 or #) Each week participants read and discuss one or two primary research articles.

**Psy 8937. Seminar in Human Behavioral Genetics.** (3 cr [max 9 cr]. Prereq—5137 or #) Advanced topics vary with each offering. Sample topics: gene identification in complex human traits, behavioral genetics of alcoholism, twin-family methodology.

**Psy 8965. Seminar: Well-Being.** (3 cr) Various issues in emerging field of well-being research. Conceptual issues, measurement, judgmental processes, goals/values, adaptation, close relationships, culture, psychophysiology, temperaments/personality.

**Psy 8993. Directed Studies: Special Areas of Psychology and Related Sciences.** (1-6 cr [max 36 cr]. Prereq—#) Special area of psychology or a related science.

**Psy 8995. Research Problems.** (1-6 cr [max 36 cr]) Research problems.

## Public Affairs (PA)

### Hubert H. Humphrey Institute of Public Affairs

**PA 5001. Intellectual Foundations of Public Action.** (1.5 cr; A-F only. Prereq—Major in publ aff or publ policy or sci, tech, and environ policy or urban and regional planning or publ hlth or #) Evolution of intellectual approaches that underlie public planning, management, and policy analysis as strategies for public action. How public decision making is shaped by knowledge and values; role of rationality. Conceptual approaches to public action along descriptive/normative lines and structure/process lines.

**PA 5002. Introduction to Policy Analysis.** (1.5 cr; A-F only. Prereq—Major in publ aff or publ policy or sci, tech, and environ pol or urban and regional planning or publ hlth or #) Process of public policy analysis from problem structuring to communication of findings. Commonly used analytical methods. Alternative models of analytical problem resolution.

**PA 5003. Introduction to Financial Analysis and Management.** (1.5 cr; A-F only. Prereq—Major in publ aff or publ policy or sci, tech, and environ pol or urban and regional planning or publ hlth or #) Basic finance and accounting concepts and tools used in public and nonprofit organizations. Fund accounting, balance sheet and income statement analysis, cash flow analysis, and public sector and

nonprofit sector budgeting processes. Lectures and discussions, as well as cases and examples from nonprofit and public sector organizations.

**PA 5004. Introduction to Planning.** (3 cr; A-F only. Prereq—Major in [publ aff or publ policy or sci, tech, and environ policy] or [urban and regional planning] or publ hlth or #)

History, institutional development of urban planning as a profession. Intellectual foundations, planning theory. Roles of urban planners in U.S./international settings. Scope, legitimacy, limitations of planning and of planning process. Issues in planning ethics and in planning in settings of diverse populations/stakeholders.

**PA 5011. Public Management and Leadership.** (3 cr; A-F only. Prereq—Major in [publ aff or publ policy or sci/tech/environ policy or urban/regional planning or publ hlth] or #)

Challenges facing higher-level managers in public/nonprofit organizations in a mixed economy and democratic republic. Distinctive features of public/nonprofit management, skills necessary for effective management, manager's role as creator of public value. Lectures, case discussions.

**PA 5012. The Politics of Public Affairs.** (3 cr; A-F only. Prereq—Major in publ aff or publ policy or sci, tech, and environ policy or urban and regional planning or publ hlth or #)

Stages of policy making from agenda setting to implementation. Role and behavior of political institutions (courts, legislatures, executives, and bureaucracies) and citizens, social movements, and interest groups. Concepts of political philosophy. Theories of the state. Team taught interdisciplinary course with small discussion sections.

**PA 5013. Law and Urban Land Use.** (1.5 cr; A-F only. Prereq—Major in publ aff or publ policy or sci, tech, and environ policy or urban and regional planning or publ hlth or #)

Role of law in regulating and shaping urban development, land use, environmental quality, and local and regional governmental services. Interface between public and private sector.

**PA 5021. Economics for Policy Analysis and Planning I.** (2-3 cr; A-F only. Prereq—Major in publ aff or publ policy or sci, tech, and environ policy or urban and regional planning or publ hlth or #)

Introduction to a selection of tools useful for public policy: intermediate microeconomics, rudiments of macroeconomics, and central concepts of international trade.

**PA 5022. Economics for Policy Analysis and Planning II.** (2-3 cr; A-F only. Prereq—5021 or equiv, major in publ aff or publ policy or sci, tech, and environ policy or urban and regional planning or publ hlth or #)

Application of economic reasoning to a variety of public policy issues that may vary by section. Includes cost-benefit analysis, nonmarket valuation, and tax analysis.

**PA 5031. Empirical Analysis I.** (2-3 cr; A-F only. Prereq—Major in publ aff or publ policy or sci, tech, and environ policy or urban and regional planning or publ hlth or #)

Basic statistical tools for empirical analysis of public policy alternatives. Frequency distributions, descriptive statistics, elementary probability and probability distributions, statistical inference, estimation and hypothesis testing, cross-tabulation and chi-square distribution, analysis of variance, correlation, simple and multiple regression analysis.

**PA 5032. Intermediate Regression Analysis.** (1-1.5 cr; A-F only. Prereq—5031 or equiv, major in publ aff or publ policy or sci, tech, and environ policy or urban and regional planning or publ hlth or #)

Bivariate and multivariate models of regression analysis and assumptions behind them. Problems using these models when such assumptions are not met.

**PA 5033. Multivariate Techniques.** (1-1.5 cr; A-F only. Prereq—5031 or equiv, major in publ aff or publ policy or sci, tech, and environ policy or urban and regional planning or publ hlth or #)

Examines public affairs topics using maximum likelihood estimation approaches.

**PA 5034. Community Analysis and Planning**

**Techniques.** (2 cr. Prereq—5031 or equiv, major in publ aff or publ policy or sci, tech, and environ policy or urban and regional planning or publ hlth or #)

Data analysis techniques for practitioners in fields of planning, management, and policy analysis who work at community and regional levels. Population analysis and forecasting techniques relevant for small geographic areas. Techniques for regional and local economic analysis, such as shift-share analysis, economic base, and location quotient analysis.

**PA 5035. Survey Research and Data Collection.** (1.5 cr; A-F only. Prereq—5031 or equiv, major in publ aff or publ policy or sci, tech, and environ policy or urban and regional planning or publ hlth or #)

Introduction to survey research methods emphasizing applications to policy and applied research. Research design choices (e.g., descriptive, experimental, case studies), sampling, variable specification and measurement, conducting interviews, mailed questionnaires, qualitative techniques.

**PA 5101. Management and Governance of Nonprofit Organizations.** (3 cr. Prereq—Grad or #)

Draws on theories, concepts, and real world examples to explore critical managerial challenges. Governance systems, strategic management practices, effect of different funding environments, management of multiple constituencies. Different types of nonprofits using economic/behavioral approaches.

**PA 5102. Organization Design and Change.** (1.5 cr. Prereq—Grad or #)

Basic concepts related to organizational design decisions. Managerial challenges associated with organizational change in context of public sector agencies and nonprofit organizations. Major forces for change, kinds of change, management of change. Case-based analysis/discussion.

**PA 5111. Financial Management in Public and Nonprofit Organizations.** (3 cr. Prereq—[5003, grad] or #)

Design, installation, and use of accounting/control systems in public/nonprofit organizations. Public accounting standards/practices, financial administration/reporting, debt management, budgeting, contract/procurement management systems. Lecture, discussion, case analysis.

**PA 5112. Public Budgeting.** (4 cr. Prereq—Grad or #)

Budget processes in legislative/executive branches of federal, state, and local government. Program planning evaluation/administration. Techniques of budget/program analysis. Use of budget as policy/management tool. Analysis of fund flows within/among governments.

**PA 5113. State and Local Public Finance.** (3 cr. Prereq—Grad or #)

Theory/practice of financing. Providing public services at state/local level of government. Emphasizes integrating theory/practice, applying materials to specific policy areas, and documenting wide range of institutional arrangements across/within the 50 states.

**PA 5122. Law and Public Affairs.** (3 cr. Prereq—Grad or #)

Overview of evolution of American legal system. Role of courts, legislatures, and political actors in changing law. How law is used to change public policy.

**PA 5123. Financing Nonprofits: Philosophies and Realities.** (3 cr. Prereq—Grad student or #)

Brief history of philanthropy in the United States. Foundation/other sources of funding for nonprofit activity. Philosophies of fundraising/grantmaking. Types of foundations/agencies that fund. Practical approaches to getting/managing money.

**PA 5131. Conflict Management: Readings in Theory and Practice.** (3 cr. Prereq—Grad or #)

Current theory. Review of conflict resolution strategies. Aspects of interpersonal, group, organizational, and systemic conflict.

**PA 5132. Mediation Training.** (3 cr. Prereq—Grad student or #)

Creating an arena for mediation. Skills/expectations needed to mediate disputes between individuals, among groups: balanced (peer or colleague), imbalanced (power differentials). Role playing, group debriefing, critique. Cases.

**PA 5133. Conflict Management Proseminar.** (1 cr. Prereq—Grad student or #)

Topics in conflict management research/practice. Theoretical implications, practical applications from the perspectives of participants. National/international issues.

**PA 5134. Conflict Management Proseminar.** (1 cr. Prereq—Grad student or #)

Topics in conflict management. Theoretical implications, practical applications from the perspectives of participants. National/international issues.

**PA 5142. Public Issues Facilitation Strategies.** (1 cr. Prereq—Grad student or #)

Course equips facilitators with processes that encourage civic participation and effective, timely decision-making. Students identify and examine facilitation components and link them to public issues, examine one approach or theory of facilitation and apply it to a case study, and share experiences and cases with other learners.

**PA 5143. Teaching Leadership for the Common Good.** (1 cr. Prereq—Grad student or #, basic ability to use the Internet and Web browsers)

Introduces learners to main concepts in "Leadership for the Common Good" framework, offers a number of tools and exercises for applying these concepts, and prepares learners to teach others about leadership for the common good.

**PA 5190. Topics in Public and Nonprofit Leadership and Management.** (1-3 cr [max 9 cr]. Prereq—Grad student or #)

Selected topics.

**PA 5201W. American Cities I: Population and Housing.** (4 cr. Prereq—Grad or #)

Emergence of North American cities. Residential building cycles, density patterns. Metropolitan housing stocks, supply of housing services. Population/household types. Neighborhood-level patterns of housing use. Housing prices. Intraurban migration. Housing submarkets inside metro areas. Emphasizes linking theory, method, and case studies.

**PA 5202W. American Cities II: Land Use, Transportation, and the Urban Economy.** (4 cr. Prereq—Grad student or #)

Urban economy, its locational requirements. Central place theory. Transportation and urban land use, patterns/conflicts. Industrial/commercial land blight. Real estate redevelopment. Historic preservation. Emphasizes links between land use, transportation policy, economic development, and local fiscal issues. U.S.-Canadian contrasts.

**PA 5203W. Geographical Perspectives on Planning.** (4 cr. \$Geog 3605, \$Geog 5605. Prereq—Grad student or #)

Includes additional weekly seminar-style meeting and bibliography project on topic selected in consultation with instructor.

**PA 5211. Introduction to Land Use Planning.** (3 cr. Prereq—[[Course in spatial analysis or work experience demonstrating knowledge of field], grad student] or #)

Physical/spatial basis for community/regional development. Role of public sector in guiding private development processes. Issues in design of settlements. Applied case studies examine public regulatory frameworks.

**PA 5212. Managing Urban Growth and Change.** (3 cr. Prereq–Grad student or #)  
Theory/practice of planning, promoting, and controlling economic growth/change in urban areas. Economic development tools available to state/local policymakers, historic context of their use in the United States. legal, social, and economic implementation constraints. Interactions among economic, social, and demographic trends.

**PA 5221. Private Sector Development.** (3 cr. Prereq–Grad student or #)  
Roles of various participants in land development. Investment objectives, effects of regulation. Overview of development process from private/public perspective.

**PA 5231. Transit Planning and Management.** (3 cr. Prereq–Grad student or #)  
Principles/techniques related to implementing transit systems. Historical perspective, characteristics of travel demand, demand management. Evaluating/benchmarking system performance. Transit-oriented development. Analyzing alternative transit modes. System design/finance. Case studies, field projects.

**PA 5251. Strategic Planning and Management.** (1.5 cr. Prereq–Grad student or #)  
Theory/practice of strategic planning/management for governments, public agencies, and nonprofit organizations. How to promote strategic thinking/acting by policy-making bodies and management teams. Determining what an organization should do, how it should do it, and why. Lectures, case discussions.

**PA 5252. Strategy and Tactics in Project Planning and Management.** (1.5 cr. Prereq–Grad student or #)  
Planning, analysis, evaluation, and implementation of short-term plans/projects. Technical analyses, interactional elements of completing projects within budget/time constraints. Strategic/tactical choices in planning. Case examples.

**PA 5253. Participatory Management and Public Involvement Strategies.** (3 cr. Prereq–Grad student or #)  
Survey of strategies, techniques, and tools for involving groups members, teams, organizations, and stakeholders (including public at large) in problem definition, policy/plan formulation, decision making, and implementation. Emphasizes public/nonprofit organizations, citizen involvement.

**PA 5261. Housing Policy.** (3 cr. Prereq–Grad student or #)  
Institutional/environmental setting for housing policy in the United States. Competing views of solving housing problems through public intervention in the market. Federal/local public sector responses to housing problems.

**PA 5290. Topics in Planning.** (1-3 cr [max 9 cr]. Prereq–Grad student or #)  
Selected topics.

**PA 5301. Population Methods and Issues for the United States and Third World.** (3 cr. Prereq–Grad student or #)  
Basic demographic measures/methodology. Demographic transition, mortality, fertility. Diverse perspectives on nonmarital fertility, marriage, divorce, and cohabitation. Cultural differences in family structure, aging, migration, refugee movements, population policies. Discussion of readings on population growth and environment.

**PA 5311. Program Evaluation.** (3 cr. Prereq–Grad student or #)  
Principal methods, primary applications of evaluation research as applied to policies/programs in health/human services, education, or the environment. Conducting evaluations. Becoming a critical consumer of studies.

**PA 5390. Topics in Advanced Policy Analysis Methods.** (1-4 cr [max 9 cr]. Prereq–Grad student or #)  
Topics in advanced policy analysis methods.

**PA 5401. Poverty, Inequality, and Public Policy.** (3 cr. Prereq–Grad student or #)  
Nature/extent of poverty/inequality in the United States, causes/consequences, impact of government programs/policies. Extent/causes of poverty/inequality in other developed/developing countries.

**PA 5411. Child Welfare Policy.** (3 cr. Prereq–Grad student or #)  
Intersection of conceptual orientations of developmental psychology with policies that affect children/families. Demographic, historical, social trends that underlie assumptions driving policies directed at women/children. Projections of future policies.

**PA 5412. Aging and Disability Policy.** (3 cr. Prereq–Grad student or #)  
Policy debates concerning populations that are aging or disabled. Students learn/practice analyses in context of important health, social, and economic policy debates. Readings on current theory/evidence.

**PA 5421. Racial Inequality and Public Policy.** (3 cr. Prereq–Grad student or #)  
Historical roots of racial inequality in American society. Contemporary economic consequences. Public policy responses to racial inequality. Emphasizes thinking/analysis that is critical of strategies offered for reducing racism and racial economic inequality.

**PA 5431. Public Policies on Work and Pay.** (3 cr. Prereq–[[PA 5031 or equiv], grad student] or #)  
Public policies affecting employment, hours of work, and institutions in labor markets. Public programs impacting wages, unemployment, training, collective bargaining, job security, and workplace governance. Policy implications of the changing nature of work.

**PA 5441. Education Policy and the State Legislature.** (3 cr. Prereq–Grad student or #)  
How Minnesota legislature decides K-12 issues. Implications for higher education. How to increase one's influence in process. Discussions with persons who influence statewide educational policy. Presentations. Field trip to state legislature.

**PA 5442. Policy Design for Education and Human Development.** (3 cr. Prereq–Grad student or #)  
Designing effective educational policies. Using interdisciplinary approaches to identify/understand core variables (economic, psychological, etc). Work on policy design.

**PA 5451. Immigrant Health Issues.** (3-4 cr. Prereq–Grad student or #)  
How to access demographic, health, background information on U.S. immigrants. Characteristics and health needs of immigrants. Designing culturally competent health programs. How to advocate for change to promote immigrant health. Community visits required. Online course.

**PA 5490. Topics in Social Policy.** (1-4 cr [max 9 cr]. Prereq–Grad student or #)  
Selected topics.

**PA 5501. Economic Development I.** (2 cr. Prereq–Grad student or #)  
Economic development theories/strategies at national/regional levels in developing countries and the United States. Redistributive and basic needs strategies, institutional approaches, dependency/Neo-Marxist approaches, gender and development, sustainable development, effects of globalization on workers/communities, public policy responses.

**PA 5502. Economic Development II.** (2 cr; A-F only. Prereq–[[5501 or equiv], grad student] or #)  
Economic development from macroeconomic/open-economy perspective. Sources of economic growth. Agricultural development. Import-substitution industrialization. Endogenous growth models. Population, migration, and human development. Policy reform/adjustment.

**PA 5511. Community Economic Development.** (3 cr. Prereq–Grad student or #)  
Contexts/motivations behind community economic development activities. Alternative strategies for organizing/initiating economic development projects. Tools/techniques for economic development analysis/planning (market analysis, feasibility studies, development plans). Implementation at local level.

**PA 5521. Development Planning and Policy Analysis.** (4 cr. Prereq–[[5031 or equiv], [5501 or equiv], grad student] or #)  
Techniques/assumptions of development planning and policy analysis at national, regional, and project levels. Direct/indirect effects of external shocks and government interventions on national/regional economies. Macroeconomic modeling, input-output analysis, social accounting matrices/multipliers, project appraisal/evaluation techniques.

**PA 5522. Economic Development Policies in Latin America.** (3 cr. Prereq–[[5021 or equiv], [5502 or equiv], grad student] or #)  
Evolution of economic development policies from import-substituting industrialization policies of 1950s/1960s through beginning of reform in 1970s, economic crisis of 1980s, and reform into 1990s. Emphasizes privatization, economic integration, exchange rate/trade, and domestic/adjustment policies.

**PA 5531. Strategies for Sustainable Development: Theory and Practice.** (3 cr. Prereq–[Microecon course, grad student] or #)  
Economic, environmental, and social aspects of sustainable development. Strategies, methods of implementation, and applications of sustainable development in different economic systems of industrialized/developing countries. Special attention to countries in transition.

**PA 5590. Topics in Economic and Community Development.** (1-3 cr [max 9 cr]. Prereq–Grad student or #)  
Selected topics.

**PA 5601. Survey of Women, Law, and Public Policy in the United States.** (3 cr. Prereq–Grad student or #)  
Gendered nature of public policy. Historical analysis of welfare, single motherhood, and protective legislation. How laws structure public policy. How courts are arenas for policy making. Emphasizes employment discrimination and reproductive rights. Differences among women. Intersection of oppression based on class/race/sexual orientation.

**PA 5611. Feminist Economics.** (1.5 cr. Prereq–[5021, grad student] or #)  
Feminist philosophy, methodology, and economic practice. Feminist perspectives on development and the global economy, work/family. Heterodox traditions in economics.

**PA 5690. Topics in Women and Public Policy.** (1-3 cr [max 9 cr]. Prereq–Grad student or #)  
Selected topics.

**PA 5701. Science and State.** (3 cr. Prereq–Grad student or #)  
Relationship between science and contemporary society. Nature of science: its values, processes, and ways of knowing. How science has influenced U.S. political institutions and political/judicial processes. Issues in current debate over U.S. science policy.

**PA 5711. Science and Technology Policy.** (3 cr. Prereq–Grad student or #)  
Effect of science/technology on global economy, politics, environment, security. Role of national science/technology policies in development, diffusion, and adoption of technologies nationally/internationally. Issues related to technology, technology policy, technological development, impact of technology, international cooperation.

**PA 5721. Energy and Environmental Policy.** (3 cr. Prereq–Grad student or #)  
Impact of energy production/consumption choices on environmental quality, sustainable development, and other economic/social goals. Emphasizes public policy choices for energy/environment, linkages between them.

**PA 5722. Environmental and Resource Economics Policy.** (3 cr. Prereq—[Intermediate microeconomics, intermediate policy analysis, grad student] or #) Public policy associated with natural resource use and environmental protection. Develops/applies economic concepts/methodologies/policy mechanisms. Principles of environmental/resource economics. Issues related to renewable/nonrenewable resources and environmental pollution. Focuses on scientific/political aspects of policy.

**PA 5790. Topics in Science, Technology, and Environmental Policy.** (1-3 cr [max 9 cr]. Prereq—Grad or #) Selected topics.

**PA 5801. U.S. Foreign Policy: Process and Analysis.** (3 cr. Prereq—Grad student or #) U.S. general diplomacy, foreign economic policy. Emphasizes analysis. Broad security strategy. Policy towards specific geographic regions. Trade, investment, monetary policy. Immigration policy. Environmental cooperation.

**PA 5812. Open Economy Models: An Assessment.** (3 cr. Prereq—[Intermediate macroeconomics, trade theory, grad student] or #) Open economics, implications for policy making/implementation. Issues at level of international/domestic economies.

**PA 5890. Topics in Foreign Policy and International Affairs.** (1-5 cr [max 9 cr]. Prereq—Grad student or #) Selected topics.

**PA 5900. Computer Applications in Public Affairs (Summer).** (0.5 cr [max 6 cr]; S-N only. Prereq—#) Introduction to basic computer systems/applications in public affairs practice (e.g., MS Windows, MS Word). Offered summer.

**PA 5901. Computer Applications in Public Affairs.** (0.5-3 cr [max 6 cr]; S-N only. Prereq—#) Introduction to computer systems/applications in public affairs practice.

**PA 5902. Computer Applications in Public Affairs.** (0.5-3 cr [max 6 cr]; S-N only) Introduction to computer systems/applications in public affairs practice.

**PA 5903. Introduction to Computers and Applications at the Humphrey Institute.** (2 cr; S-N only. Prereq—International HHH fellow) Computers/applications. Basic skills. Software such as MS Word, Excel, PowerPoint, Access. Using Internet, e-mail, search engines (for research), HTML (through Web page creation software).

**PA 5931. Role of the Media in Public Affairs.** (3 cr. Prereq—Grad student or #) Historical/contemporary role of news media in defining/shaping public opinion/policy, primarily in the United States. Emphasizes critical research, professional skills in three forms of journalism: hard news coverage, investigative reporting, documentaries. Field experience, practice in governmental public relations.

**PA 5941. Leadership for the Common Good.** (4 cr. Prereq—#) Personal, team, organizational, visionary, political, and ethical aspects of leadership. Emphasizes building/experiencing a learning community.

**PA 5951. Global Commons Seminar.** (3 cr [max 6 cr]; S-N only. Prereq—International Hubert H. Humphrey Fellows) Meets specific needs of International Humphrey Fellows. Topics vary each year depending on the interests and needs of the fellows.

**PA 5990. Topics: Public Affairs—General Topics.** (0.5-3 cr [max 9 cr]. Prereq—Grad student or #) General topics in public policy.

**PA 8001. Synthesis Seminar.** (4 cr; A-F only. Prereq—Grad PA major or #) Development of interdisciplinary understanding of one or more policy areas through explorations of theory, readings, cases, and model-building exercises. This

understanding is then used to articulate possible policy or system improvements, along with leadership implications for formulating and implementing them.

**PA 8002. Synthesis Workshop.** (4 cr; A-F only. Prereq—[8001, grad PA major] or #) Development of public policy to advance public interest, common good. Recommendations flow from interdisciplinary understanding of problem, stakeholder analyses, modeling/analysis. Political feasibility, marketing, entrepreneurship, advocacy.

**PA 8081. Capstone Workshop.** (3 cr; A-F only. Prereq—[Grad major in [public policy or [urban and regional planning] or [science, technology, and environment policy]], completion of core courses] or #) Project external client on issue agreed upon by student, client, and instructor. Students apply interdisciplinary methods, approaches, and perspectives studied in core courses to the issue. Written report includes analysis of issue and policy recommendations. Oral presentation of major findings. Concentration/topic vary term-to-term.

**PA 8105. Human Resources and Organizational Performance.** (2 cr. Prereq—5032, 5022 or equiv) Impact of human resource policies and practices on organizational productivity and effectiveness. Role of government, unions, and private sector institutions on organizational effectiveness.

**PA 8183. Managing Collaborations.** (3 cr; A-F only) Management challenges of operating within multiparty (combination of nonprofit, for-profit, and public enterprises) collaborations formed to deal with a social problem. Combines in-class discussions of conceptual materials with application in community. Student teams work for half a semester with local collaborations on management problems.

**PA 8186. Public Services Redesign.** (3 cr; A-F only) Theory, strategy, politics, and some practical mechanics required to adapt public service system given constraints on resources and continuing pressure for effectiveness and equity. In-class and out-of-class interviews with persons involved in redesign. Student papers on current redesign issues.

**PA 8190. Advanced Topics in Public and Nonprofit Leadership and Management.** (1-3 cr [max 6 cr]) Selected topics.

**PA 8201. Environment and Infrastructure Planning.** (4 cr; A-F only. Prereq—[Urban and regional planning] grad student or #) Relationship between infrastructure, human settlement design. Natural resource systems as foundation of infrastructure provision. Environmental basis of, and political/legal/institutional frameworks for, land-use planning. Parallel computer lab, practicum assignment.

**PA 8202. Networks and Places: Transportation, Land Use, and Design.** (4 cr; A-F only. \$8212. Prereq—[Urban and regional planning] grad student or #) Relationship between land use and transportation. Developing synthetic design skills for linking land use transportation in urban/regional settlements. Economic, political, legal, institutional frameworks for planning. Parallel computer lab, practicum assignment.

**PA 8203. Neighborhood Revitalization Strategies and Theories.** (4 cr; A-F only. Prereq—[Urban and regional planning] grad student or #) Policymaking/politics of planning in housing, community development, social policy. Connecting policy to local/regional politics. Role of institutional decision-making structures on policy outcomes. Importance of citizens, social movements, interest groups in policymaking process.

**PA 8204. Regional, Economic, and Workforce Development Planning.** (4 cr; A-F only. Prereq—5021 or 5202, ¶5034) Provides a rigorous foundation in the evolution and current state of regional development planning in the United States and abroad; in theories of regional and local economic development, linked to various

techniques of analysis and implementation; and in workforce development planning at the regional and local level.

**PA 8212. Networks and Places: Transportation, Land Use, and Design.** (3 cr; A-F only. \$8202. Prereq—Transportation Certificate student or #) Relationship between land use and transportation. Developing synthetic design skills for linking land use transportation in urban/regional settlements. Economic, political, legal, institutional frameworks for planning.

**PA 8286. International Development and Urban Planning.** (3 cr; A-F only) Urbanization process and planning responses in cities of developing world. Urban sustainability, migration, housing, transportation, employment, and urban service delivery. Phenomena such as squatter settlements and informal economy that normally proceed unplanned and without formal government control.

**PA 8290. Advanced Topics in Planning.** (1-3 cr [max 6 cr]) Selected topics.

**PA 8311. Case Studies in Policy Analysis.** (3 cr) Topics in microeconomics applied to systems problems of government. Market and nonmarket resource allocation; cost-effectiveness and cost-benefit analysis. Case method employed.

**PA 8312. Analysis of Discrimination.** (3 cr) Introduces students of policy analysis and other applied social sciences to tools for measuring and detecting discrimination in market and nonmarket contexts. Application of modern tools of labor econometrics and race relations research to specific problems of market and nonmarket discrimination.

**PA 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**PA 8386. Research Methods in Social and Labor Policy.** (3 cr; A-F only. Prereq—5032 or 5033, 5022 or equiv) Use of social science research methods in analyzing and developing public policies.

**PA 8390. Advanced Topics in Advanced Policy Analysis Methods.** (1-3 cr [max 6 cr]) Selected topics.

**PA 8486. Work and Family in the United States and the Third World.** (3 cr; A-F only) Topics based on students' interests. Topics must relate to formal and informal labor force work, household work, child care, child labor, youth employment, education, training, or their interrelationships. Data collection and measurement issues; economic and demographic theories of work and education decisions in context of the family.

**PA 8490. Advanced Topics in Social Policy.** (1-3 cr [max 6 cr]) Selected topics.

**PA 8583. Capstone Workshop on Economic and Community Development.** (3 cr; A-F only) Comprehensive overview of state, local, community-based economic development strategies. Processes involved in producing broadly conceived economic development strategy. Institutional structures/processes to deal with economic change, new political realities.

**PA 8590. Advanced Topics in Economic and Community Development.** (1-3 cr [max 6 cr]) Selected topics.

**PA 8686. Feminist Organizations.** (3 cr; A-F only) Uses social movement literature and histories of U.S. second-wave feminism to study feminist organizations and movements examined through comparative studies of feminism in Latin America, Eastern Europe, Britain, and Italy. Methods and sources for studying feminism.

**PA 8690. Advanced Topics in Women and Public Policy.** (1-3 cr [max 6 cr])  
Selected topics.

**PA 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**PA 8790. Advanced Topics in Science, Technology, and Environmental Policy.** (1-3 cr [max 6 cr])  
Selected topics.

**PA 8811. Strategic Issues in International Economic Policy.** (3 cr)

Compares/contrasts experiences of industrial/developing countries in trade, investment, exchange rates, and immigration.

**PA 8821. National Security Policy.** (3 cr)  
Politics and economics of national security policy. Defense policy, military strategy, and weapons procurement. While emphasis is on the United States, other countries also discussed.

**PA 8890. Advanced Topics in Foreign Policy and International Affairs.** (1-3 cr [max 6 cr])  
Selected topics.

**PA 8991. Independent Study.** (1-3 cr [max 6 cr]. Prereq—#)

## Public Health (PubH)

### School of Public Health

**PubH 5003. Fundamentals of Alcohol and Drug Abuse.** (1 cr. \$3003, \$3004. Prereq—Educ student or #)  
Scientific/socio-cultural aspects of alcohol/drug problems. Emphasizes role of education in health conservation and drug abuse prevention.

**PubH 5005. Topics: Community Health Education.** (1-4 cr [max 20 cr]. Prereq—#)  
Topics of interest in community health education.

**PubH 5010. Public Health Interventions for AIDS.** (3 cr. Prereq—Grad student or professional school student or #)  
Survey of public health approaches to AIDS epidemic. Epidemiological/clinical features of HIV infection. Impact of AIDS on certain communities/populations. Behavior change principles as they apply to AIDS interventions.

**PubH 5017. Culture and Health Behavior.** (2 cr. Prereq—Grad or professional school student or #)  
Heightens cultural sensitivity regarding public health practice and individual health behaviors. Cultural diversity and its impact on health behaviors; etic (universal) and emic (culture-specific) approaches.

**PubH 5020. Fundamentals of Social and Behavioral Science.** (3 cr. Prereq—Public health or #)  
Four major approaches to public health problems: psychosocial, economic, community, policy. Lectures provide overview of theory/implementation. Small groups provide opportunity to practice skills.

**PubH 5030. Prevention of High-Risk Behavior Among Adolescents.** (2 cr; A-F only. Prereq—[Grad-level behavioral sci course [5050 preferred], [CHE or MCH or PubH Nutr or Epi MPH or Epi grad]] or #; 2nd-yr master's student recommended)  
Definitions/etiology of high-risk behaviors among adolescents. Intervention programs. Review of current literature. Students design prevention program overview based on theory/etiological data using health education/behavior change methods.

**PubH 5034. Program Evaluation for Public Health Practice.** (3 cr. Prereq—Che or MCH major or #)  
Developing useful program evaluations. Emphasizes skills for program administrators, planners. Needs assessments, evaluability assessments, formative evaluation, implementation studies, outcome evaluations. Quantitative/qualitative data collection methods. Ethical considerations.

**PubH 5035. Applied Research Methods.** (3 cr. Prereq—[5414 or 5450 or equiv], [5034 or 5806 or equiv], [che or pub hlth nutr major or #]; 5420 recommended)  
Complements master's project work using forms, questionnaires, interviews. Literature searching, questionnaire development, scale construction, item analysis, data coding, entry/analysis, report writing. Use of computer software package to develop questionnaire and analyze data.

**PubH 5040. Dying and Death in Contemporary Society: Implications for Intervention.** (2 cr. Prereq—Grad student or professional school student or #)  
Concepts, attitudes, ethics, and lifestyle management related to dying, death, grief, and bereavement. Emphasizes intervention and educational aspects for community health and helping professionals and for educators.

**PubH 5049. Legislative Advocacy Skills for Public Health.** (3 cr; A-F only. Prereq—5078, #)  
State legislature as arena for public health practice. Skills necessary to operate in that arena. Analyzing emergence, development, and resolution of legislative issues of public health importance.

**PubH 5050. Community Health Theory and Practice I.** (3 cr. Prereq—Che major or #)  
Socioenvironmental factors influencing health-related behavior. Role of groups, institutions, social structures in encouraging healthy, unhealthy behavior. Role of interventions affecting social environment; barriers to effective interventions. Individual behavior change theories, models targeting psychosocial approaches; application of theories in practice.

**PubH 5051. Community Health Theory and Practice II.** (3 cr. Prereq—Che major or #)  
Conceptualizing, planning, and implementing community health education programs and interventions. Examines health education/promotion organizations; how organizational factors shape health education practice. Focuses on planning health education/promotion efforts. Students gain experience in developing a hypothetical community health intervention.

**PubH 5055. Social Inequalities in Health.** (2 cr. Prereq—Hlth sci professional school student or hlth sci or soc work or pub affairs grad student or #)  
Extent/causes of social inequalities in health. Degree to which understanding of these inequalities is hampered by methodological limitations in health research. Focuses on individual, community, and policy approaches to reducing social inequalities in health.

**PubH 5060. Smoking Intervention.** (2 cr. Prereq—[CHE or MCH or EPI MPH] or EPI grad student or #)  
Impact of smoking on U.S. public health. Review of research on onset/prevention. Factors maintaining dependence, cessation/intervention strategies. Public health campaigns. Public policies, second-hand smoking controversies. International issues.

**PubH 5061. Community Health Education in Health Care Settings.** (2 cr. Prereq—Public health student or #)  
Scope/effectiveness of and barriers to health education in clinical settings. Role of public health professional in implementing/maintaining health education guidelines. Emphasizes health education for risk factor modification.

**PubH 5074. Mass Communication and Public Health.** (2 cr. Prereq—PubH MPH or grad student or Jour grad student or #; [background or coursework] in [social or behavioral] science recommended)  
Role, functions, effects of mass media on public health. Planned/unplanned effects. Review of literature on how theories, models, assumptions of mass communication research relate to public's health.

**PubH 5075. Obesity and Eating Disorders.** (2 cr. Prereq—[Grad or prof school] student or #)  
Definition, measurement, and prevalence. Social, behavioral, physiological causes. Health consequences. Treatment, prevention.

**PubH 5078. Public Health Policy as a Prevention Strategy.** (2 cr. Prereq—CHE or MCH or PubH Nutr or EPI MPH or EPI grad student or #)  
Philosophical, ethical, economic, political, efficacy rationale for policy approach to prevention. Historical/current application of prevention policy to public health problems.

**PubH 5080. Seminar: Policy, Politics, and Ethics of Public Health Decision Making.** (2 cr; S-N only. Prereq—[2nd yr MPH or MS or PhD student in [CHE or EPI or MCH or PubH nutr or clin research] or public affairs or MS/JD or PhD/JD or 3rd yr law student], #)  
Political/ethical factors that decision-makers must consider as public health policy is debated, adopted, and implemented. Role of public health professional in policy making. Focuses on current topics such as tobacco, privacy, genetics, and health care financing.

**PubH 5091. Independent Study: Community Health Education.** (1-4 cr [max 4 cr]. Prereq—CHE major, #)  
Independent study supervised by a community health education faculty member.

**PubH 5094. Master's Project: Community Health Education.** (1-6 cr [max 6 cr]. Prereq—CHE major, #)  
Directed research towards completion of master's project in community health education.

**PubH 5096. Field Experience: Community Health Education.** (1-6 cr [max 6 cr]; S-N only. Prereq—CHE major, #)  
Supervised community health education field study in health or public health setting under academic/professional supervision. Emphasizes application of acquired knowledge/skills to relevant issues/problems.

**PubH 5100. Topics: Environmental and Occupational Health.** (1-4 cr [max 20 cr]. Prereq—#)  
New course offerings or topics of interest in environmental and occupational health.

**PubH 5101. Master's Project: Environmental Health.** (1-3 cr [max 5 cr]; S-N only. Prereq—EH major, #)  
Directed research towards completion of the Master's Project in Environmental Health.

**PubH 5102. Field Experience: Environmental Health.** (1-5 cr [max 5 cr]; S-N only. Prereq—EH major, #)  
Supervised environmental health field study in health or public health setting under academic/professional supervision. Emphasizes application of acquired knowledge/skills to relevant issues/problems.

**PubH 5103. Exposure to Environmental Hazards.** (2 cr; A-F only. Prereq—Eh major or #)  
Concepts, assessment, and control of exposure to biological, physical, and chemical hazards in the environment. Environmental health as an essential component of public health.

**PubH 5104. Environmental Health Effects: Introduction to Toxicology.** (2 cr; A-F only)  
Identifying mechanisms/effects on human health of environmental agents. Chemical, biological, physical, and psychological agents.

**PubH 5105. Environmental and Occupational Health Policy.** (3 cr; A-F only. Prereq—Eh major or #)  
Students develop an understanding of environmental and occupational health policies, laws, key concepts and principles, proposals and approaches for regulatory reform, approaches to policy analysis, and overall phases and issues in the policy-making process.

**PubH 5111. Preventing Pollution: Innovative Approaches to Environmental Management.** (3 cr. Prereq—Pub hlth or grad or honors undergrad student or #)  
Interdisciplinary approach to pollution problems, including sustainability, pollution prevention, risk assessment, regulatory reform, and strategic environmental management.

**PubH 5112. Risk Analysis: Application to Risk-Based Decision Making.** (3 cr. Prereq—Pub hlth or grad student or #)  
Introduction to risk in context of regulatory decision making.

**PubH 5113. Public Policy and Risk: Strategies for Effective Decisions and Discourse.** (3 cr. Prereq–Pub h1th or grad student or #)

Introduction to policy making in public health, environment characterized by substantial risk/uncertainty. Basic mathematics of decision making under risk/uncertainty. Cognitive psychology of how people react to risk. Methods of risk communication.

**PubH 5114. Foundation of Environmental and Worker Protection Law.** (1 cr. \$PubH 5110)  
Traditional/constitutional law-making authority of courts, legislatures, and administrative agencies.

**PubH 5115. Worker Protection Law.** (1 cr. \$5110. Prereq–5114)  
Role of government in protecting rights of citizens. Labor movement history as starting point for discussion of modern systems for protecting workers for unsafe workplaces and compensating them for injuries. Review of law that protects individuals against class-based discrimination.

**PubH 5116. Environmental Law.** (1 cr. \$5110. Prereq–5114)  
Several difficult legal questions that arise when pollution protection law conflicts with policy encouraging the use of natural resources. Conflict that arises when government restricts the use of property without compensating its owner. Increasing authority of government agencies to audit businesses to assure compliance.

**PubH 5120. Injury Prevention in the Workplace, Community, and Home.** (2 cr)  
Injury epidemiology: analyses of major injury problems affecting the public in the workplace, community, and home using epidemiological model and conceptual framework; emphasis on strategies/program development for prevention and control.

**PubH 5121. Topics: Injury Prevention in the Workplace, Community, and Home.** (1-2 cr [max 2 cr]. Prereq–[5120 or 5194], 5320, #)  
Selected projects.

**PubH 5122. Seminar: Safety in the Workplace.** (1 cr)  
Realm of and potential risk factors for occupational safety problems; strategies for prevention and control.

**PubH 5123. Violence Prevention and Control: Theory, Research, and Application.** (2 cr)  
Analysis/critique of major theories and of epidemiological research pertinent to violence, including characteristics of violence and relevant risk factors, reporting/treatment protocols, and current/potential intervention efforts and prevention initiatives. Emphasizes interdisciplinary contributions to violence prevention/control.

**PubH 5130. Occupational Medicine: Principles and Practice.** (2-3 cr. Prereq–Environmental Health [MPH or MS or PhD major] or #)  
Pathogenesis of diseases caused by occupational hazards. Evaluating work-related illnesses. Overall regulatory framework governing occupational health/safety.

**PubH 5131. Working in Global Health.** (1-2 cr)  
Introduction to key issues in global health: global burden of disease; cultural issues and health; nutrition; infectious diseases; environmental problems; women and children. Background for health professionals and for working overseas. Instructors have all had experience working in foreign countries.

**PubH 5140. Occupational and Environmental Epidemiology.** (2 cr. Prereq–Basic course in [epi, biostats])  
Principles/concepts in identifying health effects in workplace. Strategies for identifying excess risk, evaluating strengths/weaknesses of research techniques, assessing bias/confounding.

**PubH 5150. Interdisciplinary Evaluation of Occupational Health and Safety Field Problems.** (3 cr. Prereq–Eh major or #)  
Guided evaluation of potential health/safety problems at work site, recommendations and design criteria for correction/evaluation of occupational health/safety programs.

**PubH 5160. Physiological Disposition of Xenobiotics.** (3 cr. Prereq–1 course each in biochem, mol biol, org chem or #)  
Pharmacokinetics/toxicokinetics and xenobiotic metabolism. Mechanisms by which phase I and phase II enzymes bioactivate and detoxify xenobiotics. Implications of these biochemical reactions for human health.

**PubH 5161. Regulatory Toxicology.** (2 cr. Prereq–Some background in [toxicology or pharmacology or related field] is recommended)  
In-depth introduction to laws (and associated regulations) of U.S. federal regulatory agencies, such as CPSC, EPA, FDA, OSHA, and DOT, that require/use toxicological data/information in their mission of protecting human/environmental health.

**PubH 5170. Introduction to Occupational Health and Safety.** (3 cr. Prereq–Environmental health major or #)  
Concepts/issues in occupational health/safety. Application of public health principles/decision-making process in preventing injury/disease, promoting health of adults, protecting worker populations from environmental hazards. Observational visit to manufacturing facility.

**PubH 5171. Properties, Behavior, and Measurement of Airborne Contaminants.** (3 cr; A-F only. Prereq–[Eh major, [industrial hygiene specialty or equiv]] or #)  
Airborne contaminants in outdoor/indoor environments. Emphasizes workplace environments. General physical properties of matter in gaseous/aerosol forms. Measurement/characterization of airborne concentrations of pollutants, human exposures to them. Setting of health-related environmental standards.

**PubH 5172. Industrial Hygiene Applications.** (2 cr. Prereq–[Eh major, 5170] or #)  
Recognition, evaluation, and control of occupational health/safety hazards. Practice application to specific industrial hygiene problems related to gases/vapors, aerosols, and physical agents.

**PubH 5173. Hazard-Related Exposure to Physical Agents in the Environment.** (3 cr. Prereq–Eh major, [industrial hygiene specialty or equiv or #])  
Nature, health effects, monitoring, and control of physical agents in working/living environments, ionizing/non-ionizing radiations (e.g., lasers/ultraviolet, visible, and infrared light), noise/vibration, heat/cold stress. Dose, response, and engineering interventions.

**PubH 5174. Control of Exposure to Physical and Chemical Hazards.** (3 cr. Prereq–[Eh major, [industrial hygiene specialty or equiv]] or #)  
Hierarchy of options for controlling human exposures to airborne contaminants, both gaseous and aerosol. Science/practice of process control and exhaust ventilation in workplaces and other indoor air spaces and in air cleaning. Control of emissions to ambient environment.

**PubH 5175. Industrial Hygiene Measurements Laboratory.** (2 cr. Prereq–5171 or #)  
Broad treatment of occupational health field. Role of industrial hygienist. Emphasizes practical application of industrial hygiene concepts/methods. Lectures/demonstrations, lab exercises, project.

**PubH 5176. Hazardous Materials and Waste Management.** (3 cr. Prereq–5170, courses in chemistry [including organic or equiv])  
Generation, control, disposal of hazardous materials/wastes. Recognizing, evaluating, controlling, preventing hazards from chemicals that threaten occupational/environmental health. Lectures, case studies, workshops, field trips.

**PubH 5180. Environmental Microbiology.** (3 cr. Prereq–Basic course in microbiology or #)  
Sources, monitoring, and control of microorganisms in the environment that are significant to human health.

**PubH 5181. Surveillance of Foodborne Diseases and Food Safety Hazards.** (2 cr. Prereq–[[Professional school or grad student], PubH 5330] or #)  
Principles/methods for surveillance of foodborne diseases. Investigation of outbreaks, assessment of food safety hazards. Focuses on integration of epidemiologic/laboratory methods.

**PubH 5190. Environmental Chemistry.** (3 cr. Prereq–One course each in gen chem, org chem or #)  
Overview air, water, and soil chemistry; pertinent environmental problems; human and ecological multimedia exposures to chemicals in the environment.

**PubH 5193. Directed Study: Environmental and Occupational Health.** (1-4 cr [max 20 cr]; S-N only. Prereq–#)  
Directed study in a topic agreed upon by student and faculty member.

**PubH 5197. Air Pollution.** (3 cr; A-F only. Prereq–[General, organic chemistry] or #)  
Overview of many facets of air pollution. Primary/secondary sources. Transport mechanisms, including meteorological effects, atmospheric transformations of pollutants, and deposition processes involved in removal of pollutants. Human/ecosystem health effects, nuisance effects. Regulations/standards in place and under review that affect air pollution management.

**PubH 5200. Environmental Health.** (2 cr)  
Principles of environmental health relating to macro- and micro-environments and to products consumed or used by people.

**PubH 5201. Issues in Environmental and Occupational Health.** (2 cr. Prereq–Pub h1th student or #)  
The field, current issues, principles/methods of environmental/occupational health practice.

**PubH 5281. Immigrant Health Issues.** (3-4 cr. Prereq–Public health or grad student or #)  
How to access demographic, health, and background information on U.S. immigrants. Characteristics and health needs of immigrants. Designing culturally competent health programs. How to advocate for changes to promote immigrant health. Community visits required.

**PubH 5290. Topics: Public Health Practice.** (1-4 cr [max 20 cr])  
New course offerings or topics of interest in public health practice.

**PubH 5294. Master's Project: Public Health Practice.** (1-3 cr [max 3 cr]; S-N only. Prereq–[PHP or PHPE] major, #)  
Directed field research. Original or secondary analysis of data sets related to public health practice.

**PubH 5296. Field Experience: Public Health Practice.** (1-3 cr [max 3 cr]; S-N only. Prereq–[PHP or PHPE] major, #)  
Directed field experience or clinical rotation/practicum in selected community or public health agencies/institutions. Integration of knowledge/skills in population science for public health.

**PubH 5299. Public Health Practice: Introductory Seminar for Health and Human Resources Professionals.** (1 cr [max 3 cr]; S-N only. Prereq–Baccalaureate degree or degree from a health professional program or grad student in [dentistry or medicine or nursing or pharmacy or public health or veterinary medicine])  
Science/art of public health. Emphasizes interdisciplinary linkages to practice communities. National/local priorities as outlined in “Healthy People 2010” serve as framework for presentations on current issues/trends by public health leaders.

**PubH 5301. Perspectives: Interrelationships of People and Animals in Society Today.** (2 cr. \$3301, \$UC 4301, \$SCVM 6050)  
Social, psychological, economic, and health consequences of people/animal relationships. Diversity of cultural perspectives on human/animal relationships. Animals and people sharing an urban environment. Hunting and wildlife conservation. Biomedical research. Animal rights and human/animal bond.

**PubH 5320. Fundamentals of Epidemiology.** (3 cr. Prereq–Pub hltH or grad student or #) Basic concepts and knowledge of epidemiology, a methodology used to study the etiology, distribution, and control of diseases in human populations.

**PubH 5330. Epidemiology I.** (4 cr [max 4 cr]. Prereq–Epi MPH or Epi PhD or clinical research MS student or #; 5414 or §5414 or PubH 5450 or ¶PubH 5450 or equiv recommended) Epidemiologic principles applicable to infectious/non-infectious disease. Introduction to measures of disease frequency. Study designs (randomized trials, cohort, case-control, cross-sectional, and ecological studies). Issues of bias, confounding, and casual inference. Data analysis using tabular methods.

**PubH 5333. Principles of Human Behavior I.** (2 cr; A-F only. Prereq–Epi PhD student or #) Theoretical perspective on etiology/modification of health behavior in individuals/communities.

**PubH 5334. Human Behavior II.** (2 cr; A-F only. Prereq–[5333, Epi grad student in behavioral track] or #) Critical evaluation of major behavioral public health intervention research. Experience in research designs/methods in health behavior intervention.

**PubH 5335. Epidemiology and Control of Infectious Diseases.** (2 cr. Prereq–Epi major or #) Principles and methods. Strategies for disease control and prevention, including immunization. Relevance of modes of transmission of specific agents for disease spread and prevention. Public health consequences of infectious diseases at local, national, and international levels.

**PubH 5336. Advanced Seminar in Infectious Disease Epidemiology.** (1 cr [max 2 cr]; S-N only. Prereq–5330, 5335, #) How infectious disease epidemiologic principles are applied in the “real world” to contemporary or controversial issues, including development of prevention and control strategies.

**PubH 5337. Analysis of Infectious Disease Data.** (2 cr; A-F only. Prereq–5330, 5340, 5335, [EPI or MPH or EPI] grad student, #) Methods to analyze/model infectious disease data. Emphasizes critical understanding of methods, statistical analysis specific to infectious disease areas. Infection models, surveillance/epidemic modeling, transmission models, pathogenesis models.

**PubH 5340. Epidemiology II.** (4 cr. Prereq–[Epidemiology [MPH or PhD] student, [5330 with grade of at least B-, one biostats course]] or #) Measures of disease occurrence. Strategies/design principles for etiologic/evaluative studies. Measurement of problems, interactions, sensitivity. Precision, validity, data specification, control of variables.

**PubH 5345. Epi Methods: Data Collection.** (2 cr. Prereq–[5330, 5450, [Epi MPH or clin research student]] or #) Methods/techniques for collecting/managing epidemiologic research data. Practical aspects of sampling, response rates/bias, forms design, selecting/training interviewers. Data preparation, entry, cleaning, management. Ethical issues in research.

**PubH 5348. Writing Research Grants.** (2 cr; S-N only. Prereq–[5330, 5450, [Epi PhD or clinical research MS student]] or #) Focuses on NIH-type grants. Mechanisms of grant development/writing, principles of informed consent, budget development, grant-review process, identifying funding sources.

**PubH 5351. Molecular Epidemiology.** (2 cr; A-F only. Prereq–PubH 5330, at least one college-level general biology course, [Epi MPH or Epi grad student or #]) Introduction to molecular epidemiology. Sample collection, processing, methodology. Biomarkers used in cancer, cardiovascular disease, and infectious epidemiologic studies.

**PubH 5355. Pathophysiology of Human Disease.** (4 cr. Prereq–Epi MPH or Epi PhD or public hltH nutrition or #) Compendium of human diseases relevant to public health professionals. Focuses on cardiovascular disease, cancer, and infectious disease. Presented from epidemiologic perspective. Significance of diseases in terms of prevalence, incidence, morbidity, and mortality. Risk factors, prevention strategies.

**PubH 5363. Design and Analysis of Group-Randomized Trials in Epidemiology.** (3 cr. Prereq–5340, 5452, [EPI MPH or EPI] grad student, #) Community, school-based, and work-site trials. Trials involving randomization of other identifiable groups to study conditions. Experimental/quasi-experimental designs and threats to their validity.

**PubH 5365. Epidemiology of Aging.** (2 cr. Prereq–Grad or professional school student, 5330 or equiv or #) Major concepts and issues. Emphasizes methodological issues unique to studies of older populations with measurement of epidemiologic characteristics especially important. Scope of epidemiologic studies of older populations; most prevalent health conditions.

**PubH 5370. Alcohol and Other Drugs: Epidemiology, Prevention, and Control.** (3 cr. Prereq–Eh or epi grad major or pub hltH or biol or dent or nurs grad or med school or pharm student or #) Population patterns regarding who uses which drugs, why they use them, and health consequences of alcohol and other drug use. Does not focus on treatments, care, rehab, or exploration of personal attitudes, practices regarding alcohol or other drug use.

**PubH 5379. Epidemiology Master’s Project Seminar.** (1 cr; S-N only. Prereq–#) Seminar for epidemiology MPH master’s project presentations. Students present their projects and give/receive feedback.

**PubH 5381. Genetics in Public Health.** (2 cr. Prereq–Grad or professional school student or #) Mechanisms of molecular genetics. Issues related to medical/public health genetics, including basis of human diversity, Human Genome Project, novel genetic mechanisms underlying diseases, ethical/legal issues.

**PubH 5386. Public Health Aspects of Cardiovascular Disease.** (2 cr. Prereq–[5330, 5450, [Epi MPH or Epi PhD student]] or #) Detailed perspective on well-established risk factors for cardiovascular disease (CVD), prevention of CVD, and national recommendations for treatment/prevention. Introduces emerging risk factors and current controversies in CVD.

**PubH 5387. Cancer Epidemiology.** (2 cr. Prereq–5330, 5340, hltH sci grad and professional school student or #) Epidemiologic aspects of cancer, including theories of carcinogenesis, incidence, site-specific risk factors, and issues of cancer control and prevention.

**PubH 5389. Nutritional Epidemiology.** (2 cr. Prereq–[5330], [Epi MPH or Epi PhD or public hltH nutrition MPH student]] or #) Nutrition/disease relationships through application of epidemiologic methods. Characterization of various exposures to food/nutrient intakes, biological basis for nutrition/disease relationships. Studies of specific chronic diseases and nutritional intake. Design/interpretation of studies using nutritional measures.

**PubH 5396. Field Experience: Epidemiology.** (1-4 cr [max 4 cr]; S-N only. Prereq–[Epi MPH or grad student], #) Supervised epidemiologic field study in health or public health setting under academic/professional supervision. Emphasizes application of acquired knowledge/skills to relevant issues/problems.

**PubH 5399. Topics: Epidemiology.** (1-4 cr [max 20 cr]. Prereq–#) New course offerings or topics of interest.

**PubH 5414. Biostatistical Methods I.** (3 cr. §5450. Prereq–Pub hltH or hltH sci grad student or #) Descriptive statistics, graphical methods. Use of Excel. Proportions, relative risk, odds ratios. Random sampling. Estimates of mean, medians, measures of variability. Normal distribution, t-/chi-square tests. Confidence intervals. Correlation/regression. Inference/causality.

**PubH 5415. Biostatistical Methods II.** (3 cr. Prereq–PubH 5414) Statistical computing using SAS. Multiple regression. Data transformations. Relative risk, odds ratio estimation. Logistic regression. Survival analysis. Kaplan-Meier tables, survival curves.

**PubH 5420. Introduction to SAS Programming.** (1 cr. Prereq–Health sciences grad student or #) Use of SAS for analysis of biomedical data. Data manipulation/description. Basic statistical analyses (t-tests, chi-square, simple regression).

**PubH 5421. Advanced Statistical Computing.** (3 cr. Prereq–[5465, biostatistics major, [C or FORTRAN]] or #) Statistical computing using SAS, Splus, and FORTRAN or C. Use of pseudo-random number generators, distribution functions. Matrix manipulations with applications to regression and estimation of variance. Simulation studies, minimization of functions, nonlinear regression, macro programming, numerical methods of integration.

**PubH 5450. Biostatistics I.** (4 cr. Prereq–[Math 1031, health science grad student] or #) Descriptive statistics. Gaussian probability models, point/interval estimation for means/proportions. Hypothesis testing, including t, chi-square, and nonparametric tests. Simple regression/correlation. ANOVA. Health science applications using output from statistical packages.

**PubH 5452. Biostatistics II.** (4 cr. Prereq–[5450, competence in SAS through 5420] or equiv or grade of at least B in [5414, 5415]) Two-way ANOVA, interactions, repeated measures, general linear models. Logistic regression for cohort and case-control studies. Loglinear models, contingency tables, Poisson regression, survival data, Kaplan-Meier methods, proportional hazards models.

**PubH 5456. Biostatistics Consulting Seminar.** (2 cr; S-N only. Prereq–[5466, biostatistics major] or #) Professional roles/responsibilities of practicing biostatistician as consultant/collaborator in health science research. Discussion, written assignments, student presentations, meeting notes, interviews, guests.

**PubH 5460. Introduction to Biostatistical Thinking.** (1 cr; S-N only. Prereq–Biostatistics major or #) Aspects of Biostatistics as practiced at U of M and as described in research literature.

**PubH 5462. Clinical Trials: Design, Implementation, and Analysis.** (3 cr. Prereq–5452 or 5466 or #) Introduction to and methodology of randomized clinical trials: design issues, sample size, operational details, interim monitoring, data analysis issues, and overviews.

**PubH 5465. Biostatistics: Regression.** (4 cr. §5450, §5452. Prereq–[[Stat 5101 or ¶Stat 5101], biostats major] or #) T-tests, confidence intervals, power, type I/II errors. Exploratory data analysis. Simple linear regression, regression in matrix notation, multiple regression, diagnostics. Ordinary least squares, violations, generalized least squares, nonlinear least squares regression. Introduction to General linear Model. SAS and S-Plus used.

**PubH 5466. Biostatistics: ANOVA and Design.** (4 cr. §5450, §5452. Prereq–5465, [[Stat 5102 or ¶Stat 5102], biostats major] or #) Single factor ANOVA, diagnostics, classical non-parametrics, multifactor ANOVA, multiple comparisons, power and sample size determination, calculating expected mean squares, random/mixed effects models. ANOVA in regression notation. Randomized block designs, nested designs, repeated measures designs, cross-over designs. SAS and S-Plus used.

**PubH 5467. Analysis of Categorical Data.** (3 cr. Prereq–5465; [Stat 5102 or Stat 5102]) Contingency tables, odds ratio, relative risk, chi-square tests, log-linear models, logistic regression, conditional logistic regression, Poisson regression, matching, generalized linear models for independent data. SAS/S-Plus used throughout.

**PubH 5470. Topics: Biostatistics.** (1-4 cr [max 20 cr]. Prereq–#)  
Topics of interest in biostatistics.

**PubH 5482. Latent Variable Models.** (3 cr. Prereq–[5414, 5415] or [5450, 5452] or #)  
Introduction to use of statistical techniques known collectively as latent variable models. Exploratory/confirmatory factor analysis, path analysis, structural equation modeling, latent trait models, latent class models. SAS/AMOS software are used.

**PubH 5483. Statistical Methods for Correlated Data.** (3 cr. Prereq–[[5420 or equiv], [5452 or 5466 or Stat 5303 or equiv], familiarity with matrix notation] or #)  
Correlated data arising from data collected over time or space, group randomizations, cluster sampling, nested designs, or random effects assumptions. Modeling, analysis, and interpretation appropriate for such data, for normally or non-normally (e.g. binary, Poisson, gamma) distributed outcomes. Computing using SAS software.

**PubH 5494. Master's Project: Biostatistics.** (1-3 cr [max 3 cr]; S-N only. Prereq–[Bio MPH or grad student], #)  
Directed research toward completion of Master's or Plan B project in biostatistics.

**PubH 5501. Fundamentals of Clinical Research.** (3 cr. Prereq–Clinical research student or #)  
Concepts of clinical research design/implementation. Concepts that aid in applied investigation in epidemiology/biostatistics.

**PubH 5502. Clinical Research Literature Review Seminar.** (1 cr. Prereq–Clinical research grad student or #)  
Students review clinical research literature, critique: hypotheses/goals, methodology of population selection, study design, subject measurement.

**PubH 5503. Clinical Research Project Seminar.** (2 cr. Prereq–[5502, clinical research grad student, master's project/thesis paper [underway or near completion]] or #)  
Students to present their master's project/thesis, give/receive feedback.

**PubH 5510. Topics: Clinical Research.** (1-4 cr [max 20 cr]. Prereq–#)  
Topics of interest in clinical research.

**PubH 5550. Clinical Research: Introductory Seminar for Health Professionals.** (2 cr. \$5501. Prereq–[Bachelors degree or degree from health professional program or grad student in [dentistry or medicine or nursing or pharmacy or public health or veterinary medicine]], #; not for clinical research MS students)  
Design/implementation of clinical research protocols. IRB, FDA, and other regulations. Practical tools for survey management.

**PubH 5592. Readings in Clinical Research.** (1-4 cr [max 4 cr]. Prereq–CR grad student, #)  
Current readings in clinical research.

**PubH 5593. Directed Study: Clinical Research.** (1-4 cr [max 4 cr]. Prereq–CR grad student, #)  
Directed research or field practice in clinical research.

**PubH 5605. Reproductive and Perinatal Health.** (2 cr; A-F only. Prereq–Pub hlth or grad student or #)  
Issues, programs, services, and policies. Social, cultural, psychological, physiologic, environmental, economic, and political factors that affect reproductive health, pregnancy, and childbearing.

**PubH 5606. Health of Children.** (2 cr. Prereq–Pub hlth or grad student or #)  
Overview of public health issues related to children in the United States. Focus on identifying and planning effective public health strategies, policies, and programs to improve the health of infants and children.

**PubH 5607. Adolescent Health: Issues, Programs, and Policies.** (2 cr. Prereq–Pub hlth or grad student or #)  
Major public health issues of adolescents in the United States. Emphasis on prevention and health promotion strategies and on effectiveness of programs and policies.

**PubH 5610. Principles of Maternal and Child Health.** (2 cr. Prereq–Pub hlth or grad student or #)  
For MCH students and others interested in learning about the needs of children and families. Examines MCH activities in the context of "Healthy People 2000," including the history and organization of programs, policies, and advocacy activities.

**PubH 5613. Chronic Illness and Disability in Childhood: Principles, Programs, and Policies.** (2 cr. Prereq–Pub hlth or grad student or #)  
Principles, policies, programs, and practices for identifying and meeting the needs of children and adolescents with chronic health conditions and of their families. Skills emphasized: needs assessment, program development/evaluation, family empowerment, interdisciplinary team building, integrated/coordinated service delivery, advocacy.

**PubH 5627. Sexuality Education: Criteria, Curricula, and Controversy.** (1 cr. Prereq–Prefer public health student or grad student or professional in public health or in education; 5 seats reserved for UC students)  
Issues/controversies affecting K-12 sexuality education. Current research/guidelines for effective, responsible education and curricula selection. Various curricula being used in the United States. Challenges in teaching sensitive issues inherent in sexuality education.

**PubH 5628. Seminar: Race, Class, and Family Formation.** (1 cr; S-N only. Prereq–Public health student or grad student or #)  
Impact of race/class on family formation, family dynamics, and family resiliency/maintenance. Explores whether traditional approaches in family intervention are effective among individuals who are not engaged in traditional social institutions.

**PubH 5634. Advocating for Change for Children.** (2 cr. Prereq–Pub hlth or grad student or #)  
Strategies for changing systems, building skills in public policy research, information/perception management, coalition building, personal persuasion, advocacy.

**PubH 5639. Prevention: Theory, Practice, and Application in Public Health Service.** (3 cr. Prereq–Jr or sr or grad student or professional school student)  
Current issues/controversies around prevention and how it relates to health services. History of prevention as an idea. Terminology, lifestyle intervention. Programs and legislative issues. Education, roles/implications for societal action.

**PubH 5645. Families and Health: an Ecosystems Approach.** (2 cr. Prereq–Pub hlth or grad student or #)  
Interrelationships between individual, family, and community health. Family theories/research, effect of sociocultural context, public policies, and community structures on health. Primary/secondary prevention strategies for promoting family health.

**PubH 5648. Topics: Maternal and Child Health.** (1-4 cr [max 20 cr]. Prereq–#)  
Topics of interest in maternal/child health.

**PubH 5654. Adolescent Sexual Identity: Teen Risk and Professional Responsibility.** (1 cr. Prereq–Professional in pub hlth or medicine or ed or soc work or counseling or youth service)  
Issues that gay, lesbian, and bisexual adolescents and their families face in coming to terms with sexual orientation. Helpful ways to work with this hidden population and their families. One-day workshop.

**PubH 5655. Sexual Orientation Issues for Adolescents.** (2 cr. Prereq–Baccalaureate degree or employment in ed or hlth or soc service field)  
Adolescent sexual orientation from perspective of individual identity; impact of the community and response of the community toward gay, lesbian, bisexual, and transgender youth; and interventions/roles of professionals in the school and community.

**PubH 5661. Community Organizing for Public Health.** (2 cr. Prereq–Pub hlth or grad student or #)  
Principles of community organizing. Challenges/strategies for public health professionals engaged in community organizing. Decreasing barriers to community participation, encouraging leadership, building coalitions/alliances, sustaining community organizing efforts.

**PubH 5673. Grant Writing for Public Health.** (1 cr. Prereq–MCH or CHE or PubH Nutr or EPI MPH or #)  
Hands-on workshop. Focuses on children, youth, and families. Identifying successful elements of a grant application. Grant review process. Critiquing a grant. Writing an application.

**PubH 5675. Women's Health.** (2 cr. Prereq–Public health [MPH or MS or PhD] student or health sciences grad student or #)  
Programs, services, and policies that affect women's health in the United States. Methodological issues in research. Emphasizes social, economic, environmental, behavioral, and political factors. Measurement/interpretation of factors, how they translate into interventions, programs, and policies.

**PubH 5691. Independent Study: Maternal and Child Health.** (1-4 cr [max 4 cr]. Prereq–MCH major, #)  
Independent study supervised by a Maternal and Child Health faculty member.

**PubH 5694. Master's Project: Maternal and Child Health.** (2-4 cr [max 4 cr]; S-N only. Prereq–MCH major, #)  
Directed research toward completion of the master's project in maternal and child health.

**PubH 5696. Field Experience: Maternal and Child Health.** (2-4 cr [max 4 cr]; S-N only. Prereq–MCH major, #)  
Supervised maternal/child health field study in health or public health setting under academic/professional supervision. Emphasizes application of acquired knowledge/skills to relevant issues/problems.

**PubH 5700. Foundations of Public Health Administration.** (3 cr. Prereq–PHA major or #)  
Organization of public health, predominately in the United States. Role of public health administration. Problem-solving skills necessary for effective administration.

**PubH 5705. Community Health Assessment.** (3 cr. Prereq–[Grad-level epidemiology course, [public health or grad student]] or #)  
Two of the three core functions of public health: health assessment, assurance. Lectures, discussion, group activities, oral presentations.

**PubH 5708. Analysis of Administrative Data.** (3 cr. Prereq–Public health or grad student or #)  
How to use data for various research designs. Origin, quality, strengths, limitations of data. Files based on Medicare/Medicaid data are used for hands-on learning. Emphasizes broad concepts/skills.

**PubH 5711. Public Health Law.** (2 cr. Prereq–Grad student or professional school student or #)  
Basic concepts of law, legislative process, and legal bases for existence/administration of public health programs. Legal aspects of current public health issues/controversies, regulatory role of government in health services system.

**PubH 5717. Decision-Making Under Uncertainty.** (2 cr. Prereq–PubH or grad student or #)  
Introduction to theory/application of decision analysis. Focuses on normative (as opposed to descriptive) modeling of decision-making under uncertainty.

**PubH 5721. Managing Collaborative Networks.** (2 cr. Prereq–Grad student or professional school student or #)  
How to manage inter-organizational networks to coordinate provider organizations for associations and rural health networks.

**PubH 5724. The Health Care System and Public Health.** (3 cr. Prereq—Public health or grad student or #) Overview of health care delivery, finance systems within public health context. Components of health care system: financing, role of employers/public programs, health care delivery system, managed care. Collaborative interventions between managed care, public health.

**PubH 5726. Medical Device Industry: Business and Public Policy.** (3 cr. Prereq—Public health or grad student or #) Business, public policy, regulatory, technology management issues concerning medical device/biotechnology industries. Nature/effects of private-public sector interactions. Involvement by leaders in Minnesota organizations.

**PubH 5727. Health Leadership and Effecting Change.** (2 cr. Prereq—Grad student or professional school or #) Applications of a broad theoretical base in planned change to solve managerial/organizational problems in students' future roles as leaders in health professions.

**PubH 5740. Organizational Behavior.** (2 cr. Prereq—Grad or professional school student or #) Human behavior in organizations. Motivation, leadership, influence of organizational structure, informal group behavior, interpersonal relations, supervision. Emphasizes preventing/solving problems among individuals/groups in organizations.

**PubH 5741. Ethics in Public Health: Professional Practice and Policy.** (1 cr. Prereq—Public health or grad student or #) Introduction to ethical issues in public health practice/policy. Ethical analysis, recognizing/analyzing moral issues.

**PubH 5742. Ethics in Public Health: Research and Policy.** (1 cr. Prereq—Public health or grad student or #) Introduction to ethical issues in public health research/policy. Ethical analysis. Recognizing/analyzing moral issues.

**PubH 5751. Principles of Management in Health Services Organizations.** (2 cr. Prereq—[Grad or professional school] student) Role of health-care services administrators, principles of management, administrative process. Lectures, case studies.

**PubH 5752. Public Health Management.** (3 cr. Prereq—[Grad or professional school] student or #) Managing projects/organizations in public health. Skills/knowledge necessary to determine mission of an organization, structure it to support individuals in their work, and motivate/manage to achieve goals.

**PubH 5760. Healthcare Financial Management: Public Sector Emphasis.** (2 cr. Prereq—Grad student or professional school student or #) Theory of managerial/financial accounting and of healthcare finance as they relate to program development for non-profit organizations. Emphasizes methods whereby programmatic goals/objectives can be integrated into financial planning, budget preparation, and budget control. Examining an overall program through financial analytical techniques.

**PubH 5761. Financial Analysis: Topics for Public Health.** (1 cr. Prereq—Grad student or professional school student or #) How financial management intersects at macro/micro level. Focuses on financial analysis at department, organizational, and system level. Financial trends.

**PubH 5762. Health Finance Applications.** (2 cr. Prereq—5761, [grad student or professional school student or #]) Top management perspective of healthcare financial management responsibility in context of strategic issues. Emphasizes balancing theory and applications. Capstone course.

**PubH 5780. Topics: Public Health Administration.** (1-4 cr [max 20 cr]. Prereq—#) Topics of interest in public health administration.

**PubH 5791. Independent Study: Public Health Administration.** (1-4 cr [max 4 cr]. Prereq—PHA major, #) Independent study supervised by a public health administration faculty member.

**PubH 5794. Master's Project: Public Health Administration.** (3 cr; 5-N only. Prereq—PHA major, #) Students work with their adviser to complete one of three types of master's projects: research project, critical literature review, or applied field project.

**PubH 5796. Field Experience: Public Health Administration.** (3 cr; 5-N only. Prereq—PHA major, #) Supervised public health administration field study in health or public health setting under academic/professional supervision. Emphasizes application of acquired knowledge/skills to relevant issues/problems.

**PubH 5802. Seminar: Technology of Data Operations in Health Care Studies.** (3 cr. Prereq—Familiarity with [Windows-based environment, Microsoft Word, Excel, Access, Web browser, graphical package, data collection/analysis projects, internet] or #) Overview of data collection tools in health care studies: workflow design; scanned/faxed, web-based forms; voice response; palmtop computers; relational databases. Managing workflow. Selecting tools to ensure data quality and low cost. Case studies.

**PubH 5806. Principles of Public Health Research.** (2 cr. Prereq—Pub hlth or grad or professional school student or #) Evaluation of public health research literature and planning for independent research projects. Formulation of research question, research design, sampling techniques, use of research concepts, and data analysis. Data collection techniques, including questionnaires, interviews, and data analysis.

**PubH 5812. Managed Care.** (3 cr; A-F only. Prereq—Pha or hsrp&a major or MHA student or #) Development/organization of HMOs. Risk sharing. Provider contracts. Utilization management. Quality improvement. Marketing and new product development. Employer relations. Medicare/Medicaid contracting. Budgeting. Financial performance. Pricing. Regulation.

**PubH 5832. Economics of the Health Care System.** (3 cr; A-F only. Prereq—Microecon theory course or #) Economic analysis of U.S. health-care sector. Emphasizes problems of pricing, production, and distribution. Health-care services as factor contributing to nation's health.

**PubH 5835. Health Services Policy.** (2 cr. Prereq—PHA major or [HSRPA or MHA or PA] grad student or #) Social, political, and economic context within which U.S. health-care system developed. Influence of these contextual elements on public policies guiding/regulating organization/delivery of health services.

**PubH 5852. Program Evaluation in Health and Mental Health Settings.** (3 cr. Prereq—#) Overview of evaluation, models of evaluation, objectives of an evaluative study, sampling of subjects, methods of data collection, methodological designs, interpretation of data, preparation of final report, and ethical and political considerations.

**PubH 5861. Health Insurance.** (2 cr; A-F only. Prereq—Microecon theory course or #) Financing personal health care: theory of insurance, health insurance markets, cost sharing, HMOs, PPOs, public and catastrophic health insurance, and the uninsured. Emphasis on public policy.

**PubH 5862. Cost-Effectiveness Analysis in Health Care.** (3 cr. Prereq—#; introductory econ course recommended) Government regulations. New technologies. Diagnosis/treatment protocols. Strengths, limitations, appropriateness of different approaches.

**PubH 5863. Understanding Health-Care Quality.** (2 cr) Introduction to assessing and assuring quality of care. Emphasizes both process and outcomes approaches, paralleling interest in the appropriateness and effectiveness of care. Issues around creating needed behavioral changes.

**PubH 5864. Conducting Health Outcomes Research.** (3 cr. Prereq—Intro crse in [epidemiology or health services research methods] or #) Major concepts/principles in conducting health outcomes research that evaluates medical care. Developing study designs matched to research questions. Frequently used study designs. Evaluating health outcomes. Analytical approaches.

**PubH 5881. Topics: Health Services Research and Policy.** (1-4 cr [max 20 cr]. Prereq—#) Topics of interest in health services research/policy.

**PubH 5900. Public Health Nutrition: Principles and Programs.** (2 cr. Prereq—Pub hlth nutr major or #) Principles of public health nutrition, roles and functions of public health nutritionists, programs and delivery mechanisms for promoting nutritional status of populations. Students explore their beliefs and competencies in relation to principles and philosophy of public health nutrition.

**PubH 5902. Maternal and Infant Nutrition.** (2 cr. Prereq—3xxx nutr course or equiv or #) Nutritional needs of childbearing women and of infants. How to meet these needs through programs/services.

**PubH 5905. Human Nutrition and Health.** (2 cr. Prereq—Jr or sr or grad or professional school student) Broad range of nutrition topics of contemporary interest. Concepts and facts about science of human nutrition in relation to personal and community nutrition problems and concerns. Applied, introductory graduate-level course with labs.

**PubH 5907. Assessment of Dietary Intake.** (1 cr. Prereq—Pub hlth nutr major or #) Methods for assessing dietary intake of populations and individuals; appropriate uses of dietary assessment methods in public health, clinical, and research settings; evaluation and interpretation of dietary data.

**PubH 5908. Anthropometric Assessment of Nutritional Status.** (1 cr. Prereq—5450 or 5414 or equiv, grad or professional school student) Anthropometry as used to assess nutritional status; training and experience in taking basic measurements; practical experience in anthropometry; conceptual rationales and interpretation of anthropometric data.

**PubH 5909. Topics: Public Health Nutrition.** (1-4 cr [max 20 cr]. Prereq—#) Topics of interest in public health nutrition.

**PubH 5910. Critical Review of Research in Public Health Nutrition.** (1 cr. Prereq—Pub hlth nutr or mch major, grad-level course each in research, biostat, epi or #) Applying principles of nutrition, epidemiology, and biostatistics to evaluate scientific research on topics of significance in public health nutrition. Interactive seminar format with lecture, discussion, and student presentations.

**PubH 5911. Biochemical Assessment.** (1 cr. Prereq—Grad or professional school student, 5450 or 5414 or equiv or #) Use of biochemical measurements for evaluation of nutritional status. Biochemical measurement methods, data analysis, and application of reference data; protein, vitamin, and mineral status.

**PubH 5914. Community Nutrition Intervention.** (3 cr. Prereq—Grad or professional school student or #) Nutrition intervention strategies used in health programs. Selecting appropriate strategies, applying them to specific target audiences, and evaluating their usefulness in relation to program objectives.

**PubH 5932. Nutrition: Adults and the Elderly.** (2 cr; A-F only. Prereq—Grad or professional school student or #) Current literature and research on nutrition needs and factors affecting nutritional status of adults and the elderly.

**PubH 5933. Nutrition: Health/Disease Relationships.** (2 cr. Prereq—5330, F5cN 5622 or MdBc 5201 or equiv or #) Issues in nutrition and public health; biological and epidemiologic bases for public health dietary recommendations. Relation of nutrition to heart disease, cancer, hypertension, obesity, and other conditions.

**PubH 5935. Child and Adolescent Nutrition.** (2 cr. Prereq—Grad or professional school student or #) Current issues and literature. Major nutrition issues of youth; biological, cultural, and psycho-social factors influencing food behaviors; and strategies for improving nutritional health.

**PubH 5991. Independent Study: Public Health Nutrition.** (1-4 cr [max 4 cr]. Prereq—[PubH Nutr MPH student or Nutr grad student], #) Independent study supervised by a public health nutrition faculty member.

**PubH 5994. Master's Project: Public Health Nutrition.** (1-4 cr [max 4 cr]. Prereq—PubH Nutr major, #) Directed research toward completion of master's project in public health nutrition.

**PubH 5996. Field Experience: Public Health Nutrition.** (1-6 cr [max 6 cr]; S-N only. Prereq—PubH Nutr major) Supervised public health nutrition field study in health or public health setting under academic/professional supervision. Emphasizes application of acquired knowledge/skills to relevant issues/problems.

**PubH 8100. Topics: Environmental and Occupational Health.** (1-4 cr [max 20 cr]. Prereq—#) New course offerings or topics of interest in environmental/occupational health.

**PubH 8101. Directed Research: Environmental and Occupational Health.** (1-6 cr [max 6 cr]. Prereq—EH major or MPH grad student) Research, with direction from faculty member, in environmental/occupational stresses on human health.

**PubH 8120. Occupational Injury Epidemiology and Control Program (OIECP) Research Seminar.** (1 cr [max 12 cr]. Prereq—Eh grad major, OIEC specialty or equiv, 5120, 5320, 5450 or #) Facilitates student research efforts in occupational injury epidemiology and control through roundtable discussions and interdisciplinary involvement.

**PubH 8140. Validity Concepts in Epidemiologic Research.** (2 cr. Prereq—5330, 5340 [with grade of at least B]) Conceptual basis for validity in observational epidemiologic research. Recognizing, evaluating, preventing, and correcting for confounding specification error, measurement-error bias, and selection/follow-up bias.

**PubH 8141. Doctoral Seminar in Observational Inference.** (2 cr [max 20 cr]; S-N only. Prereq—8140, doctoral student in public health, #; 5330, 5340, 8140 recommended) Fundamentals of epidemiologic inference, including methods for designing, analyzing, and interpreting epidemiologic studies.

**PubH 8160. Advanced Toxicology.** (2 cr. Prereq—[5160, 1 course in biochem, one course in molecular bio] or #) Cellular/molecular mechanisms by which xenobiotics cause toxicity. Investigative approaches to current research problems in toxicology/carcinogenesis. Apoptosis, cell cycle regulation, genetic toxicology, molecular mechanisms of chemical carcinogenesis, genetic basis for susceptibility to environmental toxicants.

**PubH 8161. Current Literature in Toxicology.** (1 cr [max 3 cr]; S-N only. Prereq—5104) Modern methods in toxicology, critical thinking skills. Topics vary each semester. Students read/discuss toxicological literature.

**PubH 8162. Chemical Carcinogenesis and Chemoprevention.** (3 cr; A-F only. Prereq—[[BioC 3001, BioC 3021, BioC 4331] or equiv], [Chem 2302 or equiv]) Fundamental background in chemical carcinogenesis, carcinogen activation/detoxification, carcinogen-DNA adduct formation, cellular oncogenesis, cancer chemoprevention, nutrition/cancer. Topics integrated/interrelated.

**PubH 8170. Advanced Industrial Hygiene Applications.** (2 cr; A-F only. Prereq—5170, eh grad major) Recognition, evaluation, and control of occupational health/safety hazards. Application of concepts to specific industrial hygiene problems related to gases/vapors, aerosols, and physical agents.

**PubH 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**PubH 8350. Advanced Epidemiologic Theory.** (2 cr; S-N only. Prereq—Epi PhD major or #) Integrates concepts from PubH 5330, 5340—Epidemiology I, II. Critical discussion of current theoretical paradigms of epidemiology, philosophy of causal inference in epidemiology, and estimation of causal parameters.

**PubH 8377. Seminar: Chronic Disease and Behavioral Epidemiology.** (1 cr [max 2 cr]; S-N only. Prereq—Epi grad major or #) Readings, presentations, classroom discussions, and exercises provide experience in epidemiologic research methods in chronic diseases and behaviorally based diseases other than infectious and cardiovascular diseases and cancer.

**PubH 8378. Advanced Seminar in Epidemiology.** (1-3 cr [max 12 cr]; S-N only. Prereq—Epi grad major or #) Discussion of one or more major research areas of current interest.

**PubH 8379. Seminar in Epidemiology.** (2 cr; S-N only. Prereq—Epi grad or MPH major or #) Discussion of selected current problems.

**PubH 8388. Topics: Epidemiology.** (1-4 cr [max 20 cr]. Prereq—#) New course offerings or topics of interest in epidemiology.

**PubH 8389. Seminar: Topics in Epidemiology.** (3 cr. Prereq—Epi grad or epi major or che MPH major or #) Current theoretical measurement/research issues. Topics drawn from infectious/chronic disease epidemiology, epidemiologic methodology, and biostatistical applications.

**PubH 8390. Teaching Practicum in Epidemiology.** (2 cr; S-N only. Prereq—Epi grad major or #) Instruction and hands-on experience in teaching methods at the graduate level.

**PubH 8391. Independent Study: Epidemiology.** (1-4 cr [max 4 cr]. Prereq—[EPI major or grad student], #) Independent study supervised by epidemiology faculty member.

**PubH 8392. Readings in Epidemiology.** (1-4 cr [max 4 cr]. Prereq—[Epi MPH or grad student], #) Current readings in epidemiology.

**PubH 8420. Survival Analysis.** (3 cr. Prereq—[5466 or equiv], 5467, Stat 5102) Statistical methodologies in analysis of survival data, including Kaplan-Meier estimator, Cox's proportional hazards multiple regression model, time-dependent covariates, analysis of residuals, and multiple failure outcomes. Typical biomedical applications, including clinical trials and person-years data.

**PubH 8422. Modern Nonparametrics.** (2 cr. Prereq—5466, Stat 5102, MPH or grad student or #) Classical nonparametric inference, exact tests and confidence intervals, robust estimates, the jackknife, bootstrap and cross-validation, nonparametric smoothing and classification trees. Variety of models and applications; formal development sufficient for understanding statistical structures and properties. Substantial computing.

**PubH 8429. Probability Models for Biostatistics.** (3 cr. Prereq—8420, 8421, Stat 5102, advanced biostats or stats major or #) Three basic models used for stochastic processes in the biomedical sciences: point processes (with emphasis on Poisson processes), Markov processes (with emphasis on Markov chains), and Brownian motion. Probability structure and statistical inference studied for each process.

**PubH 8430. Sequential Analysis.** (2 cr. Prereq—8420, 8429, Stat 5102, advanced biostats or stats major or #) Probability theory underlying sequential analysis, including stopping times, Brownian motion, comparison of frequentist and Bayesian approaches. Biomedical applications, including monitoring clinical trials, laboratory quality control, sequential design and allocation, inference following sequential design.

**PubH 8431. Bayesian Decision Theory and Data Analysis.** (3 cr. Prereq—[[5421 or experience with FORTRAN or with [C, S+]], Stat 5101, Stat 5102, Stat 8311, grad student in [biostatistics or statistics] or #) Theory/application of Bayesian methods. Bayesian methods compared with traditional, frequentist methods.

**PubH 8433. Advanced Longitudinal Data Analysis.** (3 cr. Prereq—[Stat 5101, Stat 8311, experience with [SAS or S+], advanced [biostat or stat] student] or #) Methods of inference for outcome variables measured repeatedly in time or space. Linear/nonlinear models with either normal or non-normal error structures. Random effects. Transitional/marginal models with biomedical applications.

**PubH 8434. Advanced Survival Analysis.** (2 cr. Prereq—8420, 8429, Stat 5102, advanced biostats or stats major or #) Martingale methods and counting process theory as applied to survival data, including martingale foundations, statistical tests for comparing survival among groups, Cox proportional hazards model, diagnostics and analysis of residuals, multivariate survival data, and extensions to event history analysis.

**PubH 8436. Spatial Biostatistics.** (3 cr. Prereq—Stat 5101, Stat 5102, some experience with S-plus; [5470 or 8431], Stat 8311 are recommended) Spatial data, spatial statistical models, and spatial inference on unknown parameters or unobserved spatial data. Introduces the nature of spatial data and the special analysis tools that help to analyze such data. Follows a blend of theory and applications.

**PubH 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**PubH 8470. Topics: Biostatistics.** (1-4 cr [max 20 cr]. Prereq—#) New course offerings or topics of interest in biostatistics.

**PubH 8494. Directed Research: Biostatistics.** (1-4 cr [max 4 cr]; S-N only. Prereq—#) Research, with direction from a faculty member, in biostatistics.

**PubH 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**PubH 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**PubH 8800. Topics of Interest in Health Services Research and Policy.** (1-4 cr [max 20 cr]. Prereq—HSRP&A major or SPH or grad student or #) First-time offering. Course title, content, instructor and credit load vary.

**PubH 8801. Health-Services Policy Analysis: Theory.** (3 cr; A-F only. Prereq—Hsrp&a grad major or #) Integrated overview of U.S. health-services policy; theoretical and empirical literature related to this field. Analysis of alternative policy-making models and political and philosophical underpinnings of those models.

**PubH 8802. Health Services Policy Analysis: Applications.** (2 cr; A-F only. Prereq—Hsrp&a grad major or #) Emphasizes relationships between health services research and policy, and uses case studies to examine how research influences policy and vice versa.

**PubH 8803. Long-Term Care: Principles, Programs, and Policies.** (2 cr. Prereq—Grad-level health-care policy course or #)

Long-term care policy for functionally impaired persons, particularly the elderly. Team taught from healthcare and social services perspective; grounded in research literature on evidence of program effects. Innovative programs addressing current fragmentation of services.

**PubH 8805. Sociology of Health and Illness.** (3 cr; A-F only. Prereq—HSRP&A grad major or #)  
Affect of social structure on health outcomes/ behaviors. Current/historical events/issues from perspective of sociological/social psychological theories. Students apply theories to a topic they identify.

**PubH 8806. Sociology of Health Occupations and Organizations.** (3 cr. Prereq—HSRP&A grad major or #)  
Sociological theories of occupations/organizations as applied to health care. Functional, conflict, evolutionary theories applied to health care reorganization such as managed care, technology on organization of work/occupations. Emphasizes application of theories to develop hypotheses.

**PubH 8810. Research Studies in Health Care.** (3 cr [max 6 cr]; A-F only. Prereq—Grad student or professional school student or #)

Introduction to philosophy of science, conceptual modeling, experimental design, survey/sample design, and issues relevant to health services research.

**PubH 8811. Research Studies in Healthcare.** (3 cr; A-F only. Prereq—8810 or #)  
Research methods commonly used in analysis of health services research and health policy problems.

**PubH 8813. Measurement of Health-Related Social Factors.** (3 cr; A-F only. Prereq—Intro stat course, understanding of simple correlations or #)  
How social factors such as innovativeness, compliance, religiosity, and stress are measured and tested for reliability and validity. Relationships between theory, concepts, variables, data.

**PubH 8820. Health Economics I.** (3 cr; A-F only. Prereq—One course each in intermediate microeconomics, calculus, intro to linear algebra)  
Application of microeconomic theory to healthcare decisions of consumers and producers under different assumptions about market structure and behavior.

**PubH 8821. Health Economics II.** (3 cr; A-F only. Prereq—8820 or #)  
Examines application of microeconomic theory to health services research through selected reading from published and unpublished health economics literature.

**PubH 8830. Research Project in Health Care.** (1 cr; A-F only. Prereq—Hsrp&a grad major or #)  
Development and articulation of a research proposal.

**PubH 8831. Research Project in Health Care.** (1 cr; A-F only. Prereq—8830 or #)  
Development and articulation of a research proposal.

**PubH 8836. Integration of Public Health Research Methods in Health Services Research and Policy.** (2 cr. Prereq—Professional school or grad student or #)  
Integration of concepts/designs of public health research methods, how they can be integrated into health services research and policy analysis. Experiential learning opportunities in clinical settings that illustrate need for integration.

**PubH 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

**PubH 8893. Directed Study: Health Services Research, Policy, and Administration.** (1-3 cr [max 3 cr]. Prereq—HSRPA grad student, #)

**PubH 8894. Directed Research: Health Services Research, Policy, and Administration.** (1-8 cr [max 8 cr]. Prereq—HSRPA grad student, #)

## Radiology (Rad)

*Department of Radiology*

*Medical School*

**Rad 8100. Gastrointestinal Roentgenology.** (1-15 cr)

**Rad 8101. Urologic Roentgenology.** (1-15 cr)

**Rad 8102. Neurological Roentgenology.** (1-15 cr)

**Rad 8103. Cardiovascular Roentgenology.** (1-15 cr)

**Rad 8104. Pediatric Roentgenology.** (1-15 cr)

**Rad 8105. Pulmonary Roentgenology.** (1-15 cr)

**Rad 8150. Research: Roentgenology.** (1-15 cr)

**Rad 8200. Nuclear Medicine.** (1-15 cr)

**Rad 8210. Fundamentals of Nuclear Medicine.** (1 cr. Prereq—1st-yr resident)

**Rad 8250. Research: Nuclear Medicine.** (1-15 cr)

**Rad 8450. Research: Radiation Biology.** (1-15 cr)

**Rad 8550. Research: Radiological Physics.** (1-15 cr)

## Recreation, Park, and Leisure Studies (Rec)

*School of Kinesiology*

*College of Education and Human Development*

**Rec 5101. Foundations of Recreation.** (3 cr; A-F only. Prereq—Med or grad student or #)

Investigation of the rational, sociological, psychological, and philosophical foundations of the recreational use of leisure in contemporary society. Includes a survey of leisure services.

**Rec 5111. Sports Facilities.** (3 cr; A-F only. \$Kin 5111. Prereq—Kin or rec major or #)  
Steps in planning and building facilities for athletics, physical education, and sport for college, professional, and public use.

**Rec 5115. Event Management in Sport.** (3 cr; A-F only. Prereq—Grad student, #)  
Techniques/principles of planning, funding, and managing sport events. Collegiate championships, non-profit events/benefits, professional events.

**Rec 5161. Recreation Land Policy.** (3 cr; A-F only. Prereq—1501 or 5101 or #)  
Historical development of recreational land policy in the United States and related contemporary issues in policy, management, interpretation, and research.

**Rec 5191. Commercial Recreation and Tourism.** (3 cr; A-F only. Prereq—3551 or #)  
Scope and development of profit-oriented recreation agencies, including an emphasis on the tourism industry.

**Rec 5211. Introduction to Therapeutic Recreation.** (3 cr; A-F only. Prereq—1501 or ¶5101, rec major or #)  
Purposeful intervention; roles of specialist/recreation therapists in meeting cognitive, physical, emotional, social needs of people with disabling conditions through recreation services; roles of specialist/recreation therapists changing societal attitudes toward illness and disability and the self-concepts of individuals with impairments.

**Rec 5215. Assess and Monitor Patient/Client Functioning in Recreation Therapy.** (3 cr. Prereq—TR major or academic health professional or #; majors A-F only)  
Selecting appropriate techniques/tools, analysis of individual p/c supports/deficits. Monitoring/recording progress in RT and in collaborative services: standard notes; team meetings; on-line reporting for quality assurance, referral, augmentation/termination of services.

**Rec 5221W. Comprehensive Therapeutic Recreation Services Development and Management.** (4 cr. Prereq—5211 or #, rec major)

Guided development of written plans including development of protocols and critical pathways, intervention programs/activities, individual treatment plans and standards for appropriate placement of individuals in group intervention, and management of patient/client service delivery, record keeping, and administrative responsibilities.

**Rec 5231. Therapeutic Recreation and Diagnostic Groups.** (3 cr; A-F only. Prereq—5211 or #)  
Definitions, philosophies, methodologies regarding therapeutic recreation services for persons in diagnostic groups of cognitive, physical, sensory, communication, and psychiatric impairments/disabilities. Lectures, group discussion. Presentations by parents, professionals, and self-advocates. Clinical or community practicum assignment.

**Rec 5241. Functional Intervention: Recreation Therapy in Geriatric Care.** (3 cr; A-F only. Prereq—3541 or 5111 or #)

Role of leisure in maintenance of mental, physical, social-emotional health/functioning. Issues relative to prevention of impairment/disability. Rehabilitation, support of vital life involvement, effect on design/delivery of recreation services.

**Rec 5271. Community Leisure Services for Persons With Disabilities.** (3 cr; A-F only. Prereq—1501, rec major, or #)

Exploration and application of concepts and techniques of normalization and least restrictive environment strategies to leisure service delivery in inclusive community settings for a range of individuals with disabilities.

**Rec 5288. Grant Writing in Human Services.** (3 cr; A-F only)  
Identify, develop, and procure financial assistance for programs in human services, including education, recreation, and social programs. Skills and strategies for preparing and evaluating competitive proposals for grant support through federal agencies and private foundations or corporations.

**Rec 5301. Wilderness and Adventure Education.** (4 cr; A-F only)  
Rationale for, methods in applying wilderness/adventure education programs in education, recreation, corporate, human service settings. Emphasizes adventure/wilderness program management.

**Rec 5311. Programming Outdoor and Environmental Education.** (3 cr; A-F only)  
Methods, materials, and settings for developing and conducting environmental and outdoor education programs.

**Rec 5371. Sport and Society.** (3 cr; A-F only. Prereq—[3126, grad student] or #)  
Sport, sporting processes, social influences, systems, and structures that have effected and exist within/ among societies, nations, and cultures. Issues concerning social differentiation. Social concerns such as violence and honesty.

**Rec 5421. Sport Finance.** (3 cr; A-F only. Prereq—Grad student, #)  
Introduction to financial analysis in sport. Cash flow statements, budgeting issues, traditional/innovative revenue producing strategies available to sport organizations. Discussion, practical analysis of current market.

**Rec 5461. Foundations of Sport Management.** (3 cr; A-F only. Prereq—[Rec or Kin] student or #)  
Theories/techniques in administering/managing sport enterprises. Organizational theory/policy. Practical examples of sport management skills/strategies.

**Rec 5511. Women in Sport and Leisure.** (3 cr; A-F only. \$Kin 5511)  
Critically examines women's involvement in/contributions to sport, physical activity, and leisure.

**Rec 5601. Ethics in Sport Management.** (2 cr; A-F only. Prereq—Grad student, #)  
How we develop morally. Sport and perpetuation of violence in society. Moral reasoning. Moral/ethical conduct in sport. Historical, philosophical, and sociological perspectives. Critical reading, writing, discussion.

**Rec 5631. Programming and Promotion in Sport.** (3 cr; A-F only. Prereq—Grad student, #)  
Introduction to marketing concepts as they apply to sport industry. Consumer behavior, market research, marketing mix, corporate sponsorship, licensing concepts. Discussion, practical application.

**Rec 5801. Legal Aspects of Sport and Recreation.** (4 cr; A-F only. \$Kin 5801. Prereq—3551 or 5461 or #)  
Legal issues related to recreation, park, and sport programs/facilities with public/private sectors.

**Rec 5900. Special Topics: Contemporary Issues in Leisure Services.** (1-12 cr [max 12 cr])  
Contemporary issues emphasizing administrative and supervisory functions for recreation and allied professionals; individual offerings, to be determined by faculty, focus on special issues and professional groups.

**Rec 5981. Research Methodology in Kinesiology, Recreation, and Sport.** (3 cr; A-F only. \$Kin 5981. Prereq—MEd or grad student or #)  
Defines/reviews various types of research in exercise and sport science, physical education, and recreation studies. Qualitative research, field studies, and introspective research strategies as alternatives to traditional scientific paradigm.

**Rec 5992. Readings: Recreation.** (1-3 cr [max 9 cr]. Prereq—#)  
Independent study under tutorial guidance by a faculty member in leisure studies. Intended as an opportunity to conduct in-depth study and reading on particular topic(s) not covered in regular coursework.

**Rec 5995. Problems in Recreation, Park, and Leisure Studies.** (1-12 cr [max 30 cr]. Prereq—MEd or grad student or #)  
Independent study of leisure service programs, systems, facilities, or policies; focus on conduct of recreation programs. Intended for scholarly projects (e.g., library or field research) or demonstration projects in the field of leisure studies and services. Not intended for additional fieldwork, practicum, or programming experience.

**Rec 8310. Seminar: Leisure Services.** (3 cr; A-F only. Prereq—Rec MEd or grad student or #)  
Critical study and special problems in recreation, park, and leisure services and in therapeutic recreation.

**Rec 8320. Seminar: Theoretical Perspectives in Leisure Behavior.** (3 cr; A-F only. Prereq—5101 or #)  
Major theoretical paradigms and empirical findings, where appropriate, from leisure studies in particular and social sciences in general.

**Rec 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**Rec 8390. Seminar: Administrative Problems in Leisure Services and Therapeutic Recreation.** (3 cr; A-F only. Prereq—Rec MEd or grad student or #)  
Administrative and management issues and problems in leisure services and therapeutic recreation.

**Rec 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Rec 8980. Graduate Research Seminar in Recreation, Park, and Leisure Studies.** (1-3 cr; S-N only. Prereq—5981, EPsy 5261 or #)  
Analyzing, designing, and reporting on research problems in leisure studies.

**Rec 8995. Research Problems in Recreation, Park, and Leisure Studies.** (1-4 cr [max 16 cr]; S-N only. Prereq—#)  
Conducting individual scholarly research. Intended for M.A., Ph.D., or other graduate-level students with a major emphasis in recreation, park, and leisure studies. Not for working on an M.A. Plan A or Ph.D. thesis.

## Recreation Resource Management (RRM)

Department of Forest Resources  
College of Natural Resources

**RRM 5101. Natural and Heritage Based Tourism.** (3 cr; A-F only. Prereq—Grad student or #)  
Interaction of resource based tourism with cultural/natural environments. Impacts of tourism on environment.

**RRM 5232. Managing Recreational Lands.** (4 cr; A-F only. Prereq—Grad student or #)  
Recreation management tools from a public agency perspective. Social carrying capacity, recreation opportunity spectrum, limits of acceptable change, benefits based management, visitor experience/resource protection. Various projects. Group project to develop a management plan.

**RRM 5259. Visitor Behavior Analysis.** (3 cr; A-F only. Prereq—RRM major or NRES major or grad student or #)  
Application of social science theory/methods to recreation and resource-based tourism visitor behavior. Culture and cultural identity. Influences on behavior. Mitigating environmental impacts. Theory/analysis of surveys, observation, and content. Implications for sustainable resource management.

## Rehabilitation Science (RSc)

Department of Physical Medicine and Rehabilitation  
Medical School

**RSc 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**RSc 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**RSc 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**RSc 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**RSc 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

## Religions in Antiquity (RelA)

Department of Classical and Near Eastern Studies  
College of Liberal Arts

**RelA 5013. Biblical Law and Jewish Ethics.** (3 cr. \$3013, \$JwSt 3013, \$JwSt 5013)  
Significance of religious law in Judaism. Babylonian background of biblical law. Biblical creation of the person as a legal category. Rabbinic transformations of biblical norms. Covenant in Christianity/Islam. Contemporary Jewish literature/philosophy.

**RelA 5070. Topics in Ancient Religion.** (3 cr. Prereq—RelA 3071 or 3072 or 3073 or 5071 or 5073 or any RelS course or #)  
Study of a specific aspect of religion in Classical and Near Eastern antiquity such as healing cults, magic and divination, Gnosticism, or prophecy and authority. Topics specified in *Class Schedule*.

**RelA 5071. Greek and Hellenistic Religions.** (3 cr. \$3071, \$3171)  
Greek religion from the Bronze Age to Hellenistic times. Sources include literature, art, and archaeology. Homer and the Olympian deities; ritual performance; prayer and sacrifice; temple architecture; oracles; death and the afterlife; mystery cults; philosophical religion; Near Eastern salvation religions. Meets with 3071.

**RelA 5072. The New Testament.** (3 cr. \$3072, \$3172)  
Early Jesus movement in its cultural, historical setting. Origins in Judaism; Jesus traditions. Apostle Paul, his controversies and interpreters. Questions of authority, religious practice, structure; emergence of the canon. Contemporary methods of New Testament study; biblical writings as history and narrative. Meets with 3072.

**RelA 5073. Roman Religion and Early Christianity.** (3 cr. \$3073)  
Etruscan, Republican religion. Appeal of non-Roman cults. Ruler worship. Christians in Asia Minor, Egypt, and the West. Popular piety, Christian and non-Christian. Rabbinic Judaism. Varieties of Christianity in 2nd and 3rd centuries. Influence of Greco-Roman culture on emerging church. Constantine and Julian. Meets with 3073.

**RelA 5080. New Testament Proseminar.** (3 cr. Prereq—RelA 1082 or 3072 or equiv)  
Discussion seminar. Study of some specific aspect of the New Testament and related literature. Topics specified in *Class Schedule*.

**RelA 5088. Archaeology in Biblical Lands I: Old Testament Period.** (3 cr. \$3088)  
Archaeological data relevant to the Old Testament; major sites in the Holy Land and other areas of the Mediterranean and Near East. Evidence of pottery, inscriptions, manuscripts, and coins. Excavation methods. Archaeology as a tool for study of ancient religions. Meets with 3088.

**RelA 5089. Archaeology in Biblical lands II: New Testament Period.** (3 cr. \$3089)  
Archaeological data relevant to Jewish scriptures and New Testament; major sites in the Holy Land and other areas of the Mediterranean and Near East. Evidence of pottery, inscriptions, manuscripts, and coins. Excavation methods. Archaeology as a tool for study of ancient religions. Meets with 3089.

**RelA 5112. Jewish Mysticism, Magic, and Kabbalah.** (3 cr; A-F only)  
Mystical traditions from early rabbinic traditions to Zohar (Book of Splendor) in 13th century. Literature of heavenly ascent (Hekhalot, Merkavah), Book of Creation (Sefer Yetzirah), precursors of Zohar—the Bahir. Schools of Provence, Gerona, and Zohar. Tension between legal/mystical aspects, magical theurgic techniques, evolution of doctrine of Sefirot, mystical interpretation of Scripture, erotic dimension.

**RelA 5115. Mishnah and Midrash in Translation.** (3 cr)  
Jewish law studies as mirror of society and as way to actualize its value. Original socioreligious contexts, current applications. Selections include biblical interpretations addressing moral, theological, legal, and literary problems.

**RelA 5251. Archaeology of Herodian Israel.** (3 cr; A-F only. Prereq—One course in [archaeology or ancient history] or grad student)  
Archaeological sites in Israel dating to era of Herod the Great (37-4BC). Palaces, religious edifices, and remains from Jewish/gentile settlements throughout the kingdom. Course readings consist of contemporary literary sources and excavation reports.

**RelA 5503. History and Development of Israelite Religion I.** (3 cr. \$RelA 3503)  
Survey of the evolution of Israelite religion. Cultic practices, law and religion, prophecy, religion and historiography. Relationship to surrounding religious systems.

**ReIA 5504. Development of Israelite Religion II.** (3 cr)  
Ancient Judaism from the Persian restoration (520 B.C.E.) to Roman times (2nd century C.E.). Religious, cultural, and historical developments are examined to understand Jewish life, work, and worship under a succession of foreign empires: Persian, Greek, Roman.

**ReIA 5513. Scripture and Interpretation.** (3 cr; A-F only. \$JwSt 5513)

Idea of divine revelation, its impact upon religion/literature. How history of Bible's creation, transmission, and interpretation helps us think critically about role of idea of revelation in history of religious traditions. What is revelation? How does belief that a text is revealed affect the way it is read within the community for which it constitutes revelation?

**ReIA 5993. Directed Studies.** (2-4 cr [max 10 cr])  
Guided individual reading or study.

**ReIA 8190. Comparative Seminar in Religions in Antiquity.** (3 cr [max 6 cr]; A-F only. Prereq-Grad student in relevant field; reading knowledge of Greek or Latin or Coptic or Arabic recommended)

Topics vary, see *Class Schedule*. Major cultural movement as it developed over several centuries. Draws on evidence in literature, archival records, inscriptions, documentary papyri, and archaeological remains. Artistic media such as wall painting, architectural ornament, funerary sculpture, or manuscript illumination.

## Religious Studies (ReIS)

*Department of Classical and Near Eastern Studies  
College of Liberal Arts*

**ReIS 5111. Problems in Historiography and Representation of the Holocaust.** (3 cr. Prereq-JwSt 3521/ReIS 3521 (formerly 3541) History of the Holocaust or #)

An advanced course focusing on issues connected with the Holocaust. Inclusiveness of other groups, Holocaust versus "Shoah," historiographical conflicts about perpetrators, an examination of the problems of representation in literature and art, problems of narrative theology after Auschwitz.

**ReIS 5251. Archaeology of Herodian Israel.** (3 cr; A-F only. Prereq-One course in [archaeology or ancient history] or grad student)

Archaeological sites in Israel dating to era of Herod the Great (37-4BC). Palaces, religious edifices, and remains from Jewish/gentile settlements throughout the kingdom. Course readings consist of contemporary literary sources and excavation reports.

**ReIS 5993. Directed Studies.** (1-4 cr [max 24 cr])  
Directed studies in religion. Credits may vary from term to term to a limit of nine.

## Rhetoric (Rhet)

*Department of Rhetoric  
College of Agricultural, Food and Environmental Sciences*

**Rhet 5111. Message Design: Theory and Practice I.** (3 cr; A-F only. Prereq-Grad student or #)

Audience analysis, media selection, message design through various theoretical perspectives, including cognitive/schema, social construction, feminist, intercultural theories. Usability testing, contextual inquiry as means to study effectiveness of messages.

**Rhet 5112. Message Design: Theory and Practice II.** (3 cr; A-F only. Prereq-5111)

Political, economic, social, and technical aspects of media selection and message design. Media analyses, scripts, budgets, treatments, project-design plans, interactive screens. On-line design project.

**Rhet 5196. Internship in Scientific and Technical Communication.** (3-6 cr [max 6 cr]; S-N only. Prereq-STC grad or #)

Internship sites may include the University, industry, or government agencies. An internship proposal, progress report, internship journal (optional), and final report with a letter from the internship supervisor are required.

**Rhet 5258. Information-Gathering Techniques in Scientific and Technical Communication.** (3 cr; A-F only)

Informational, employment-cycle, and problem-solving interviews. Emphasizes guides, schedules, questioning techniques, and communication theories. Descriptive statistics used to analyze data for various projects.

**Rhet 5270. Special Topics.** (1-3 cr [max 3 cr]; A-F only. Prereq-[[STC or RSTC] [major or grad student]], #)  
Topics specified in *Class Schedule*.

**Rhet 5291. Independent Study.** (1-3 cr [max 3 cr]. Prereq-#, Δ)

Supervised reading/research on advanced projects not covered in regularly scheduled offerings.

**Rhet 5511. Research in Scientific and Technical Communication.** (3 cr; A-F only)

Experimental/survey research techniques for quantitative/qualitative methodologies in scientific/technical communication. Face-to-face, phone, focus group interviewing. Questionnaire development, contextual inquiry. Using rating, ranking, q-sort methods. Ethics, experimental bias, inferential statistical analysis.

**Rhet 5531. Scientific and Technical Communication Course Development and Pedagogy I.** (3 cr; A-F only. Prereq-Grad)

Pedagogical philosophy/methodology in beginning writing, speaking, and technical communication class. Introduction to theories underlying teaching/tutoring with technology.

**Rhet 5532. Scientific and Technical Communication Course Development and Pedagogy II.** (3 cr; A-F only. Prereq-5531 or #)

Pedagogical philosophy/methodology in advanced writing, technical communication, distance education courses. Introduction to theories of teaching in scientific/technical communicating/teaching with multimedia.

**Rhet 5533. Scientific and Technical Communication Course Development: Teaching Seminar.** (1 cr; A-F only. Prereq-5531 or 5532)

Mentor with faculty, usually concurrently with student's first teaching assignment. Students shares observations, solves teaching problems in seminar setting. Issues facing new teachers, developing a philosophy of teaching. Focuses on evaluating work in classroom.

**Rhet 5534. Designing Technical Training for Intercultural Audiences.** (3 cr; A-F only)

Select and research a training topic, write learning objectives and outcomes, set the conditions for learning, complete a comprehensive course outline, and one training module.

**Rhet 5562. Theory and Practice in International Business Communication.** (3 cr; A-F only. Prereq-3562 or equiv)

Theories and practice in international and intercultural scientific, technical, and business communication. Examine cultural differences by studying cultural metaphors and research studies, by interviewing people from other cultures including international business managers, and through case studies.

**Rhet 5664. Science Writing for Popular Audiences.** (3 cr; A-F only. Prereq-3562 or #)

How science is "translated" for popular audiences. Rhetorical theory used to critique popularized articles. Developing a heuristic for writing articles. Controversial issues surrounding movement from science as "science" to science as "popular."

**Rhet 5775. Major Figures in Rhetorical Tradition: Classical Period.** (3 cr; A-F only)

Classical theories of rhetoric. Epistemological status of rhetoric. Ethical implications of persuasion. Emphasizes "Aristotle's Rhetoric" as founding document. Other figures (e.g., Plato, Isocrates, Cicero, Quintilian).

**Rhet 5776. Major Figures in Rhetorical Tradition: Modern Era.** (3 cr; A-F only)

Aristotelian rhetoric in modern era. Francis Bacon, scientific revolution. George Campbell, rise of human sciences. Kenneth Burke, semiotics in 20th century. Perelman/Olbrechts-Tyteca, reconciliation with philosophy.

**Rhet 8011. Research Methods in Rhetoric and Scientific and Technical Communication.** (3 cr; A-F only. Prereq-STC/RSTC grad or #)

Quantitative/qualitative research methods. Theoretical perspectives that demonstrate/test analytical approaches to scientific/technological rhetoric.

**Rhet 8012. Applied Research Methods in Scientific and Technical Communication.** (3 cr; A-F only. Prereq-STC/RSTC grad student or #)

Methodological choices, arguments, and uses of data in case studies. Students design/conduct a pilot study and review/apply research methods, survey research, ethnographics, rhetorical/textual analysis, archival research, genre analysis, observational research, interviews, and descriptive statistics. Review responsibilities of conducting research.

**Rhet 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**Rhet 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**Rhet 8505. Design Project.** (5 cr; A-F only. Prereq-STC/RSTC grad student)

Extended problem-solving situation in business, government, or industry. Student acts as consultant to explore problem, identify possible solutions, introduce solution, apply it.

**Rhet 8510. Topics in Rhetorical Theory, History, and Criticism.** (3 cr [max 12 cr]; A-F only. Prereq-5775 or equiv)

Rhetorical theory in context of culture influenced by science/technology. Topics vary. See *Class Schedule*.

**Rhet 8520. Topics in Science and Rhetoric.** (3 cr [max 12 cr]; A-F only)

Doctoral seminar concerning relationship between rhetoric and science. Topics vary. See *Class Schedule*.

**Rhet 8530. Topics in Feminist Theory in Science, Technology, and Communication.** (3 cr [max 12 cr]; A-F only)

Doctoral seminar on interaction of gender with science/technology. Topics vary. See *Class Schedule*.

**Rhet 8540. Topics in Scientific and Technical Communication Pedagogy.** (3 cr [max 12 cr]; A-F only)

Doctoral seminar on theories of pedagogy/research studies that inform technical/scientific classroom/workplace. Topics vary. See *Class Schedule*.

**Rhet 8550. Topics in Technology and Culture.** (3 cr [max 12 cr]; A-F only)

Doctoral seminar on computer-mediated communication, democracy/technology, controversies over digital communication, privacy/ethical issues. Topics vary. See *Class Schedule*.

**Rhet 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Rhet 8775. Classical Rhetorical Theory.** (3 cr [max 12 cr]; A-F only)

Aristotle's "Rhetoric" in context of its times and of Aristotle's other works, especially "The Ethics" and "The Politics."

**Rhet 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Rhet 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer; 24 cr required)

**Rhet 8995. Special Problems in Rhetoric and Scientific and Technical Communication.** (1-3 cr [max 3 cr]. Prereq–#)

Research and readings on special problems or projects.

## Russian (Russ)

*Institute of Linguistics, ESL, and Slavic Languages and Literatures*

*College of Liberal Arts*

**Russ 5104. Introduction to Literary Analysis.** (3 cr. Prereq–3002 or equiv)

Reading and analysis of poetry and prose selections to understand rudiments of studying Russian literature. Readings are in Russian.

**Russ 5105. Russian Poetry and Prose.** (3 cr. Prereq–3002 or equiv)

Appreciation of literary values through stylistic analysis and literary interpretation; analysis of humanistic elements. Readings in Russian.

**Russ 5211. Modern Russian Literature in Translation.** (3 cr)

Literary, cultural, and political significance of modern Russian literary works.

**Russ 5404. Tolstoy in Translation.** (3 cr. \$3404)

Novels, stories, and philosophical writings of Leo Tolstoy.

**Russ 5407. Stories and Plays of Anton Chekhov in Translation.** (3 cr. \$3407)

Study of literary devices and themes in selected stories and major plays using the intrinsic approach.

**Russ 5409. 19th-Century Russian Novel.** (3 cr. \$3409)

The Russian realistic novel from origin to decline; social, political, and intellectual circumstances that led to its emergence as the dominant genre of the “age of realism” in Russia.

**Russ 5411. Dostoevsky in Translation.** (3 cr. \$3411)

Novels, stories, and other writings of Fyodor Dostoevsky.

**Russ 5421. Literature: Middle Ages to Dostoevsky in Translation.** (3 cr. \$3421)

Russian literature from about 1000 A.D. to mid-19th century; emphasizing writers of the first half of the 19th century.

**Russ 5422. Literature: Tolstoy to the Present in Translation.** (3 cr. \$3422)

Survey of Russian literature from mid-19th century to the present: realism, modernism, feminism and other trends.

**Russ 5601. Methods of Translating Fiction from Russian to English.** (3 cr. \$3601. Prereq–3102 or equiv)

Learning to appreciate a variety of literary styles through the experience of translation.

**Russ 5900. Topics in Russian Language, Literature, and Culture.** (1-4 cr. Prereq–1102 for language topics)

Variable topics in Russian language, literature, and culture.

**Russ 5993. Directed Studies.** (1-4 cr [max 16 cr]. Prereq–#, Δ, □)

Guided individual study.

## Russian Area Studies (RAS)

*Institute of International Studies*

*College of Liberal Arts*

**RAS 8333. FTE: Master's.** (1 cr; NGA. Prereq–Master's student, adviser and DGS consent)

**RAS 8777. Thesis Credits: Masters.** (1-18 cr [max 50 cr]; NGA. Prereq–Max 18 cr per semester or summer; 10 cr total required [Plan A only])

## Sanskrit (Skt)

*Department of Classical and Near Eastern Studies*

*College of Liberal Arts*

**Skt 5001. Beginning Sanskrit.** (3 cr)

Introduction to the classical language of ancient India.

**Skt 5002. Beginning Sanskrit.** (3 cr. Prereq–5001 or equiv)

Introduction to the classical language of ancient India

**Skt 5201. Intermediate Sanskrit.** (3 cr. Prereq–5002 or equiv)

Readings in Sanskrit literature.

**Skt 5202. Intermediate Sanskrit.** (3 cr)

Readings in Sanskrit literature.

**Skt 5710. Topics: Language and Literature.** (3 cr. Prereq–#)

Selected reading and/or study of linguistic problems in Sanskrit.

**Skt 5992. Directed Readings.** (3 cr. Prereq–5202 or equiv)

Guided individual reading or study.

**Skt 8993. Directed Studies.** (1-12 cr [max 30 cr])

## Scandinavian (Scan)

*Department of German, Scandinavian, and Dutch*

*College of Liberal Arts*

**Scan 5202. Scandinavian Romanticism.** (3 cr)

Study of Scandinavian literature (poetry, drama, and prose), 1800 -1870. Texts in the original languages.

**Scan 5501. Scandinavian Mythology.** (3 cr)

Study of Scandinavian mythology based on primary sources represented by *Saxo Grammaticus*, Snorri Sturluson's *Edda and Ynglinga Saga*, and the *Poetic Edda*. Myths are analyzed using contemporary critical approaches. All readings in translation.

**Scan 5502. The Icelandic Saga.** (3 cr)

Study of the sagas written in 13th-century Iceland. Discussion includes cultural and historical information about medieval Iceland and analysis of a selection of saga texts using contemporary critical approaches. All readings in translation.

**Scan 5613. Contemporary Scandinavian Literature.** (3 cr)

An investigation of issues which emerged as extremely important after 1945 in Scandinavia, as articulated by writers and analyzed by researchers in social sciences. All readings in translation.

**Scan 5615. Ibsen and the Beginnings of Modern Drama.** (3 cr)

Close reading of Ibsen's “modern tragedies” from *A Doll's House* (1879) to *When We Dead Awaken* (1899). Focus is on the dialectics between Ibsen and his society, and dramatic structure and staging conventions in the context of modern theater. Readings in English for nonmajors.

**Scan 5616. Strindberg and the Drama in Revolt and Change.** (3 cr)

Strindberg as the master of naturalistic drama and the precursor of modernity in European and American theater. Close reading of plays with emphasis on dramatic structure and staging conventions in the context of modern theater. All readings in English for nonmajors.

**Scan 5670. Topics in Scandinavian Studies.** (3 cr [max 9 cr])

Topic may focus on a specific author, group of authors, genre, period, or subject matter. Topics specified in *Class Schedule*. Readings in English for nonmajors. May meet with 3670.

**Scan 5701. Old Norse Language and Literature.** (3 cr)

Acquisition of a reading knowledge of Old Norse; linguistic, philological and literary study of Old Norse language and literature.

**Scan 5702. Old Norse Saga Reading and Analysis.** (3 cr. Prereq–5701 or equiv reading knowledge of Old Norse)

Reading and analysis of Old Norse prose narratives, including close reading and discussion of the critical literature about the prose narratives and medieval Icelandic culture. All primary texts read in Old Norse.

**Scan 5703. Old Norse Poetry.** (3 cr. Prereq–5701 or equiv reading knowledge of Old Norse)

Reading and analysis of either eddic poetry from the Poetic Edda or skaldic poetry. Texts read in Old Norse.

**Scan 5704. History of the Scandinavian Languages.** (3 cr)

Investigation of the development of the Scandinavian languages from the earliest periods to the present.

**Scan 5711. Structure of the Scandinavian Languages.** (3 cr. Prereq–Introductory course in linguistics or #)

Investigation of the philological, grammatical, and lexical systems of the Scandinavian languages.

**Scan 5993. Directed Studies.** (1-4 cr [max 12 cr]. Prereq–#, Δ, □)

Guided individual reading and study.

**Scan 8002. Introduction to Scandinavian Studies.** (3 cr)

Introduction to history of Scandinavian studies, to field of Scandinavian studies as an integral area with particular disciplines, and to study of Scandinavian languages, literatures, and cultures. Integrated sections on Scandinavian bibliography.

**Scan 8500. Seminar in Medieval Scandinavian Languages and Literature.** (3 cr [max 9 cr])

Sample topics: *Volsunga Saga*, studies in Snorri Sturluson's *Edda*, dialogue analysis in the Icelandic saga.

**Scan 8510. Seminar in Scandinavian Linguistics.** (3 cr [max 9 cr])

Selected problems in synchrony and diachrony of the Scandinavian languages (e.g., history or structure of Scandinavian languages).

**Scan 8610. Seminar in Scandinavian Drama.** (3 cr [max 9 cr])

Sample topics: dilemma of representation in modern drama, epic theater.

**Scan 8630. Seminar in Scandinavian Criticism.** (3 cr [max 9 cr])

Sample topics: feminist theory in Scandinavia, writing literary history in Scandinavia.

**Scan 8702. Philological Proseminar II: History of Germanic Philology.** (3 cr; A-F only)

Introduction to history and development of Germanic philology from 1800 to the present. See Ger 8701.

**Scan 8975. Scandinavian Immigrant Languages and Literatures.** (3 cr)

Introduction for graduate students in Scandinavian and related fields to research opportunities. Sources and methodology.

**Scan 8994. Directed Research.** (1-3 cr [max 12 cr]. Prereq–#, Δ; may be taken as tutorial with #)

## Scientific Computation (SciC)

### Institute of Technology

**SciC 8001. Parallel High-Performance Computing.** (3 cr. Prereq—Undergrad degree in field using sci comp or #)

Interdisciplinary overview of computer science aspects of scientific computation, both hardware and techniques. Parallel computing, architectures, programming, and algorithms; restructuring compilers and data structures.

**SciC 8011. Scientific Visualization.** (3 cr.

Prereq—Undergrad degree in field using sci comp or #) Basic issues in scientific visualization, visualization software, graphics, representation of scientific data, modeling, hardware for visualization, user interface techniques, output, commonly used algorithms and techniques for visualization, animation, information visualization, higher dimensional data, case studies, and examples of successful visualizations.

**SciC 8021. Advanced Numerical Methods.** (3 cr.

Prereq—Undergrad degree in field using sci comp or #) Interdisciplinary overview of advanced numerical methods of scientific computation, emphasizing computational aspects. Approximation methods for partial differential equations, numerical linear algebra, sparse matrix techniques, iterative methods, solution of eigenvalue problems, and case studies.

**SciC 8031. Modeling, Optimization, and Statistics.** (3 cr. Prereq—Undergrad degree in field using sci comp or #)

Interdisciplinary overview of mathematical modeling, optimization, and statistics techniques for scientific computation. Nonlinear equations and nonlinear optimization, statistics, control theory, modeling, and simulation.

**SciC 8041. Computational Aspects of Finite Element Methods.** (3 cr. Prereq—Undergrad degree in field using sci comp or IT grad student or #)

Fundamental concepts and techniques of finite element analysis. Variational equations and Galerkin's method; weak formulations for problems with nonsymmetric differential operators; Petrov-Galerkin methods; examples from solid and fluid mechanics; properties of standard finite element families, implementation.

**SciC 8095. Problems in Scientific Computation.** (1-3 cr [max 9 cr]. Prereq—Undergrad degree in field using sci comp or #)

Selected topics in interdisciplinary aspects of scientific computing.

**SciC 8190. Supercomputer Research Seminar.** (1 cr [max 3 cr]. Prereq—Undergrad degree in field using sci comp or #)

Series of seminars by distinguished lecturers.

**SciC 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**SciC 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**SciC 8594. Scientific Computation Directed Research.** (1-4 cr [max 9 cr]. Prereq—Undergrad degree in field using sci comp or #)

**SciC 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**SciC 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**SciC 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

## Slavic (Slav)

### Institute of Linguistics, ESL, and Slavic Languages and Literatures

#### College of Liberal Arts

**Slav 5900. Topics in Slavic Languages and Literatures.** (3 cr)

Topics specified in *Class Schedule*.

## Social, Administrative, and Clinical Pharmacy (SACP)

### College of Pharmacy

**SACP 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser approval, DGS approval)  
Directed research

**SACP 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser approval, DGS approval)  
Directed research

**SACP 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Doctoral student who has not passed prelim oral)

**SACP 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Plan A)

**SACP 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA)

## Social and Administrative Pharmacy (SAPh)

### Department of Pharmacy Practice

#### College of Pharmacy

**SAPh 8054. Advanced Studies in Pharmaceutical Care Practice.** (4 cr; A-F only)

Analyzing practice/implementation of pharmaceutical care. Student confront their assumptions about pharmacy profession, pharmacy practice, and pharmaceutical care. Discussions, guest speakers, intensive literature searches/evaluation.

**SAPh 8100. Seminar.** (1 cr [max 8 cr]. Prereq—Grad SAPh major or #)

Contemporary issues and research problems in sociobehavioral pharmacy, pharmacoconomics and policy, and clinical research.

**SAPh 8173. Principles and Methods of Implementing Research.** (3 cr. Prereq—Two grad stat courses)

Integrates scientific, statistical, and practical aspects of research. Interrelationships among design, sample selections, subject access, human subjects requirements, instrument selection and evaluation, data management, analyses plans, grant writing, and research career issues. Field experiences.

**SAPh 8200. Research Problems.** (1-8 cr [max 16 cr]. Prereq—Grad SAPh major or #)

Individually designed research experience directed at contemporary problems related to drug use process.

**SAPh 8235. Pharmaceutical Economics and Policy.** (3 cr; A-F only. Prereq—Grad SAPh major or #)

Economic analysis of pharmaceutical sector of health care systems. Problems of pricing production and distribution of pharmaceuticals. Domestic or international policy issues relevant to price and access of pharmaceuticals.

**SAPh 8255. Pharmaceutical Marketing.** (3 cr; A-F only. Prereq—Grad SACP major or #)

Historical development of distributive systems, marketing channels, institutions, policies, and

practices as they relate to pharmaceutical industry. Contemporary issues/theory related to pharmaceutical marketing. Pharmaceutical proportion, especially directed to consumer advertising.

**SAPh 8270. Clinical Conferences.** (2 cr. Prereq—Grad SAPh major or #)

**SAPh 8420. Social and Behavioral Aspects of Pharmacy Practice.** (3 cr; A-F only. Prereq—Grad SAPh major or #)

Historical development of the profession, its growth and development, emphasizing forces of education, professionalization, attitude modification, and changes occurring as a product of legal and organizational forces in society.

**SAPh 8500. Pharmacy and Its Environment.** (3 cr; A-F only. Prereq—Grad SAPh major or #)

Cultural foundations of pharmacy. Development of present state of pharmacy practice. Role of pharmacist as health practitioner in relation to other health practitioners. Identification of factors (health policy, regulation, economics, research and development, promotion) that affect individual responses to drug therapy.

**SAPh 8700. Hospital Pharmacy Administration.** (3 cr; A-F only. Prereq—Grad SAPh major or #)

History, classification, organization, and functions of hospital departments in relation to the pharmacy service.

**SAPh 8702. Hospital Pharmacy Survey.** (1 cr [max 3 cr]. Prereq—Grad SAPh major or #)

Readings for self-directed students to explore contemporary issues in hospital pharmacy practices.

**SAPh 8810. Social Psychology of Health Care.** (2 cr. Prereq—Grad SAPh major or #)

Behavioral and social aspects of recovery responses to drugs and other therapies, patients' compliance with prescribed therapies, relationships between healthcare professional and patient.

**SAPh 8840. Social Measurement.** (3 cr; A-F only.

Prereq—Intro stat course, understanding of simple correlations or #)

How social factors such as innovativeness, compliance, religiosity, and stress are measured and tested for reliability and validity. Relationships between theory, concepts, variables, data.

## Social Work (SW)

### School of Social Work

#### College of Human Ecology

**SW 5051. Human Behavior and the Social Environment.** (2-3 cr; A-F only. Prereq—Grad student or 8 cr social sciences or #)

Social, psychological, biological, and cultural factors of individual and group development as applied to social work practice. Behavior and life-cycle development focusing on diversity and each stage of life. Discuss development in terms of the individual, and in terms of overlapping social systems such as the multigenerational family, culture, community, and society.

**SW 5052. Ecologies of Child Development Within Communities of Color.** (3 cr. Prereq—Grad or #)

Examine social, affective, and cognitive development of children of color via a life course, ecological systems framework. Family, school, peers, and community are studied as ecological contexts which influence developmental trajectories for these children and youth. Attention is given to poverty, racism, and oppression.

**SW 5101. Historical Origins and Contemporary Policies and Programs in Social Welfare.** (3-4 cr; A-F only. Prereq—Grad or 8 sem cr of social sciences)

Contemporary policies and programs in social welfare are examined in light of their historical origins and evolution. A framework is then developed for analysis of concepts and principles in contemporary social policy for social welfare programs and services. The emergence of the profession of social work also examined.

**SW 5105. Women and Public Policy.** (3 cr)

Study of feminist organizations; issues and conflicts within organizations and movements; methods and sources for studying feminism.

**SW 5107. Child Development and Social Policy.** (3 cr. Prereq–Grad or #)

Examine the intersection of conceptual orientations of developmental psychology with policies that affect children and families. Demographic, historic, and social trends underlying the assumptions that drive policies directed at women and children; projections of future policies.

**SW 5309. Case Management with Special Populations.** (3 cr. Prereq–Grad or adult special or #)

Examine concepts and principles of case management practice with special populations such as older adults, persons with developmental disabilities, and persons with serious and persistent mental illness. The core functions of case management practice in a range of settings are addressed in relationship to issues of diversity, vulnerability, and empowerment.

**SW 5313. Social Work with Older Adults.** (2 cr. Prereq–Grad or adult special or #)

The practice components of social work with older adults including assessment, intervention, and case management. Taught from the perspective of biopsychosocial strengths and challenges and within the context of current social policy and delivery systems.

**SW 5314. Social Work in the Schools.** (2 cr. Prereq–Grad or adult special or #)

Application of social work methods in a school setting. Emphasizes assessment, diagnosis, consultation, advocacy, interdisciplinary team building, and crisis intervention.

**SW 5315. Social Work Practice in Hospitals and Health Care Settings.** (2 cr. Prereq–Grad or adult special or #)

Prepares students for social work practice in a hospital or health care setting. Focus on integration of conceptual and practice subject matter that covers differential assessment, clinical intervention models, impact of acute and chronic illness, special populations, managed care, legal and ethical issues, interdisciplinary team work, and transition planning in health care.

**SW 5316. Brief Treatment and the Task-Centered Approach.** (2 cr. \$8303. Prereq–Grad or adult special or #)

The advent and current prominence of brief treatment models in work with individuals, families, and groups including their theoretical and empirical bases. Practice with diverse populations in a context of managed care. Emphasis on the task-centered approach including skill training and supervised practice.

**SW 5317. Social Work With Involuntary Clients.** (2 cr. Prereq–Grad or adult special or #)

Includes theory, ethics, effectiveness, and intervention methods for work with client systems that experience involuntary contact with a social worker. Interventions at micro, mezzo, and macro levels are included. Practice in varied settings such as child welfare, mental health, corrections, and public schools as well as practice related to organizational responses to change.

**SW 5318. Family Centered Home Based Services.** (2 cr. \$8314. Prereq–Grad or adult special or #)

Ecological, multisystems approach focusing on the family system. Triadic theory, meta-neutrality, strengths-focus, case management and team treatment. Family-based services evaluated for high-risk, multi-problem families and as an alternative to foster placement.

**SW 5319. Adolescents: Norms, Culture, and Health.** (2 cr)

Relationships among familial, social, societal, political, economic, environmental, psychosocial, and cultural determinants of adolescent behavior that affect health; major public health issues and problems of adolescents.

**SW 5481. Child Abuse Prevention I: Research and Theory.** (3 cr. Prereq–Bachelor's degree or #)

Foundation of research/theory for level I child abuse prevention studies certificate.

**SW 5482. Child Abuse Prevention II: Program Development, Evaluation, and Advocacy.** (3 cr. Prereq–5481)

Design and evaluation of policies and programs of interventions to prevent child abuse. This is the second course in the Level I Child Abuse Certificate program.

**SW 5483. Child Abuse Prevention III: Skill Building I—Cultural and Legal Issues.** (3 cr. Prereq–Bachelor's degree or #)

Risk factors, protective factors, resilience in cultural settings. Identifying/designing strategies appropriate to cultural characteristics. First course for level II child abuse prevention certification.

**SW 5484. Child Abuse Prevention IV: Skill Building II—Risk Assessment and Interviewing.** (3 cr. Prereq–Bachelor's degree or #)

Designing instruments for child abuse risk assessment. Culturally/ethnically competent interviewing. Ethnographic interviewing. Strengths-based ecosystemic assessment. Strategies for evaluating interventions. Second course for level II child abuse prevention certification.

**SW 5519. Mediation and Conflict Resolution.** (2 cr. \$8519)

Develop mediator skills for making informed decisions regarding the appropriateness of mediation for conflicts that frequently confront social worker practitioners such as divorce, neighborhood disputes, conflicts between parents and adolescents, conflicts between spouses, and conflicts between crime victims and offenders.

**SW 5525. Global Perspectives on Social Welfare, Peace, and Justice.** (3 cr. Prereq–2001 or #)

Role of international social welfare in meeting basic human needs and promoting human rights, social justice, and peace. Theories, models, and social policies in different economic and political systems with emphasis on Third World nations.

**SW 5705. Violence in Families.** (3 cr. \$5707.

Prereq–Grad student or adult special or #) Prevention/intervention with perpetrators, survivors, and social institutions. Perpetration, effects on victims, social responses to family violence. Child abuse/neglect. Abuse of women/vulnerable adults. Roles of gender, race, culture, age, physical ability, and sexual orientation.

**SW 5706. Issues and Interventions in Child Sexual Abuse.** (2 cr. Prereq–Grad student or adult special or #)

Major issues/interventions in child sexual abuse. Working with sexually abused children and their families. Perceptions of victims, non-offending parents, perpetrators, and other family members. Interviewing. Justice system. Child protection.

**SW 5707. Interventions with Battered Women and Their Families.** (2 cr. \$5705. Prereq–Grad or adult special or #)

Current theories, research, and evaluation of interventions with battered women and their families. Focus on practice, e.g., direct work with social institutions, victim-survivors, and assailants and their families.

**SW 5708. Substance Abuse and Social Work.** (3 cr. Prereq–Grad or adult special or #)

Assessment and intervention in situations involving substance abuse with special emphasis on cross cultural practice. Relationships of substance abuse to areas such as child welfare, mental illness, and violence within families are examined.

**SW 5709. Applied Psychopharmacology for Human Service Professionals.** (2 cr; A-F only)

Categories of psychoactive drugs. Medications to treat mental disorders. Legal drugs such as alcohol, nicotine, cocaine, and marijuana. What is occurring physiologically when someone takes a psychoactive drug.

**SW 5711. Co-Occurring Addictive and Mental Health Disorders.** (2 cr; A-F only. Prereq–Cannot be taken for cr by MSW students)

Mentally ill, chemically abusive, or dependent clients. Intervention, advocacy, education, and support for client and those who are part of his or her environment. Social, environmental, and multicultural factors. Meets partial state requirements for becoming licensed as an alcohol/drug counselor.

**SW 5810. Seminar: Special Topics.** (1-4 cr [max 10 cr])

Topics specified in *Class Schedule*.

**SW 5811. Social Work Ethics.** (2 cr. \$8801. Prereq–Grad student or adult special or #)

Acquire knowledge base and develop skills required to identify ethical issues, resolve ethical dilemmas, and make ethical decisions within the context of the professional practice of social work. Values base and ethical standards of the profession and ethical decision-making models examined in-depth.

**SW 5813. Child Welfare and the Law.** (2 cr. Prereq–2nd yr MSW or advanced standing or #)

Social work practice in juvenile court. Child abuse/neglect reporting laws, risk assessment, reasonable efforts, case plan, custody proceedings, permanency planning, termination of parental rights, child testimony, social worker testimony, adoption laws.

**SW 5991. Independent Study in Social Work.** (1-4 cr [max 4 cr])

Independent study in areas of special interest to students and faculty.

**SW 8010. Seminar: Field Practicum I.** (1-8 cr [max 8 cr]; S-N only. Prereq–8201)

Integrates classroom learning with direct experience of a social work field internship. Professional support/learning groups focus on student-and facilitator-identified issues. Students discuss professional/personal biases, ethical dilemmas, and supervisory issues. Cross-cultural understanding, implications of cross-cultural practice.

**SW 8020. Field Practicum II.** (1-6 cr [max 6 cr]; S-N only. Prereq–8010)

Integrates classroom learning within a concentration with the direct experience of an internship. Students expand competency in cross-cultural practice.

**SW 8030. Advanced Standing Social Work Practicum.** (1-8 cr [max 8 cr]; S-N only. Prereq–Adv standing)

Integrates classroom learning with direct experience of a social work field internship. Professional support/learning groups discuss issues raised in field placement. Groups focus on professional/personal biases, ethical dilemmas, supervisory issues, cross-cultural sharing, and implications of students' privilege/power in relation to client systems.

**SW 8041. Specialized Field Placement.** (3-4 cr; S-N only. Prereq–8030, MSW adv-standing)

Internship within an agency or a specific population. Applied practical experience in specialized concentration area of practice.

**SW 8051. Psychopathology and Social Work Practice.** (3 cr. Prereq–All foundation courses for full program or advanced standing or #)

Psychopathology from ecosystemic perspective. Biopsychosocial influences on incidence, course, treatment of common mental disorders diagnosed from infancy through adulthood. Differential effects on populations at risk. Diagnostic skills, alternative intervention strategies, social work roles.

**SW 8101. Social Policy and Delivery Systems for Child Welfare and Family Services.** (3 cr. Prereq–[8211, advanced standing] or #)

Federal, state, and local policies related to contemporary child welfare system and system of social services to families. Current debates about policies, financing, and structure and organization of service delivery; process of influencing policy changes in children and family services.

**SW 8103. Health and Mental Health Policy.** (3 cr. Prereq-[8211, advanced standing] or #) Factors affecting health and mental health status of variety of populations. Policies on organizational, local, state, and federal levels affecting health status; financing; and delivery of health and mental health services. Ethical issues embedded in policies, issues in need of policy development.

**SW 8105. Economic Security of Disadvantaged Populations.** (3 cr. Prereq-[8211, advanced standing] or #) Impact of social policy and macro economic trends on economic security of disadvantaged populations. Focuses on antipoverty/welfare programs in the United States, although international perspective is used as well.

**SW 8150. Special Topics in Social Policy.** (1-9 cr [max 9 cr]. Prereq-#)

**SW 8201. Social Work Methods: Practice With Individuals and Systems.** (3 cr; A-F only. Prereq-MSW student) Introduction to theories, knowledge, values, skills in initial phases of social work practice. Practice phases: assessment, goal setting, contracting, intervention, treatment. Developing relationships, interviewing skills in practice with diverse populations. Ecological problem-solving framework from empowerment orientation.

**SW 8202. Social Work Methods: Practice With Families and Groups.** (3 cr; A-F only. Prereq-8201 or #) Intervention theories, roles, methods, evaluation in practice with families/groups. Continues ecological problem-solving framework from 8201.

**SW 8211. Macro Social Work Practice and Policy Advocacy.** (3 cr; A-F only. Prereq-5101 or #) Policy analysis, development, implementation, community development, social action, social planning. Ecological, problem-solving, empowerment perspectives, policy/methods. Theories of organizational/community development/change.

**SW 8301. Advanced Child Welfare Practice.** (3 cr. Prereq-All foundation courses for full program or advanced standing or #) Child welfare policies. Use of multisystemic interventions. Impact of poverty, race, ethnicity, and gender on policy/practice. Developments in family preservation, relative placement, foster care, adoptions, and Indian child welfare. Role of social work in child protection services.

**SW 8303. Advanced Mental Health Practice With Adults.** (3 cr. Prereq-8051 or #8051 or all foundation courses for full program or advanced standing or #) Theory/practice of cognitive, cognitive-behavioral, and psychodynamic social work treatment in community/clinical settings. Criteria for differential applications, including brief treatment and crisis-oriented approaches. Cultural/social aspects of mental health, issues important to populations at risk.

**SW 8304. Advanced Practice With Children and Adolescents.** (3 cr. Prereq-All foundation courses for full program or advanced standing or #) Practice with children, adolescents, and their families. Ecosystemic model that undergirds assessment/intervention. Mastery of developmental tasks and enhanced social functioning as protective mechanisms. Biopsychosocial focus. Integrates familial/community contributions, especially in face of loss or disruption.

**SW 8313. Professional Practice in Interdisciplinary Teams and Collaboratives.** (3 cr. Prereq-[Foundation curriculum, [advanced standing or grad student in health and human service or in educational professional program]] or #) Principles of interdisciplinary/interorganizational collaboration in human services, health, and educational settings. Team building, decision-making models, engaging value differences, managing conflict on team, role/status disparities, relational communications. Emerging approaches to interorganizational collaboration.

**SW 8314. Social Work Interventions With Families.** (3 cr. \$5318. Prereq-Adv standing or 8202 or #) Interventions based on systems perspective of family as center of focus, in environmental context. Policy/practice principles of working with families in their home, community environment.

**SW 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**SW 8411. Life-Cycle Therapy.** (2 cr. Prereq-Advanced standing or 8202 or #) Strength-based approach to client treatment grounded in Erik H. Erikson's theory of the life cycle. Model explicitly considers differences in environmental supports and in "healthy" outcomes, based on culture, race, gender, sexual orientation, spiritual belief, and age. Focus on maximizing health and remediating disorders.

**SW 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**SW 8460. Special Topics: Practice With Individuals, Families, and Groups.** (1-3 cr [max 9 cr]. Prereq-8201 or #) Advanced practice courses.

**SW 8501. Planning, Marketing, and Program Development.** (3 cr. Prereq-[Foundation curriculum, advanced standing] or #) Principles, applied practice of management concepts in human service settings. Management theories, organizational planning, program development, marketing/communications. Management practice that is client/community-focused, results-oriented, and seeks to achieve positive social change.

**SW 8502. Resource Development and Management.** (3 cr. Prereq-[Foundation curriculum, advanced standing] or #) Procuring/managing financial resources in social work settings. Principles of philanthropy. Fund raising, grant writing, preparing/monitoring budgets, interpreting basic financial reports. Management information systems, accountability requirements.

**SW 8503. Personnel Leadership and Management.** (3 cr. Prereq-[Foundation curriculum, advanced standing] or #) Skills/principles in effective leadership. Legal/strategic considerations in personnel management. Workplace diversity. Selection, hiring, and development of paid/unpaid staff. Evaluation, compensation, and benefits. Promotions and staff termination. Management of work groups and collaboratives.

**SW 8505. Advanced Community Organization and Advocacy.** (3 cr. Prereq-[Foundation curriculum, advanced standing] or #) Methods for stimulating/supporting joint action for constructive change to fulfill community needs. Principles of working with local organizations. Social action to accomplish specific changes.

**SW 8507. Community Practice Seminar.** (1 cr. Prereq-[Foundation curriculum, advanced standing] or #) Links content from human services management and from community organization and advocacy. Integrating framework that draws upon knowledge/skills used in agency/organizational management and in community organization/change.

**SW 8519. Mediation and Conflict Resolution for Social Workers.** (3 cr. \$5519. Prereq-MSW student or grad conflict mgmt minor or #) Advanced mediator skills for social workers; appropriateness of mediation for conflicts that frequently confront social work practitioners, such as divorce, neighborhood disputes, and conflicts between parents and adolescents, between spouses, and between crime victims and offenders.

**SW 8525. Global Perspectives on Social Welfare, Peace, and Justice.** (3 cr. Prereq-[8211, advanced standing] or #) Role of international social welfare in meeting basic human needs and promoting human rights, social justice, and peace. Theories, models, and strategies of social welfare in different economic/political systems.

Emphasizes Third World nations. Skills for social workers and other professionals in the helping professions.

**SW 8601. Social Work Research Methods.** (3 cr; A-F only. Prereq-MSW student or #) Introduction to quantitative and qualitative social work research skills fundamental to development and critical use of information relevant to social work practice decision-making and evaluation at case, program, policy levels. Social research ethics, development of research questions, sampling, measurement, research design, data collection and analysis.

**SW 8602. Direct Practice Evaluation.** (2 cr. Prereq-8601 or equiv or #) Students design evaluations that incorporate current evaluation methods and principles derived from research, theory, practice wisdom, their own experience. Evaluation methods include single-system designs, client-focused evaluations, practitioner-focused evaluations, and use of event analyses, standardized instruments, self-constructed instruments.

**SW 8603. Program Evaluation.** (2 cr. Prereq-8601 or equiv or #) Conceptual, methodological, political, psychological, and administrative factors related to conduct and consequences of social work program evaluation. Social programs as cause and effect; models, types, and strategies of evaluation; appraisal of selected research literature.

**SW 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer, doctoral student who has not passed prelim oral)

**SW 8693. Directed Study.** (1-6 cr [max 6 cr]. Prereq-#) Independent study under tutorial guidance.

**SW 8694. Directed Research.** (1-6 cr [max 6 cr]. Prereq-#) Individual or small group research inquiry translating introductory course content into research design and study. Projects may be conducted in conjunction with field learning experiences or other coursework.

**SW 8702. Advanced Social Work Practice With Diverse Populations.** (2 cr. Prereq-All foundation courses for full program or advanced standing or #) Models of ethnic-sensitive social work practice applied in human service management or direct practice settings. Critical examination of human needs and organizational responses to racially and culturally competent practice with populations at risk.

**SW 8801. Social Work Ethics and Legal Issues.** (3 cr. \$5811. Prereq-Foundation courses or adv standing or #) Develops knowledge base and skills required to identify and understand legal and ethical issues, resolve ethical dilemmas, and make ethical decisions within social work. Values base, ethical standards, ethical decision-making models, and laws and legal procedures related to social work. Legal aspects of child welfare practice.

**SW 8803. Social Work Supervision, Consultation, and Leadership.** (3 cr. Prereq-Foundation courses or advanced standing or #) Principles, practices, and models of supervision in human service systems: administrative, educational, and supportive functions. Organizational leadership and mediation skills. Contextual factors that influence supervisory role and function. Principles and methods of teamwork, staff development, and consultation.

**SW 8851. History of Social Work and Historical Research Methods.** (3 cr. Prereq-Required research courses for soc work PhD student; equiv research methods courses for other grad students) Methods of historical research in, and survey of, history and evolution of social welfare and social work, using primary and secondary source materials.

**SW 8855. Social Policy Formulation and Analysis.** (3 cr. Prereq-Soc wk PhD student or #) Application of theoretical perspectives, conceptual frameworks, and research methodologies to analysis of social issues and analysis and formulation of social welfare policy.

**SW 8861. Theory and Model Development in Social Work.** (3 cr. Prereq–Soc wk PhD student or #)  
Intervention research methods and contemporary social work practice models. Practice models studied include direct intervention in variety of systems from individual to community. Theoretical, value, empirical foundations of contemporary practice models examined through lens of intervention research.

**SW 8863. Social Work Teaching Methods and Educational Issues.** (3 cr. Prereq–Soc wk PhD student or 2nd-yr MSW student or #)  
Teaching methods, skills, strategies, and issues related to teaching, scholarship, and service roles in context of social work education. Familiarizes students with current issues, including curriculum development. Includes concurrent teaching experience in a social work class.

**SW 8871. Social Work Research Seminar I.** (3 cr. Prereq–Soc wk PhD student or #)  
First of two required Ph.D. seminars. Students review and expand their knowledge of basic concepts and methods of social research; current issues and controversies in social science and social work research and knowledge development. Development of research questions, sampling, measurement, data collection strategies in qualitative and quantitative research.

**SW 8872. Social Work Research Seminar II.** (3 cr. Prereq–8871 or #)  
Additional topics: methodologies and design of quasi-experiments, surveys, descriptive research, grounded theory, and analysis of quantitative and qualitative data.

**SW 8875. Research Practicum.** (2 cr [max 6 cr]; S-N only. Prereq–Soc wk PhD student or #)  
Experience in conduct of research, following completion of 8871 and 8872. Students work under faculty direction.

**SW 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer, 24 cr required)

## Sociology (Soc)

Department of Sociology  
College of Liberal Arts

**Soc 5090. Topics in Sociology.** (1-3 cr. Prereq–1001 or #)  
Topics specified in *Class Schedule*.

**Soc 5091. Independent Study.** (1-4 cr. Prereq–#)  
Independent study of an established 5xxx course.

**Soc 5301W. Social Movements.** (3 cr. Prereq–# for undergrads; 3301 or #)  
Origins, dynamics, and consequences of social movements. Dilemmas and challenges facing movement organizations. Relationship among movements, parties, and states and role of movements in bringing about change. Case studies of civil rights, labor, environmental, women's, gay rights, and student movements.

**Soc 5455. Sociology of Education.** (3 cr. Prereq–1001 or equiv or #)  
Structures and processes within educational institutions. Links between educational organizations and their social contexts, particularly as these relate to educational change.

**Soc 5811. Intermediate Social Statistics.** (4 cr. Prereq–3811 or equiv)  
Measurement, theory of probability, and bivariate statistics. Focus on multiple regression analyses of sociological data. Primarily for first-year sociology graduate students who need preparation for advanced social statistics. Undergraduates preparing for graduate programs may register upon availability.

**Soc 8001. Sociology as a Profession.** (1 cr; S-N only. Prereq–Grad soc major)  
Sample topics: role of sociology in society, professional organizations, employment opportunities, professional ethics, and writing for publication or grant proposals.

**Soc 8011. Sociology of Higher Education: Theory and Practice.** (3 cr. Prereq–Grad soc major or #)  
Social/political context of teaching. Ethical issues, multiculturalism, academic freedom. Teaching skills (e.g., lecturing, leading discussions). Active learning. Evaluating effectiveness of teaching. Opportunity to develop a syllabus or teaching plan.

**Soc 8090. Topics in Sociology.** (1-4 cr. Prereq–#)  
Topics specified in *Class Schedule*.

**Soc 8091. Independent Study.** (1-5 cr. Prereq–#)  
Independent study of an established 8xxx course.

**Soc 8093. Directed Study.** (1-4 cr. Prereq–#)

**Soc 8094. Directed Research.** (1-4 cr. Prereq–#)  
May be used to fulfill sociology graduate requirement for advanced methodological training.

**Soc 8101. Sociology of Law.** (3 cr)  
Sociological analysis of law and society. In-depth review of research on why people obey the law, of social forces involved in creation of law (both civil and criminal), procedures of enforcement, and impact of law on social change.

**Soc 8111. Criminology.** (3 cr)  
Overview of theoretical developments and empirical research. Underlying assumptions, empirical generalizations, and current controversies in criminological research.

**Soc 8148. Law, Society, and the Mental Health System.** (3 cr; A-F only. Prereq–[Grad student, 4148] or #)  
Intensive survey of psychopathology. Reference to criminal behavior, criminal justice system.

**Soc 8190. Topics in Law, Crime, and Deviance.** (3 cr [max 12 cr]. Prereq–Grad student in sociology or #)  
Advanced topics in law, crime, and deviance. Social underpinnings of legal/illegal behavior and of legal systems.

**Soc 8201. Social Stratification and Mobility.** (3 cr. Prereq–3811 or equiv or #)  
Form and content of hierarchical arrangements. Relationship of hierarchy to social order and individual behavior. Structures of social stratification. Status attainment. Mobility. Inequality and economic development, social development, and technological change. Economic status in relation to social status, including race, gender.

**Soc 8211. Race Relations Theory.** (3 cr)  
Major theoretical debates. Classic and contemporary theoretical approaches to studying U.S. race relations; contemporary and historical experiences of specific racial and ethnic groups.

**Soc 8221. Sociology of Gender.** (3 cr)  
Organization, culture, and dynamics of gender relations and gendered social structures. Sample topics: gender, race, and class inequalities in the workplace; women's movement; social welfare and politics of gender inequality; theoretical and methodological debates in gender studies; sexuality; science; sociology of emotions.

**Soc 8290. Topics in Social Stratification.** (3 cr)  
Comparative perspectives on racial inequality; race, class, and gender; quantitative research on gender stratification; stratification in post-communist societies; institutional change and stratification systems; industrialization and stratification. Topics specified in *Class Schedule*.

**Soc 8311. Political Sociology.** (3 cr)  
Social dimensions of political behavior and social origins of different forms of the state. How various theoretical traditions—Marxist, Weberian, and feminist—address key issues in political sociology, including citizenship, revolution, state formation, origins of democracy, welfare state, and fascism.

**Soc 8333. FTE: Master's.** (1 cr; NGA. Prereq–Master's student, adviser and DGS consent)

**Soc 8390. Topics in Political Sociology.** (3 cr)  
Topics with common focus on social underpinnings of political behavior and political change. Sample topics: democracy and development, international legal and political systems, power and protest in advanced capitalist states, xenophobia and international migration, and civil society and democracy. Topics specified in *Class Schedule*.

**Soc 8411. Research on Formal Organizations.** (3 cr)  
Theories of the structure of and behavior in corporations and bureaucracies. Corporate structure from standpoint of role expectations, transaction costs, and structural responses to organizational failures. Power, conflict, and bargaining in organizational decision making. Course content varies.

**Soc 8421. Work and Occupations.** (3 cr)  
Sociological analysis of work, occupations, and labor markets, including contemporary theory and research. Course emphasis varies with instructor.

**Soc 8444. FTE: Doctoral.** (1 cr; NGA. Prereq–Doctoral student, adviser and DGS consent)

**Soc 8490. Advanced Topics in Social Organization.** (3 cr. Prereq–#)  
Content varies with instructor. Sample topics: gender and organizations, interorganizational relations, comparative study of organizations, nonprofit organizations, consumer behavior, industry and technology, social networks, conflict, coercion, and social exchange. Topics specified in *Class Schedule*.

**Soc 8501. Sociology of the Family.** (3 cr)  
Theoretical and empirical works from contemporary family sociology. Content varies with instructor. Sample topics: definitions of the family, family roles, family interactions, marriage and divorce, child-bearing, parenthood, and cultural variations in families.

**Soc 8540. Topics in Family Sociology.** (3 cr)  
Families and mental health; families, work, and the labor market; historical/comparative research on the family. Topics specified in *Class Schedule*.

**Soc 8551. Social Structure and the Life Course.** (3 cr. Prereq–Soc grad major or #)  
Central concepts/premises of life course analysis as applied to intersocietal (comparative); intrasocietal (socioeconomic status, race, gender); and historical variability. Institutional patterning of life course (family, education, work, polity). deviance and criminal careers. changes in the self. methodological strategies.

**Soc 8590. Topics in Life Course Sociology.** (3 cr)  
Sociology of aging, sociology of youth, and mental health and adjustment in early life course. Topics specified in *Class Schedule*.

**Soc 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq–Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Soc 8701. Sociological Theory.** (4 cr; A-F only. Prereq–Grad soc major or #)  
Traditions of social theory basic to sociological knowledge, their reflection and expansion in contemporary theory, their applications in selected areas of empirical research. Sample topics: social inequality, social organization and politics, family organization and social reproduction, social order and change, sociology of knowledge and religion.

**Soc 8711. Theories of Social Organization.** (3 cr)  
Key frameworks and theories, structure and process, micro and macro levels of analysis. Empirical literature on major substantive issues related to work, gender, and race; politics and social movements; and post-industrialization and technological change. World systems theory.

**Soc 8721. Theories of Social Psychology.** (3 cr)  
Prominent contemporary theories of sociological social psychology, including structural (social structure and personality) perspectives, social relationships and small group processes (exchange, equity, expectation states theories), and symbolic interactionism. Classical writings, theoretical statements, and empirical studies.

**Soc 8725. Sociological Theory Construction.** (3 cr.

Prereq-Δ)  
Structure of social scientific theories, basic tools for developing/critiquing them. Types of theoretical statements, concept formation, operationalization, testability. Contrasts goals/methods of different theoretical perspectives.

**Soc 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Soc 8790. Advanced Topics in Sociological Theory.** (3 cr)

Sample topics: theories of conflict, theories of purposive action, Marxist theory, and structure-agency debate.

**Soc 8801. Sociological Research Methods.** (4 cr; A-F only. Prereq—Grad soc major or #)

Multiple objectives of social research and how they inform research design. Conceptualization and measurement of complex concepts. Broad issues in research design and quantitative and qualitative approaches to data collection and management.

**Soc 8811. Advanced Social Statistics.** (4 cr; A-F only. Prereq—5811 or equiv, grad soc major or #)

Statistical methods for analyzing social data. Sample topics: advanced multiple regression, logistic regression, limited dependent variable analysis, analysis of variance and covariance, log-linear models, structural equations, and event history analysis. Applications to datasets using computers.

**Soc 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

**Soc 8890. Advanced Topics in Research Methods.** (3-4 cr. Prereq—Grad soc major, 8801, 8811 or #)

Advanced quantitative methods (e.g., multilevel models) and historical/comparative, field, and survey research. Topics specified in *Class Schedule*.

## Software Engineering (SEng)

*Department of Computer Science  
Institute of Technology*

**SEng 5115. Graphical User Interface Design, Evaluation, and Implementation.** (3 cr; A-F only. Prereq—Grad SEng major)

Design and evaluation of interactive application interfaces, user- and task-centered approaches to design, guidelines for graphical design, interface evaluation techniques, current interface trends, including web interfaces and information visualization. Group projects that include designing, prototyping, and implementing an application interface.

**SEng 5116. Graphical User Interface Toolkits.** (2-3 cr; A-F only. Prereq—Grad SEng major)

Toolkit-centered introduction to GUI implementation technology. Students learn to use a GUI toolkit to implement a graphical application. Introduction to advanced techniques, including constraint-based data management, 3D visualization tools, and toolkit structure and design.

**SEng 5131. Network Programming: Distributed Objects.** (3 cr; A-F only. Prereq—Grad SEng major)

Java programming, concurrent programming, workflow, distributed database, security, collaborative computing, object-oriented architecture/design, network publishing, messaging architecture, distributed object computing, and intranet.

**SEng 5199. Topics in Software Engineering.** (3 cr [max 6 cr]; A-F only. Prereq—SEng grad student)

Topics specified in *Class Schedule*.

**SEng 5511. Artificial Intelligence.** (3 cr; A-F only.

Prereq—Grad SEng major)  
Introduces ideas and theories of AI. Problem solving, search, inference techniques. Logic and theorem proving. Knowledge representation, rules, frames, semantic networks. Planning and scheduling. Introduces Lisp programming language.

**SEng 5551. Introduction to Intelligent Robotic Systems.** (3 cr; A-F only. Prereq—Grad SEng major)

Transformations, kinematics and inverse kinematics, dynamics, and control. Sensing (robot vision, force control, tactile sensing), applications of sensor-based robot control, robot programming, mobile robotics, and micro-robotics.

**SEng 5707. The Principles of Database Systems.** (3 cr; A-F only. Prereq—Grad SEng major)

Fundamental concepts; conceptual data organization; data models; data manipulation languages; database design; security and integrity; performance evaluation; query optimization; distributed database systems.

**SEng 5708. Object-Oriented Databases.** (2-3 cr; A-F only. Prereq—Grad SEng major)

Applications and motivation; extended relational, object-relational, and object-oriented data models; object identifier, types and constructors; versions and schema evolution; query language (recursion, path expressions, etc.); object indices, buffer management and other implementation issues; triggers, rules, complex objects, and case studies.

**SEng 5801. Software Engineering I: Software Life Cycle, Requirements Specification, and Design.** (3 cr; A-F only. Prereq—Grad SEng major)

Developing cost-effective software. Software engineering lifecycles, problem specification/analysis, system design techniques, documentation. Lectures, project.

**SEng 5802. Software Engineering II: Advanced Software Engineering.** (3 cr; A-F only. Prereq—Grad SEng major)

Topics in software engineering and in object-oriented software development. Software design/implementation using UML, object-oriented techniques, object-oriented languages such as Java. Lectures, project.

**SEng 5811. Software Testing and Verification.** (2 cr; A-F only. Prereq—5801, grad SEng major)

Theoretical/practical aspects of testing software. Analyzing a requirements document for test conditions. Writing a test plan. Designing, creating, and executing test cases. Recording defects. Writing a test report.

**SEng 5831. Software Development for Real-Time Systems.** (2-3 cr; A-F only. Prereq—Grad SEng major)

Analysis, design, verification, and validation of real-time systems. Periodic, aperiodic, and sporadic processes, scheduling theory. Pragmatic issues.

**SEng 5841. Formal Modeling and Analysis in Software Engineering.** (2 cr; A-F only. Prereq—Grad SEng major)

Formal specification of software artifacts; applicability of formal specifications; introduction to methods such as Z, SCR, and Statecharts. Formal analysis techniques; basic theorem proving; reachability analysis techniques; model checking; introduction to tools such as PVS, Statemate, SPIN, and SMV.

**SEng 5851. Software Project Management.** (3 cr; A-F only. Prereq—Grad SEng major)

Concepts used to manage software projects. Project management cycle: initiation, planning/control, status reporting, review, post-project analysis. Leadership and motivation strategies. Lecture, discussion, individual/team presentations/projects.

**SEng 5852. Quality Assurance and Process Improvement.** (3 cr; A-F only. Prereq—Grad SEng major)

Theory and application of capability maturity model: process assessment, modeling, and improvement techniques. Life cycle issues related to development and maintenance; quality, safety, and security assurance; project management; and automated support environments. Group projects and case studies.

**SEng 5899. Software Engineering Seminar.** (1-3 cr

[max 12 cr]; A-F only. Prereq—Grad SEng major, #)  
Software engineering trends. Talks by invited speakers, selected readings.

**SEng 5900. Directed Study.** (0.5-3 cr; A-F only)

Directed study/research in software engineering. Topics/scope decided in collaboration with instructor.

**SEng 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**SEng 8494. Capstone Project (Plan B Project).** (3 cr; S-N only. Prereq—SEng major)

Students work in teams on software project using tools, techniques, and skills acquired during previous coursework. Each team works with a client to establish requirements, agree upon design, and achieve a successful acceptance test of resulting software system.

## Soil Science (Soil)

*Department of Soil, Water, and Climate  
College of Agricultural, Food and Environmental Sciences*

**Soil 5111. Practicum Internship in Precision Agriculture.** (2-5 cr; S-N only. Prereq—#)

Practical experience in precision agriculture in agri-industry/business. Content and extent of work at the internship site is jointly decided by the instructor, host business representative, and student's principal adviser.

**Soil 5125. Soil Science for Teachers.** (3 cr)

Basic physical, chemical, and biological properties of soil. Soil genesis classification and principles of soil fertility. WWW used for lab. Soil survey information used to make a land-use plan. Similar to 2125 with less emphasis on chemistry.

**Soil 5211. Environmental Biophysics and Ecology.** (2 cr; A-F only. Prereq—[[Biol 1009 or equiv], Math 1271, Phys 1101, [upper div or grad student]] or #)

Basic concepts of environmental variables such as temperature, humidity, wind, and radiation. Mechanics of heat/mass transfer between a living organism and its surrounding environment. Set of practical examples to integrate concepts and transport processes.

**Soil 5212. Environmental Biophysics and Ecology Laboratory.** (1 cr; A-F only. Prereq—Biol 1009, Math 1271, Math 1282, Phys 1101)

Introduces experimental techniques in environmental biophysics and ecological studies. Measuring biophysical parameters of plants, animals, and their surrounding environments. Defining/describing physical status of a living organism, determining the rate of mass/energy exchange.

**Soil 5232. Vadose Zone Hydrology.** (3 cr. Prereq—[Math 1271 or equiv], [Phys 1042 or equiv])

Basic soil physical properties/processes governing transport of mass/energy in soils. Emphasizes water/solute transport through unsaturated root/vadose zones, their impact on subsurface hydrology and on water quality. Lectures, hands-on laboratory exercises, discussion of real world problems, problem solving.

**Soil 5311. Soil Chemistry and Mineralogy.** (3 cr. Prereq—[[Chem 1022 or equiv], Phys 1102, grad] or #)

Structural chemistry, origin/identification of crystalline soil clay minerals. Structure of soil organic matter. Chemical processes in soil: solubility, adsorption/desorption, ion exchange, oxidation/reduction, acidity, alkalinity. Solution of problems related to environmental degradation, plant nutrition, and soil genesis.

**Soil 5312. Soil Chemistry and Mineralogy Laboratory.** (2 cr. Prereq—#5311 recommended)

Companion laboratory 5311. Clay mineral preparation for x-ray diffraction, selective mineral dissolution, cation exchange properties, absorption and solubility reactions and their modeling, carbonate equilibria, and organic matter extraction and identification.

## South Asian Languages and Cultures (SALC)

*Department of Asian Languages and Literatures  
College of Liberal Arts*

**SALC 5011. Indo-Aryan Linguistics.** (3 cr)  
Phonological, morphological, and syntactic developments; Indo-European, Old Indo-Aryan, Middle Indo-Aryan, Hindi, and other major modern Indo-Aryan languages.

**SALC 5090. Instruction in South Asian Languages.** (3-5 cr)  
Individualized instruction in one of the South Asian languages.

**SALC 5201. Ancient Indian Literature in Translation.** (3 cr)  
Literary achievements of Indian civilization from the ancient period.

**SALC 5202. Modern Indian Literature in Translation.** (3 cr)  
Literary achievements of Indian civilization from the modern period.

**SALC 5204. Folklore of India.** (3 cr)  
A study of the main genres of Indian folklore—folk tales, folk songs, folk epics, folk dramas, proverbs, and riddles—their relationship to Indian society and inter-relationship with literary traditions, both great and small.

**SALC 5411. Introduction to Indian Philosophy.** (3 cr)  
Major concepts; principal schools of Indian philosophy; traditional and contemporary views.

**SALC 5412. Hinduism.** (3 cr)  
Development of Hinduism focusing on sectarian trends, modern religious practices, myths and rituals, pilgrimage patterns and religious festivals, and the interrelationship between Indian social structure and Hinduism.

**SALC 5413. Buddhism.** (3 cr)  
Historical account of Buddhist religion in terms of its rise, development, various schools, and common philosophical concept. Indian Buddhism compared with Hinduism; Buddhism's demise and revival on the Indian subcontinent.

**SALC 5414. Comparative Religions of South Asia.** (3 cr)  
Compares and contrasts basic philosophical concepts, literatures, ideologies, and ritualistic practices of Hinduism, Buddhism, and Jainism with those of Islam and Sikhism.

**SALC 5456. The Cinema of India.** (3 cr)  
Survey of cinema of South Asia; aesthetic, social, economic, and political perspectives.

**SALC 5500. Problems in Indian Philosophy.** (3 cr)  
Prereq—3411 or 3412 or 3413 or 5411 or 5412 or 5413  
An introduction to Indian philosophy emphasizing analyses of mind and knowledge.

**SALC 5521. Gandhi and Non-Violent Revolution.** (3 cr)  
Character of Gandhi, his influence over contemporaries, and his hold on the world today.

**SALC 5556. Women in India: Role and Repression.** (3 cr)  
Representation of Indian women studied through literature of contemporary Indian women and against background of traditional Indian values and roles.

**SALC 5710. Seminar in South Asian Languages.** (4-5 cr)  
Selected topics on South Asian languages; no knowledge of South Asian languages required.

**SALC 5720. Seminar in South Asian Literature.** (4-5 cr)  
Selected topics on South Asian literature.

**SALC 5730. Seminar in South Asian Culture.** (4-5 cr)  
Selected topics on South Asian cultures.

**SALC 5833. India's Gods and Goddesses.** (3 cr)  
Indian history examined by following development of the deities Krishna, Shiva, and Kali.

**Soil 5402. The Atmospheric Boundary Layer.** (3 cr)  
Prereq—Math 1271, Phys 1201, Stat 3011  
Calculus-based introduction to the atmospheric boundary layer (ABL), the interface between the earth's surface and the atmosphere. Topics include ABL development and turbulence, surface energy balance, ABL clouds, air quality, microclimate, and observational and modeling methods.

**Soil 5421. Introduction to Atmospheric Science.** (3 cr [max 3 cr])  
Prereq—Math 1271, Phys 1201, Stat 3011  
Calculus-based, introductory description of the atmosphere including atmospheric dynamics, radiation, thermodynamics, chemical composition, and cloud processes. Discuss applications to climate, meteorology, the hydrologic cycle, air quality, and biogeochemical cycles.

**Soil 5515. Soil Genesis and Landscape Relations.** (3 cr; A-F only)  
Prereq—2125 or #)  
Basic soil morphology and soil profile descriptions; pedogenic processes and models of soil development; soil geomorphology, hydrology, and hillslope processes; digital spatial analysis; soil classification; soil surveys and land use; soil geography.

**Soil 5532. Soil Morphology and Mapping.** (2 cr; A-F only)  
Prereq—2125)  
Soil genesis, landscape interpretation, soil mapping. Describing soil properties. Creating mapping legends by sampling. Landscape interpretation for describing soil variability. Geographic information systems. Interpretation of aerial photography and topographic maps. Students delineate hillslope/geomorphic elements and prepare a soil map. Involves full days working in field, physical exertion.

**Soil 5555. Wetland Soils.** (2-3 cr; A-F only)  
Prereq—1125 or 2125 or equiv or #; #4511 recommended)  
Morphology, chemistry, hydrology, formation of mineral/organic soils in wet environments. Soil morphological indicators of wet conditions, field techniques of identifying hydric soils for wetland delineations. Peatlands. Wetland benefits, preservation, regulation, mitigation. Field trips, lab, field hydric soil delineation project.

**Soil 5601. Principles of Waste Management.** (3 cr; A-F only)  
Prereq—1125 or 2125, Biol 1002/1009 or Chem 1021, Stat 3011, ApEc 1101 or #)  
Waste and waste management principles. Issues, problems, and solutions in remedying waste stream. MSW and yard waste composting. WTE incineration operation, ash disposal, recycling, land fill requirements, direct land disposal, regulatory trends, and case studies.

**Soil 5611. Soil Biology and Fertility.** (3 cr)  
Prereq—2125, Biol 1009 or equiv, Chem 1021 or equiv, sr or grad, BioC 3xxx, MicB 3xxx recommended)  
Soil microbial populations and biodiversity. Soil microorganisms. Biogeochemical cycles. Macro and micronutrient fertilization, and element function in plants and microbes. Composts, sludge and manures in fertilization. Plant microbe associations: nitrogen fixation, mycorrhizal fungi, and biological control of root pathogens. Pollution and bioremediation.

**Soil 5711. Forest Soils.** (2 cr)  
Prereq—1125 or 2125)  
Factors affecting tree growth; estimation, modification, and management effects on site productivity; regeneration.

**Soil 8005. Supervised Classroom or Extension Teaching Experience.** (2 cr)  
Prereq—#)  
Teaching experience in one of five departments: Biosystems and Agricultural Engineering; Agronomy and Plant Genetics; Horticultural Science; Soil, Water, and Climate; or Plant Pathology. Participation in discussions about effective teaching to strengthen skills and develop a personal teaching philosophy.

**Soil 8110. Colloquium in Soil Science.** (1-3 cr [max 6 cr]; S-N only)  
Research or intellectual areas in soil science or climatology not covered in regular courses. Topics vary; contact department for current offerings.

**Soil 8123. Research Ethics in the Plant and Environmental Sciences.** (0.5 cr; S-N only)  
Prereq—Enrolled in a plant/environmental sci grad research prog)

History/values relating to research and scholarship. Social responsibility, reporting misconduct. Authorship. Plagiarism. Peer review. Copyright, intellectual property. Conflicts of interest. Research data management. Fiscal responsibility, management. Environmental health/safety. Research involving humans/animals. Mentorship. Presentations by faculty and invited speakers. Meets during first seven weeks of spring semester.

**Soil 8128. Seminar in Soils.** (1 cr [max 2 cr]; S-N only)  
Students present an open seminar on an advanced topic and attend seminars presented by other graduate students.

**Soil 8195. Research Problems in Soils.** (1-5 cr [max 10 cr])  
Prereq—[Grad major in soil sci or related field], #)  
Directed research on special topics of interest in soil science or climatology supervised by individual or small groups of faculty.

**Soil 8252. Advanced Soil Physics.** (2 cr; A-F only)  
Prereq—[5232, differential equations] or #)  
Advances in measurements/modeling of soil physical properties/processes as they relate to water, solute, heat movement in soils. Measuring/estimating hydraulic/thermal properties. Scaling, media concepts. Applying fractals. Analytical/numerical solutions of non-steady state heat/water flow equations. Analytical solutions of diffusion-dispersive equation for solute movement. Spatial variability in soil physical properties/processes.

**Soil 8282. Modeling Water, Carbon, and Nitrogen Dynamics in the Soil-Plant-Air System.** (3 cr; A-F only)  
Integrative/quantitative treatment of dynamics of water, carbon, and nitrogen in soil-plant-air continuum.

**Soil 8333. FTE: Master's.** (1 cr; NGA)  
Prereq—Master's student, adviser and DGS consent)

**Soil 8444. FTE: Doctoral.** (1 cr; NGA)  
Prereq—Doctoral student, adviser and DGS consent)

**Soil 8510. Advanced Topics in Pedology.** (2-4 cr [max 12 cr]; A-F only)  
Prereq—5515)  
Sample topics: soil-landscape relations, soil genesis, landscape evolution, land use and management, precision agriculture, digital terrain modeling, forest soils.

**Soil 8541. Aquatic and Soil Chemistry.** (3 cr; A-F only)  
Prereq—5311 or CE 4541)  
Physical chemical principles, geochemical processes controlling chemical composition of natural waters, soil/sediment-water interactions. Emphasizes behavior of inorganic contaminants in natural waters, engineered systems, dissolved natural organic matter.

**Soil 8550. Teaching Experience.** (1 cr [max 6 cr]; S-N only)  
Prereq—Grad major in soil sci or related field, #)  
Provides students with practical experiences in instructional techniques in a university setting.

**Soil 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA)  
Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Soil 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA)  
Prereq—Max 18 cr per semester or summer; 10 cr total required (Plan A only))

**Soil 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA)  
Prereq—Max 18 cr per semester or summer; 24 cr required)

**SALC 5993. Directed Studies.** (1-5 cr. Prereq-#, Δ, □) Guided individual reading and study of topics not covered in regular courses. Open to qualified students for one or more semesters.

**SALC 5994. Directed Research.** (1-5 cr. Prereq-#, Δ, □) Directed research on topics of language, literature, or civilization selected by qualified students with consent of instructor and studied on tutorial basis.

**SALC 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**SALC 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**SALC 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**SALC 8710. Seminar: South Asian Languages, Literatures, and Cultures.** (1-5 cr. Prereq-#)  
Topic specified in *Class Schedule*.

**SALC 8720. Seminar: Interdisciplinary Study of South Asian Topics.** (1-5 cr. Prereq-#)  
Selected Indian topics: language problems, social structure, social and cultural change, law, and religion, as seen from a variety of social science and humanities disciplinary perspectives.

**SALC 8730. Teaching South Asian Languages, Literatures, and Cultures.** (1-5 cr. Prereq-#)  
Fundamentals of language instruction as applied to South Asian languages and literatures. Materials preparation and teaching of specific languages to a controlled group.

**SALC 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**SALC 8790. Research.** (1-5 cr. Prereq-#)

**SALC 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

## Spanish (Span)

Department of Spanish and Portuguese Studies  
College of Liberal Arts

**Span 5106. The Literature of the Reconquest and Feudal Spain.** (3 cr. Prereq-Three 3xxx or 5xxx literature courses in Spanish)

The major literary genres developed in Spain from the Reconquest to 1502, with reference to the crucial transformations of the Middle Ages, including primitive lyric, epic, clerical narrative, storytelling, debates, collections, chronicles, "exempla," and the *Celestina* (1499-1502).

**Span 5107. The Literature of the Spanish Empire and Its Decline.** (3 cr. Prereq-Three 3xxx or 5xxx literature courses in Spanish or Portuguese)

Major Renaissance and Baroque works of the Spanish Golden Age (16th- and 17th-century poetry, nonfiction prose, novel, drama) examined against the historical background of internal economic decline, national crisis, and ideological apparatus developed by the modern state.

**Span 5108. Don Quixote.** (3 cr. Prereq-Three 3xxx or 5xxx literature courses in Spanish or Portuguese)  
Analysis of Cervantes' *Don Quixote* in its sociohistorical context; focus on the novel's reception from the romantic period to postmodern times.

**Span 5109. The Crisis of the Old Regime: Spanish Literature of the Enlightenment and Romanticism.** (3 cr. Prereq-Three 3xxx or 5xxx literature courses in Spanish or #)

Major literary works and intellectual movements and conflicts represented in written culture, of the 18th and early 19th centuries (1680-1845), examined as expressions of the long crisis of Spain's Old Regime and the rise of bourgeois liberalism.

**Span 5110. Discursive Formations at the Threshold of 20th-Century Spain.** (3 cr. Prereq-Three 3xxx or 5xxx literature courses in Spanish or #)

Theory and representative examples of the realist/naturalist novel (Galdós, Pardo Bazán) in the context of its antecedents ("costumbrismo"), opposites (the idealist/sentimental novel), and turn-of-the-century innovations of modernism and the "generation of 1898."

**Span 5111. Contemporary Spanish Literature Since 1915.** (3 cr. Prereq-Three 3xxx or 5xxx literature courses in Spanish or #)

Major literary works and movements in Spain from 1915 to 2000. Neomodernism; surrealism; social realism; literatures of dictatorship and exile; postmodernism. Poetry, novel, drama, essays, film, video/TV; problems of literary history.

**Span 5221. Spanish Drama in Performance: 17th-Century Comedia.** (3 cr. Prereq-Three 3xxx or 5xxx literature courses in Spanish or Portuguese)

Major dramatists of the Spanish comedia (e.g., Cervantes, Lope, Tirso, Calderón). Traditional genres such as tragedy, farce, interludes or auto sacramentales and problems of honor, blood purity, free will, city vs. country, and poetic justice examined against the background of cultural and social history.

**Span 5234. Feminism and Literature in Spain.** (3 cr. Prereq-Three 3xxx or 5xxx literature courses in Spanish or Portuguese or #)

Spanish feminist thought and practice; literature, cultural discourse, literary and critical theory.

**Span 5272. Hispanic Modernism.** (3 cr. Prereq-Three 3xxx or 5xxx literature courses in Spanish or Portuguese)  
Critique of artistic and literary production in Hispanic cultures from mid-19th century to present. Modernity and modernization in Hispanic world. "Generation of 1898." Castilian, Catalán, and Latin American practices along interdisciplinary and comparative lines.

**Span 5316. Spanish Picaresque Narratives.** (3 cr. Prereq-Three 3xxx or 5xxx literature courses in Spanish or Portuguese)

Major picaresque narratives—*Lazarillo*, *Guzmán*, *Buscón*, Cervantes' *Picaros*, *Estebanillo González*—in relation to Spanish ambience, Western tradition, European novel, realism. Literary autobiography, episodic structure, themes of roguery, delinquency, sin, marginality, social criticism, moral preoccupations. Comparison to European counterparts.

**Span 5525. Caribbean Literature: An Integral Approach.** (3 cr. Prereq-Three [3xxx or 5xxx] literature courses in Spanish or #)

Literature of Spanish-speaking Caribbean. Emphasizes historical legacy of slavery, African culture, and independence struggles.

**Span 5526. Creole Consciousness and Mercantilist Culture.** (3 cr. Prereq-Three 3xxx or 5xxx literature courses in Spanish)

Discourse production in Spanish America between 1492 and 1700. Conquest and colonial writing and counterwriting; historical origin and evolution and the impact of cultural, political, and socioeconomic factors.

**Span 5527. National Literary Consciousness and Free Trade.** (3 cr. Prereq-Three 3xxx or 5xxx literature courses in Spanish)

Literary movements as part of the process of forming nation-states in Spanish America.

**Span 5528. Popular Literary Consciousness: 1900-1950.** (3 cr. Prereq-Three 3xxx or 5xxx lit courses in Spanish or Portuguese or Δ)

Spanish-American literature between the eve and aftermath of the two world wars. Impact of modernization, industrialization, and nationalistic and populist thought on emergence of distinctive writing, thematic trends, and literary genre conventions.

**Span 5529. National Affirmation and Transnationalization.** (3 cr. Prereq-Three 3xxx or 5xxx literature courses in Spanish or #)

Literary trends of the contemporary period (1950 to present) as a reaction to internal social demands for development of independent national cultures and in response to international cultural pressures.

**Span 5531. Hispanic Literature of the United States.** (3 cr. Prereq-Three 3xxx or 5xxx Spanish or Portuguese literature courses or #)

Interdisciplinary approach providing a framework for deconstructing issues of national identity, marginalization, and gender. U.S. Hispanic theatre/literature and its ethnic diversity, regional variations, cultural links, and scope of its genres.

**Span 5532. Literature and National Disintegration.** (3 cr)

Literary reaction to contemporary structural changes in world economic system (1970 to present). Effects on literature as institution. Texts related to revolutionary trends and social movements (feminism, theology of liberation, defense of human rights).

**Span 5536. Feminism and Literature in Latin America.** (3 cr. Prereq-Three 3xxx or 5xxx lit courses in Spanish or Portuguese or Δ)

Latin American feminism in thought and practice; literature, cultural discourse, literary theory.

**Span 5701. History of Ibero-Romance.** (3 cr. Prereq-3703, two other 3xxx or 5xxx Spanish linguistics courses or #)

Origins and developments of Ibero-Romance languages; evolution of Spanish, Portuguese, and Catalan.

**Span 5711. The Structure of Modern Spanish: Phonology.** (3 cr. Prereq-3701, two 3xxx or 5xxx linguistics courses in Spanish or #)

Formulating and evaluating a phonological description of Spanish. Approaches to problems in Spanish phonology within metrical, autosegmental, and lexical phonological theories.

**Span 5712. The Structure of Modern Spanish: Morphology.** (3 cr. Prereq-#)

Evaluating morphological theories and descriptions of Spanish. Examining of phonological and syntactic effects on morphology.

**Span 5713. The Structure of Modern Spanish: Syntax.** (3 cr. Prereq-3702, two 3xxx or 5xxx Spanish linguistics courses or #)

Study and analysis of the principal constructions found in the syntax of Spanish.

**Span 5714. Theoretical Foundations of Spanish Syntax.** (3 cr. Prereq-5713 or #)

Linguistic types/processes that appear across languages. Grammatical relations, word order, transitivity, subordination, information structure, grammaticalization. How these are present in syntax of Spanish.

**Span 5715. The Structure of Modern Spanish: Semantics.** (3 cr. Prereq-#)

Applying semantic theory to Spanish: conceptual organization and the structuring of experience; meaning and cultural values; semantic fields; categorization and prototypes; cognitive model theory; metaphor, metonymy, and mental imagery as source and change of meaning.

**Span 5716. The Structure of Modern Spanish: Pragmatics.** (3 cr. Prereq-#)

Concepts used in current literature in Spanish pragmatics, such as deixis, presupposition, conversational implicature, speech act theory, and conversational structure.

**Span 5721. Spanish Laboratory Phonology.** (3 cr; A-F only. Prereq-[5711, honors] or grad student or #)

Core literature on Spanish laboratory phonology. Phonology from a laboratory perspective. Students evaluate laboratory research methodologies, perform basic acoustic analyses, and design laboratory phonology studies.

**Span 5731. Spanish Dialectology: Regional and Social Dialects of Modern Spain.** (3 cr. Prereq—Three 3xxx or 5xxx linguistics courses in Spanish or #) Major dialect areas of Spain, with distinguishing phonological, morphological, lexical, and syntactic variations of each. Impact of recent cultural, political, and socioeconomic transformations on language.

**Span 5732. Spanish Dialectology: Regional and Social Dialects of Modern Spanish America.** (3 cr. Prereq—Three 3xxx or 5xxx linguistics courses in Spanish or #) Major dialect areas of Spanish America, with distinguishing phonological, morphological, lexical, and syntactic variations of each. Their historical origin and evolution and the impact of cultural, political, and socioeconomic transformations on the language.

**Span 5910. Topics in Spanish Peninsular Literature.** (3 cr [max 9 cr]. Prereq—Three 3xxx or 5xxx literature courses in Spanish or Portuguese) Problems in Spanish cultural history and their applicability to studies of artistic movements, ideological trends, formal methods, or literary genres. Topics specified in *Class Schedule*.

**Span 5920. Topics in Spanish-American Literature.** (3 cr [max 9 cr]. Prereq—3104 or Δ) Spanish-American literature analyzed according to important groups, movements, trends, methods, and genres. Specific approaches depend on topic and instructor. Topics specified in *Class Schedule*.

**Span 5930. Topics in Ibero-Romance Linguistics.** (3 cr [max 9 cr]. Prereq—#) Problems in Hispanic linguistics; a variety of approaches and methods.

**Span 5970. Directed Readings.** (1-4 cr [max 9 cr]. Prereq—MA or PhD candidate, #, Δ, □) Students must submit reading plans for particular topics, figures, periods, or issues. Readings in Spanish and/or Spanish-American subjects.

**Span 5985. Sociolinguistic Perspectives on Spanish in the United States.** (3 cr. Prereq—Three 3xxx or 5xxx linguistics courses in Spanish or #) Sociolinguistic analysis of issues such as language maintenance/shift in U.S. Latino communities, code switching, attitudes of Spanish speakers toward varieties of Spanish and English, language change in bilingual communities, and language policy issues.

**Span 5990. Directed Research.** (1-4 cr [max 9 cr]. Prereq—#, Δ, □)

**Span 5991. The Acquisition of Spanish as a First and Second Language.** (3 cr. Prereq—Three 3xxx or 5xxx linguistics courses in Spanish or #) Analysis of issues such as the acquisition of Spanish and English by bilingual children; Spanish in immersion settings; developmental sequences in Spanish; classroom language learners' attitudes, beliefs, and motivation; development of pragmatic competence.

**Span 8100. Research in Sociohistorical Approaches to Spanish Literature.** (3 cr [max 9 cr]. Prereq—5xxx courses in Span literature and culture) Sociohistorical functions of Spanish literary works and major theories concerning literary production of texts. Testing modern theories in terms of representative fictional discourses from specific historical periods.

**Span 8200. Spanish Literary Texts: Theories of Formal Structures.** (3 cr [max 9 cr]. Prereq—5xxx courses in Span literature and culture) Advanced research in methods of literary analysis of discourse. Emphasizes theoretical and practical frameworks within which representative texts are analyzed and interpreted from differing perspectives.

**Span 8212. Spanish Theater of the 16th Century: Drama up to Lope.** (3 cr. Prereq—5xxx courses in Span literature and culture) Medieval origins of drama to [La Celestina] (1499-1502), pastoral dialogues, crossover plays of Spanish and Portuguese dramatists, popular theater up to emerging public and private theaters under Italian influence. Rojas, Encina, Vicente, Naharro, Cervantes, and new tragedians.

**Span 8223. The Poetry of the Spanish Golden Age.** (3 cr. Prereq—5xxx courses in Span literature and culture) New Spanish poetic forms, from Garcilaso de León, mystics, and San Juan to Baroque trends by Góngora, Lope, and Quevedo. Classic traditions and modern adaptations. Ideological foundations of lyric genres—eclogue, lira, mystics, satire, conceptismo/culteranismo, and sonnet.

**Span 8252. Spanish Literature: 19th Century.** (3 cr) Critical review of 19th-century Spanish literary movements, their relationships, and recent research. Romanticism, realism/naturalism; development of the novel, poetry, theater.

**Span 8271. Spanish Theater: 20th Century.** (3 cr. Prereq—5109, 5111 or 5xxx course in Portuguese) Development and evolution of dramatic genres (experimental, absurd, or vanguard) from 1898 crisis to World War I, Civil War, World War II, and Franco era to the present: Galdós, Valle-Inclán, Unamuno, Grau, Lorca, Vallejo, Arrabal, and “Subterranean.” Emphasizes “drama in performance” and diverging ideologies.

**Span 8300. The Construction of Spanish Literary History.** (3 cr [max 9 cr]. Prereq—Two 5xxx courses in Span literature and culture) Origins and development of Hispanic literary canon: sociocultural theories of Spanish literary histories as academic and historiographic disciplines. Critiques of modern literary theories through analysis of literary works by major writers.

**Span 8312. Two Spanish Masterpieces: *Libro de Buen Amor* and *La Celestina*.** (3 cr. Prereq—5106, 5107 or 5xxx course in Portuguese) Cultural reappraisal of the late Middle Ages by reference to two Spanish masterpieces: the Archpriest's *Book of True Love* and Rojas' *La Celestina* (1499-1502). Emphasizes historical function of varied genres, motifs, and sources adapted by the authors.

**Span 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**Span 8444. FTE: Doctoral.** (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

**Span 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Span 8710. Seminar in Spanish and Portuguese Phonology.** (3 cr [max 9 cr]. Prereq—5711, Ling 5302 or #) Critical examination of readings and research on specific topic.

**Span 8730. Seminar in Spanish and Portuguese Syntax.** (3 cr [max 9 cr]. Prereq—5714 or #) Critical examination of readings and research on specific topic.

**Span 8750. Seminar in Spanish and Portuguese Pragmatics.** (3 cr [max 9 cr]. Prereq—5716 or #) Critical examination of readings and research in specific topic.

**Span 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Span 8780. Seminar in Hispanic Sociolinguistics.** (3 cr [max 9 cr]. Prereq—5731 or 5732 or 5985 or #) Current issues.

**Span 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

**Span 8900. Spanish Seminar.** (3 cr [max 9 cr]. Prereq—Span 5xxx series required for MA or #) Projects relying heavily on advanced research in Spanish problems. Investigation of assigned fields, analysis of problems, appraisal of principles. Limited to small group of students. For list of sample seminars, consult department and director of graduate studies.

**Span 8940. Advanced Research in Spanish-American Literary Historiography.** (3 cr [max 9 cr]) Sources and procedures that have given rise to institutionalizations of Spanish-American literary history. Evaluation and review of epistemological principles and assumptions in theory of literary criticism and histories of literature.

**Span 8960. Workshop: Research in Hispanic Cultural Issues.** (3 cr [max 9 cr]; A-F only. Prereq—Reading knowledge of Spanish and Portuguese) Individualized support and advice in framing, theorizing, problematizing, and interpreting areas of cultural research. Taught in Spanish, Portuguese, and English.

**Span 8990. Advanced Comparative Research of Caribbean Genres.** (3 cr [max 9 cr]. Prereq—5525 or #) Major literary works and genres of Caribbean literature studied against the background of sociohistorical vicissitudes of the process leading to the formation and consolidation of the national states.

## Spanish-Portuguese (SpPt)

Department of Spanish and Portuguese Studies  
College of Liberal Arts

**SPPT 5930. Selected Topics in Hispanic Cultural Discourse.** (3 cr [max 9 cr]; A-F only. Prereq—Reading knowledge of Span and Port) Cultural discourses in Spanish- and Portuguese-speaking areas. Historical intersections and divergences. Taught in Spanish and/or Portuguese; English when cross-listed. Topics specified in the *Class Schedule*.

**SPPT 5999. The Teaching of College-Level Spanish: Theory and Practice.** (3 cr. Prereq—Grad or #) Theoretical grounding in the general principles of second language acquisition and guidance with their practical applications to the teaching of first- and second-year Spanish at the college-level.

**SPPT 8400. Topics in Modern Hispanic and Lusophone Culture.** (3 cr [max 9 cr]. Prereq—Three 5xxx Span or Port courses) Advanced research in methods of analysis of culture. Emphasizes theoretical and practical frameworks within which representative cultural products and events are analyzed and interpreted from differing perspectives.

**SPPT 8920. Cross-Cultural Issues in Hispanic and Luso-Brazilian Cultural Discourses.** (3 cr [max 9 cr]) Comparative study of literary and cultural production in historical periods when economic, social, political, and ideological bonds among Hispanic and Lusophone countries were intensified. Topics specified in *Class Schedule*.

## Statistics (Stat)

School of Statistics  
College of Liberal Arts

**Stat 5021. Statistical Analysis.** (4 cr. \$3011. Prereq—College algebra or #; Stat course recommended) Intensive introduction to statistical methods for graduate students needing statistics as a research technique.

**Stat 5031. Statistical Methods for Quality Improvement.** (4 cr. Prereq—[3021 or 3022 or 4102 or 5021 or 5102 or 8102], Math 1272) Random variability/sampling. Controlling statistical process. Shewhart/accumulative charting. Analyzing plant data, trend surface, and variance/design of experiments.

**Stat 5041. Bayesian Decision Making.** (3 cr. Prereq-4101 or 5021 or 5101 or #)  
Axioms for subjective probability/utility. Optimal statistical decision making. Sequential decisions/decision trees. Backward induction. Bayesian data analysis.

**Stat 5101. Theory of Statistics I.** (4 cr. \$4101, \$5651. Prereq-Math 2263)  
Logical development of probability, basic issues in statistics. Probability spaces. Random variables, their distributions and expected values. Law of large numbers, central limit theorem, generating functions, multivariate normal distribution.

**Stat 5102. Theory of Statistics II.** (4 cr. \$4102. Prereq-5101 or Math 5651)  
Sampling, sufficiency, estimation, test of hypotheses, size/power. Categorical data. Contingency tables. Linear models. Decision theory.

**Stat 5201. Sampling Methodology in Finite Populations.** (3 cr. Prereq-3011 or 3021 or 5021 or #)  
Simple random, systematic, stratified, unequal probability sampling. Ratio, model based estimation. Single stage, multistage, adaptive cluster sampling. Spatial sampling.

**Stat 5302. Applied Regression Analysis.** (4 cr. Prereq-3022 or 4102 or 5021 or 5102 or #)  
Simple, multiple, and polynomial regression. Estimation, testing, prediction. Use of graphics in regression. Stepwise and other numerical methods. Weighted least squares, nonlinear models, response surfaces. Experimental research/applications.

**Stat 5303. Designing Experiments.** (4 cr. Prereq-3022 or 4102 or 5021 or 5102 or #)  
Analysis of variance. Multiple comparisons. Variance-stabilizing transformations. Contrasts. Construction/analysis of complete/incomplete block designs. Fractional factorial designs. Confounding split plots. Response surface design.

**Stat 5401. Applied Multivariate Methods.** (3 cr. Prereq-5302 or 8102 or #)  
Bivariate and multivariate distributions. Multivariate normal distributions. Analysis of multivariate linear models. Repeated measures, growth curve and profile analysis. Canonical correlation analysis. Principle components and factor analysis. Discrimination, classification, and clustering.

**Stat 5421. Analysis of Categorical Data.** (3 cr. Prereq-5302 or 8102 or #)  
Varieties of categorical data, cross-classifications, contingency tables. Tests for independence. Combining 2x2 tables. Multidimensional tables/loglinear models. Maximum-likelihood estimation. Tests for goodness of fit. Logistic regression. Generalized linear/multinomial-response models.

**Stat 5601. Nonparametric Methods.** (3 cr. Prereq-3022 or 4102 or 5021 or 5102 or #)  
Order statistics. Classical rank-based procedures (e.g., Wilcoxon, Kruskal-Wallis). Goodness of fit. Topics may include smoothing, bootstrap, and generalized linear models.

**Stat 5931. Topics in Statistics.** (3 cr)  
Topics vary according to student needs and available staff.

**Stat 5932. Topics in Statistics.** (3 cr)  
Topics vary according to students' needs and available staff.

**Stat 5993. Tutorial.** (1-6 cr [max 12 cr]. Prereq-#)  
Directed study in areas not covered by regular offerings.

**Stat 8061. Applied Statistical Methods I.** (4 cr; A-F only. Prereq-Grad stat major or #)  
The regression problem; linear regression with one or more predictors; using graphics in regression; model building; model assessment and diagnostics; outliers; generalized linear models; logistic, Poisson, and nonlinear regression.

**Stat 8062. Applied Statistical Methods II.** (4 cr; A-F only. Prereq-8061, grad stat major or #)  
Categorical data analysis: loglinear models, logit models, multinomial response models, exact and asymptotic inference, conditional independence; models of association. Experimental design: randomization, ANOVA, contrasts and multiple testing, factorials, blocking, covariates, split plots, random effects, fractional factorials, response surfaces.

**Stat 8101. Theory of Statistics I.** (3 cr. Prereq-Grad stat major or #)  
Probability, transformations, expectation, univariate and multivariate distributions, central limit theorem, sampling and sampling distributions, sufficiency, likelihood.

**Stat 8102. Theory of Statistics II.** (3 cr. Prereq-8101, grad stat major or #)  
Point and interval estimation, maximum likelihood, delta method, hypothesis testing, decision theory, analysis of variance, regression.

**Stat 8111. Mathematical Statistics I.** (3 cr. Prereq-[5102 or 8102 or #], [Math 5615, Math 5616] or real analysis), matrix algebra)  
Probability theory, basic inequalities, characteristic functions, and exchangeability. Multivariate normal distribution. Exponential family. Decision theory, admissibility, and Bayes rules.

**Stat 8112. Mathematical Statistics II.** (3 cr. Prereq-8111)  
Statistical inference, estimation, and hypothesis testing. Convergence and relationship between convergence modes. Asymptotics of maximum likelihood estimators, distribution functions, quantiles. Delta method.

**Stat 8121. Theory of Inference.** (3 cr. Prereq-8112, Math 8657 or #)  
Topics may vary according to instructor and student interests. Sample topics: conditional distributions and sufficiency, estimation theory, comparison of statistical inference theories; Neyman-Pearson hypothesis-testing theory and its extensions, confidence regions, invariance, and nonparametric, sequential, likelihood, and Bayesian inference.

**Stat 8131. Predictive Inference.** (3 cr. Prereq-8112 or equiv)  
Traditional frequentist and nontraditional predictive approaches. Bayesian predictive methods and the purpose for which data are used. Theoretical apparatus discussed using a variety of common statistical paradigms. Model selection, comparisons and allocation, perturbation analysis and control.

**Stat 8141. Probability Assessment.** (3 cr. Prereq-5102)  
Probability as a language of uncertainty for quantifying and communicating expert opinion and for use as Bayesian prior distributions. Methods for elicitation and construction of subjective probabilities. De Finetti coherence, predictive elicitation, fitting subjective-probability models, computer-aided elicitation, and use of experts.

**Stat 8151. Statistical Decision Theory.** (3 cr; S-N only. Prereq-8112, Math 8656)  
Comparison of inferential methods in statistics (including risk comparison, minimaxity, and admissibility) using Wald's formulation of decision. Formal and proper Bayes rules compared with frequentist inferences. Topics may vary depending on instructor.

**Stat 8171. Sequential Analysis.** (3 cr. Prereq-8112)  
Wald's sequential probability ratio test and modifications. Sequential decision theory. Martingales. Sequential estimation, design, and hypothesis testing. Recent developments.

**Stat 8201. Topics in Sampling.** (3 cr; S-N only. Prereq-8102 or #)  
Sampling theory; stratified sampling, ratio estimators, cluster sampling, double sampling, superpopulation theory, Bayesian methods, multiple imputation, nonresponse.

**Stat 8311. Linear Models.** (4 cr. Prereq-Linear algebra, 5102 or 8102 or #)  
General linear model theory from a coordinate-free geometric approach. Distribution theory, ANOVA tables, testing, confidence statements, mixed models, covariance structures, variance components estimation.

**Stat 8312. Linear and Nonlinear Regression.** (3 cr. Prereq-8311)  
Nonlinear regression: asymptotic theory, Bates-Watts curvatures, super leverage, parameter plots, projected residuals, transform-both-sides methodology, Wald versus likelihood inference. Topics in linear and generalized linear models as they relate to nonlinearity issues, including diagnostics, semi-parametric models, and model assessment.

**Stat 8313. Topics in Experimental Design.** (3 cr. Prereq-8311)  
Optimal, Bayes, and nonlinear designs; algorithms for computing designs; sample size; recent developments.

**Stat 8321. Regression Graphics.** (3 cr. Prereq-8311)  
Foundations: dimension-reduction subspaces, Li-Duan Lemma, structural dimension. Inferring about central dimension-reduction subspaces by using 3D plots, graphical regression, inverse regression graphics, net-effect plots, principal Hessian directions, sliced inverse regression and predictor transformations. Graphics for model assessment.

**Stat 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**Stat 8401. Topics in Multivariate Methods.** (3 cr. Prereq-8311)  
Bivariate and multivariate distributions. Multivariate normal distributions. Hotelling's T-squared, MANOVA, MANCOVA, and regression with multivariate dependent variable. Repeated measures, growth curve, and profile analysis. Canonical correlation analysis. Principle components and factor analysis. Discrimination, classification, clustering.

**Stat 8411. Multivariate Analysis.** (3 cr. Prereq-8152)  
Multivariate normal distribution. Inference on the mean, covariance, and correlation and regression coefficients; related sampling distributions such as Hotelling's T-squared and Wishart distributions. Multivariate analysis of variance. Principal components and canonical correlation. Discriminant analysis.

**Stat 8421. Theory of Categorical Data Analysis.** (3 cr. Prereq-8062 or #)  
Categorical data, multidimensional cross-classified arrays, mixed categorical and continuous data. Loglinear, logit, and multinomial response models. Ordinal responses. Current research topics.

**Stat 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**Stat 8501. Introduction to Stochastic Processes With Applications.** (3 cr. Prereq-5101 or 8101)  
Markov chains in discrete and continuous time, renewal processes, Poisson process, Brownian motion, and other stochastic models encountered in applications.

**Stat 8511. Time Series Analysis.** (3 cr. Prereq-5102 or 8111 or #)  
Discrete and continuous parameter time series. Stationarity. Second-order descriptions of times series. Frequency domain representation and univariate and multivariate time series analysis. Smoothed modified periodograms, multi-taper estimation. Time-domain representation and time series analysis. ARIMA models, structural models.

**Stat 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Stat 8701. Computational Statistical Methods.** (3 cr. Prereq–8311, programming exper) Random variate generation, variance reduction techniques. Robust location estimation and regression, smoothing additive models, regression trees. Programming projects; basic programming ability and familiarity with standard high-level language (preferably FORTRAN or C) are essential.

**Stat 8711. Statistical Computing.** (3 cr. Prereq–8701 or #) Basic numerical analysis for statisticians. Numerical methods for linear algebra, eigen-analysis, integration, and optimization and their statistical applications.

**Stat 8721. Programming Paradigms and Dynamic Graphics in Statistics.** (3 cr. Prereq–8062, 8102) Alternative programming paradigms to traditional procedural programming, including object-oriented programming and functional programming. Applications to development of dynamic statistical graphs and representation and use of functional data, such as mean function in nonlinear regression log likelihoods and prior densities in Bayesian analysis.

**Stat 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq–Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Stat 8801. Statistical Consulting.** (3 cr; S-N only. Prereq–Grad stat major or #) Principles of effective consulting/problem-solving, meeting skills, and reporting. Aspects of professional practice/behavior, ethics, and continuing education.

**Stat 8811. Statistical Consulting Practicum.** (3 cr [max 3 cr]; S-N only. Prereq–Statistics grad student or #) Providing (under faculty supervision) statistical support to clients, primarily University researchers. Exercises in problem solving, ethics, listening/communication skills.

**Stat 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer; 24 cr required)

**Stat 8900. Student Seminar.** (1 cr [max 2 cr]; S-N only. Prereq–Statistics grad student) Preparation or presentation of seminar on statistical topics.

**Stat 8931. Advanced Topics in Statistics.** (3 cr) Topics vary according to student needs and available staff.

**Stat 8932. Advanced Topics in Statistics.** (3 cr) Topics vary according to student needs and available staff.

**Stat 8992. Directed Readings and Research.** (1-6 cr [max 12 cr]; S-N only. Prereq–#) Directed study in areas not covered by regular offerings.

## Studies in Cinema and Media Culture (SCMC)

*Department of Cultural Studies and Comparative Literature*

*College of Liberal Arts*

**SCMC 5001. Critical Debates in the Study of Cinema and Mass Culture.** (3 cr) Basic concepts in historical/international debates over production/reception of mass culture. Emphasizes cinema. Advanced orientation toward intellectual traditions that inform contemporary scholarship.

## Studies of Science and Technology (SST)

*Institute of Technology*

**SST 8000. Colloquium.** (1.5 cr [max 3 cr]; S-N only. Prereq–Grad SST minor) Series of weekly lectures by nationally and internationally known scholars with diverse disciplinary and methodological backgrounds speaking on a variety of issues.

**SST 8100. Seminar: Models, Theories, and Reality.** (3 cr. Prereq–HSci 8111 or [Phil 8601 or Phil 8602 or Phil 8605] or #) Students participate in ongoing research on the role of models and theories in science, and prepare and present research papers.

**SST 8200. Seminar: The Physical Sciences.** (3 cr. Prereq–HSci 8111 or [Phil 8601 or Phil 8602 or Phil 8605] or #) Students participate in ongoing research in history, philosophy, and social study of physical sciences and prepare and present research papers.

**SST 8300. Seminar: The Biological and Biomedical Sciences.** (3 cr. Prereq–HSci 8111 or [Phil 8601 or Phil 8602 or Phil 8605] or #) Students participate in ongoing research in history, philosophy, and social study of biological and biomedical sciences, and prepare and present research papers.

**SST 8400. Seminar: Science, Technology, and Society.** (3 cr. Prereq–HSci 8111 or [Phil 8601 or Phil 8602 or Phil 8605] or #) Students participate in ongoing research on interactions involving science, technology, and society from perspectives of history, philosophy, and social study of science, and prepare and present research papers.

**SST 8420. Social and Cultural Studies of Science.** (3 cr. Prereq–#) Recent work; theoretical and methodological differences among practitioners; selected responses from historians and philosophers of science.

## Sumerian (Sum)

*Department of Classical and Near Eastern Studies  
College of Liberal Arts*

**Sum 5011. Elementary Sumerian I.** (3 cr. Prereq–Adv undergrads with 2 yrs of another foreign lang, grads) Sumerian writing and grammar. Readings from classical Sumerian literary and historical texts.

**Sum 5012. Elementary Sumerian II.** (3 cr. Prereq–5011) Reading from classical literary and historical texts.

## Surgery (Surg)

*Department of Surgery  
Medical School*

**Surg 8200. Clinical Surgical Problems in Management.** (3 cr; A-F only. Prereq–Grad surg major) Diagnostic and management instruction in all phases of clinical surgery, inpatient and outpatient.

**Surg 8201. Surgery Roentgenological Pathology Conference.** (1 cr; A-F only. Prereq–Grad surg major) Weekly review of surgical patients presenting interesting roentgen and pathological findings. Staff from the Departments of Surgery, Radiology, and Laboratory Medicine and Pathology. Basic science and management principles of the surgical patient.

**Surg 8202. Surgical Research.** (3 cr; A-F only. Prereq–Grad surg major) Graduate students undertake original investigation of problems in either experimental or clinical surgery.

**Surg 8203. Surgery Complications and Research Conference.** (1 cr; A-F only. Prereq–Grad surg major) Evaluation of surgical patients, including postoperative course. Discussion and critical evaluation of current research problems.

**Surg 8207. Transplantation Conference.** (1 cr; A-F only. Prereq–Grad surg major) Interdepartmental discussion and evaluation of current clinical and research problems.

**Surg 8293. Applied Statistics.** (1 cr; S-N only. Prereq–Grad student in [surg or experimental surg or health sciences] or #) Interactive computer course. Concepts of applied statistics. Examples, problem sets based on surgical research. How to independently set up appropriate experiments and perform basic descriptive/inferential analysis.

**Surg 8333. FTE: Master's.** (1 cr; NGA. Prereq–Master's student, adviser and DGS consent)

**Surg 8444. FTE: Doctoral.** (1 cr; NGA. Prereq–Doctoral student, adviser and DGS consent)

**Surg 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq–Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Surg 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq–Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Surg 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer; 24 cr required)

## Sustainable Agricultural Systems (SAgr)

*Department of Agronomy and Plant Genetics  
College of Agricultural, Food and Environmental Sciences*

**SAgr 8010. Colloquium in Sustainable Agriculture.** (2 cr; A-F only. Prereq–Coursework in biological or social sciences that provides intro to ag practices or issues) Forum for University faculty and students, and representatives of the farming community, including farmers, grassroots organizations, agricultural businesses, and representatives of state agencies, to engage in discussions on topics related to sustainability of food production.

**SAgr 8020. Field Experience in Sustainable Agriculture.** (1-4 cr; S-N only. Prereq–Coursework in biological or social sciences that provides intro to ag practices or issues) 3- to 14-week internship with growers or organizations working with sustainable agriculture issues. Students analyze issues in final written project, oral seminar.

## Teaching English as a Second Language (TESL)

*Institute of Linguistics, ESL, and Slavic Languages and Literatures  
College of Liberal Arts*

**TESL 5401. Language Analysis for Teachers of English as a Second Language.** (4 cr. Prereq–Ling 5001) Overview of the structure of the English language geared to the needs of teachers of English to speakers of other languages. Study the structures of English from the point of view of second-language speakers as well as native speakers. Phonetics, phonology, morphology, and some aspects of the syntax of the English language. Part of a two-course sequence.

**TESL 5402. Language Analysis for Teachers of English as a Second Language.** (4 cr. Prereq–5401, Ling 5001)  
Overview of the structure of the English language geared to the needs of teachers of English to speakers of other languages. Study the structures of English from the point of view of second-language speakers as well as native speakers. More complex structures of English syntax, as well as English semantics, pragmatics, and discourse structures. Second in a two-course sequence.

**TESL 5610. Proseminar in Second Language Acquisition and Learning.** (3 cr [max 16 cr]. Prereq–Ling 5505 or #)  
Key issues in second language acquisition/learning research. Focuses on learning a second or foreign language in the classroom.

**TESL 5721. Methods in Teaching English as a Second Language.** (3 cr. Prereq–Ling 3001 or 5001 or #)  
Introduction to methods for teaching English as a second language to adults.

**TESL 5722. Practicum in Teaching English as a Second Language.** (4 cr [max 8 cr]; S-N only. Prereq–[[5401 or 5401], [5402 or 5402], 5721, ESL major or ESL minor] or #)  
Observation of, and practice in, teaching English as a second language to adults at college or university level.

**TESL 5723. Materials for Teaching English as a Second Language.** (3 cr. Prereq–5721, 5722 or #)  
Evaluation and preparation of teaching materials for English as a second language.

**TESL 5724. Introduction to Language Assessment.** (3 cr; A-F only)  
How to engage in meaningful, appropriate, and fair second-language assessment practices; interpret test results; and construct new forms of assessment.

**TESL 5900. Topics in Second Language Learning and Teaching.** (1-4 cr [max 16 cr])  
Topics vary. See *Class Schedule*.

**TESL 5910. Seminar in Teaching English as a Second Language.** (3 cr [max 9 cr])  
Topics related to English as a second language and applied linguistics. Topics specified in *Class Schedule*.

**TESL 5993. Directed Studies.** (1-4 cr [max 9 cr]. Prereq–#, Δ, □)  
Directed study for teaching English as a second language.

**TESL 8333. FTE: Master's.** (1 cr; NGA. Prereq–Master's student, adviser and DGS consent)

**TESL 8751. English for Specific Purposes.** (3 cr. Prereq–5721, 5401, 5402 or #)  
Critical review of literature: registers of English used in fields such as engineering, nursing, and business. Students gather data and write reports.

**TESL 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq–Max 18 cr per semester or summer; 10 cr total required [Plan A only])

## Theatre Arts (Th)

*Department of Theatre Arts and Dance*  
*College of Liberal Arts*

**Th 5100. Theatre Practicum.** (1-4 cr [max 20 cr]. Prereq–#, Δ [4 cr of 3100 for undergrads])  
Individual creative projects in production of approved plays as an actor, director, dramaturg, or playwright. (See 5500 for design practicums.)

**Th 5117. Performance and Social Change.** (3 cr; A-F only. Prereq–Jr or sr or grad student)  
Reading, writing, research, presentations and workshops explore activist performance projects. Theories of social formation and ideology provide framework to discuss/animate theater's potential for social change.

**Th 5171. History of the Theatre I.** (3 cr)  
Theatre as a mirror of society. Aesthetics, philosophy, and practices of theatre arts. Ancient to mid-18th century.

**Th 5172. History of the Theatre II.** (3 cr)  
Theatre as a mirror of society. Aesthetics, philosophy, and practices of theatre arts. Mid-18th century to the present.

**Th 5181. Blacks in American Theatre.** (3 cr)  
Historical survey of significant events in the development of American Black theatrical tradition; essays, plays, playwrights, and theatres from early colonial references to Black Arts Movement.

**Th 5182. Contemporary Black Theatre: 1960-Present.** (3 cr)  
Essays, plays, playwrights, and theatres that have contributed to contemporary Black theatre. From the beginning of the Black Arts Movement to the present.

**Th 5500. Theatre Design Practicum.** (1-3 cr [max 20 cr]. Prereq–3515, Δ, #)  
Individual projects in production of approved plays as a designer of scenery/properties, costumes, lighting, or sound. (See 5100 for other creative practicums.)

**Th 5510. Drawing, Rendering, and Painting for the Theatre Designer I.** (3 cr. Prereq–3515 or grad or #)  
Development of skills necessary for presentation of theatre scene/costume designs. Materials, layout, and techniques in scene painting. Basic drawing/graphic skills.

**Th 5515. Design Composition and Collaboration.** (3 cr. Prereq–Grad or 3515, 3711; #)  
Classical composition of art and its application to stage design and directing through the collaborative process.

**Th 5520. Scene Design.** (3 cr [max 9 cr]. Prereq–3515 or grad or #)  
Conceiving/communicating design ideas in both two-dimensional sketches and three-dimensional models for theatre and allied venues. Drafting.

**Th 5530. Costume Design.** (3 cr [max 9 cr]. Prereq–3515 or grad or #)  
Theory and process of costume design for theatrical productions (e.g., dance, opera, film) through hypothetical productions.

**Th 5540. Lighting Design for the Theatre.** (3 cr [max 9 cr]. Prereq–3515 or grad or #)  
Design aesthetics and exploration of design for various stage forms and venues. Development of the lighting plot and paperwork; use of the computer in lighting design.

**Th 5545. Stage Lighting Technology.** (3 cr. Prereq–3515 or grad or #)  
The lighting technician's skills and crafts: equipment, techniques, control operation, wiring, and maintenance.

**Th 5551. Editing and Post Production for Video and Film.** (3 cr. Prereq–#)  
Students manipulate software and other technologies used in post production. Editing, audio, image manipulation.

**Th 5553. Video Production Design and Aesthetics.** (3 cr. Prereq–4553 or #)  
Use of technologies in video/film in making a statement or communicating an idea/emotion. Creativity, sensitivity to an audience. Students explore different creative uses of technologies/medium.

**Th 5554. Multimedia Production for Live Performance.** (3 cr. Prereq–5553 or #)  
Use of multimedia production technologies in actual production. Students apply knowledge/skill in conjunction with an artistic team on a production and are an integral part of the development/realization of that production.

**Th 5556. Audio Engineering.** (3 cr. Prereq–4555 or #)  
Mixing/recording techniques specific to music and dramatic dialogue. Students explore recording different styles of music. Hands-on experience in recording bands and doing final mixes to a demo CD. Field trips to professional studios and club/concert recordings.

**Th 5558. Audio Systems Analysis and Installation.** (3 cr. Prereq–4555 or #)  
Analyzing, designing, developing specifications, and installing sound systems. Students work from client program lists, with given resources and given spaces, to arrive at best possible audio system. Hands-on experience.

**Th 5559. Sound Design for Performance.** (3 cr. Prereq–5555 or #)  
Audio technology and psychology and their impact on an audience in a performance situation. Communication, design process, psychoacoustics, and script analysis.

**Th 5560. Drawing, Rendering, and Painting for the Theatre Designer II.** (3 cr. Prereq–5510)  
Development of skills necessary for presentation of theatre scene/costume designs. Materials, layout, and techniques in scene painting. Rendering and scene painting skills.

**Th 5570. Properties/Scenery Technology.** (1-3 cr [max 15 cr]. Prereq–3515 or grad or #)  
Management, structures, upholstery, mask-making, furniture construction, stage mechanics, soft properties, faux finishes. Topics specified in *Class Schedule*.

**Th 5580. Costume Technology.** (1-3 cr [max 15 cr]. Prereq–3515 or grad or #)  
Fabric enhancement techniques, masks, wig-making, millinery, makeup prosthetics, pattern drafting, and draping. Topics specified in *Class Schedule*.

**Th 5590. Theatre Technology Practicum.** (1-3 cr [max 15 cr]. Prereq–3515, #, Δ; 4 cr max for undergrads)  
Individual creative project in technology/craft area of theatre. Practical work in costume, lighting, makeup, props, scenery, sound, or theatre management.

**Th 5711. Advanced Stage Direction.** (3 cr. Prereq–[4711, #] or grad student)  
Realistic/nonrealistic dramatic forms. Theory/technique of rehearsal. Production problems. Includes directing of three one-act plays.

**Th 5713. Theory and Practice of Performance.** (3 cr; A-F only. Prereq–[3171, 3172, [4177 or 4178], 5711] or grad student)  
Traditions of thinking about theatre, from ancient Greece to present, in practical applications. Focuses on epistemological significance of performance in current critical practices of postmodernism, psychoanalysis, and phenomenology.

**Th 5714. The Drama of Myth.** (3 cr. Prereq–[1322, 3171, 3172] or #)  
Role of myth in performance. Students choose a myth and study its iconography, tracing its journey in painting, sculpture, music, and other texts that accumulated around it throughout history. Course culminates in creation of a non-traditional performance score that embodies/reveals energies of contemporary culture within ancient metaphor of a chosen myth.

**Th 5715. Actor-Director Collaboration.** (3 cr. Prereq–Grad or 3322, 3711)  
Applying advanced acting and directing technique to an artistic, collaborative process that promotes flexibility and creativity. Actors and directors are exposed to a challenging range of roles, styles, and scenes.

**Th 5716. Stage Management for the Theatre.** (4 cr. Prereq–[1101, 1321, soph] or grad)  
Theories, practicalities, and techniques for rehearsal/performance. Organizing/managing various types of performance venues.

**Th 5718. Principles of Theatre Management.** (3 cr. Prereq-#)  
Nonprofit theatre structure: concept; mission; organization; financial, marketing, fund-raising, and grant-writing strategies. Discussion/guest professionals from Twin Cities' arts/funding communities.

**Th 5725. The Alchemy of an Object.** (3 cr. Prereq-[1322, 3171, 3172] or #, grad student)  
Stage object as vehicle for investigating role of drama in culture from Middle Ages to present. Object as first connection that dramatic text makes with material world. Object as culturally inscribed link between language of drama and world of action in a historically given moment. Object as metaphor of cultural praxis.

**Th 5753. Text Analysis for Drama.** (3 cr. Prereq-5711 or grad)

Tools for intensive textual analysis for advanced directors/designers. Traditional, Aristotelian analysis and contemporary approaches covered through theories/writings of Bertolt Brecht and Howard Barker.

**Th 5760. Advanced Stage Management.** (2-3 cr. Prereq-5716 or 15716, # 14 cr max for undergrads)  
Practical experience in stage management for specific productions of the University Theatre with emphasis on rehearsal and performance.

**Th 5780. Advanced Topics in Theatre Management.** (2-4 cr [max 8 cr]. Prereq-5718)  
Study and apply theatre management theories and techniques learned in 5718. Marketing/audience development, fundraising and grant writing strategies, and financial management of a nonprofit theatre organization.

**Th 5950. Topics in Theatre.** (1-4 cr [max 20 cr]. Prereq-Varies by topic)  
Topics specified in *Class Schedule*.

**Th 5993. Directed Study.** (1-5 cr [max 20 cr]. Prereq-6 Th cr, #, Δ, □)  
Guided individual reading or study.

**Th 8100. Theatre Practicum.** (1-4 cr [max 20 cr]. Prereq-#, Δ)  
Individual creative projects in production of approved plays as an actor, director, dramaturg, or playwright (see 8500 for design practicums).

**Th 8102. Theatre Historiography.** (3 cr)  
Current trends in historiography; research strategies and methods.

**Th 8103. The Theatre Dramaturg.** (3 cr)  
The dramaturg's role in theatrical performance: history, theory, and practice.

**Th 8111. History and Theory of Western Theatre: Ancient World and Early Medieval.** (3 cr)  
History, theories, arts, and crafts of western theatre from the ancient world to the present.

**Th 8112. History and Theory of Western Theatre: Medieval Through Renaissance.** (3 cr)  
History, theories, arts, and crafts of western theatre from the ancient world to the present.

**Th 8113. History and Theory of Western Theatre: National Theatres to the French Revolution.** (3 cr)  
History, theories, arts, and crafts of western theatre from the ancient world to the present.

**Th 8114. History and Theory of Western Theatre: Enlightenment Through Naturalism.** (3 cr)  
History, theories, arts, and crafts of western theatre from the ancient world to the present.

**Th 8115. History and Theory of Western Theatre: 20th Century Through World War II.** (3 cr)  
History, theories, arts, and crafts of western theatre from the ancient world to the present.

**Th 8116. History and Theory of Western Theatre: 20th Century From 1945 to the Present.** (3 cr)  
History, theories, arts, and crafts of western theatre from the ancient world to the present.

**Th 8120. Seminar.** (3 cr [max 12 cr])  
Selected research topics from various theatre fields and periods. Sample topics: Border Crossings—Theatre History and Representation; The Theatre and Drama of the Third Reich, 1927-1944.

**Th 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**Th 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**Th 8500. Theatre Design Practicum.** (1-3 cr [max 20 cr]. Prereq-#, Δ)

Individual creative projects in production of approved plays as a designer for scenery/properties, costumes, lighting, or sound (see 8100 for other creative practicums).

**Th 8590. Theatre Technology Practicum.** (1-3 cr [max 20 cr]. Prereq-#, Δ)

Individual creative projects in the technology or craft of costume, lighting, makeup, props, scenery, sound, or theatre management.

**Th 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Th 8711. Theory and Practice of the Modern Stage Director.** (3 cr)  
Survey of principal stage directors (e.g., Saxe-Meiningen, Meyerhold, Brecht, Strehler, Mnouchkine, Brook) and their theories and practices from 1871 to today using books, journals, firsthand accounts, and videos.

**Th 8750. MFA Directing Practicum.** (2-3 cr [max 10 cr]; A-F only. Prereq-MFA directing specialization)  
Rehearsed and performed production of published or original one-act (2 cr) or full-length play (3 cr) with budgeted design and technical support.

**Th 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Th 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

**Th 8950. Topics in Theatre.** (1-4 cr [max 20 cr]. Prereq-Varies by topic)  
Topics specified in *Class Schedule*.

**Th 8980. Internship.** (1-5 cr [max 10 cr]. Prereq-#, Δ)

**Th 8990. MFA Creative Thesis.** (3-4 cr. Prereq-#, Δ)

**Th 8994. Directed Research.** (1-5 cr. Prereq-#, Δ)

## Therapeutic Radiology (TRad)

*Department of Therapeutic Radiology  
Medical School*

**TRad 8204. Tumor Clinic Conference.** (0 cr)

**TRad 8240. Radiation Therapy Conference.** (0 cr)

**TRad 8300. Radiation Therapy.** (1-15 cr)

**TRad 8310. Fundamentals of Radiation Therapy.** (1 cr)

**TRad 8315. Radiation Therapy Pathology.** (1 cr)

**TRad 8320. Radiation Therapy Treatment Planning Problems.** (1 cr)

**TRad 8325. Radiation Therapy Pediatrics Oncology.** (1 cr)

**TRad 8350. Research: Radiation Therapy.** (1-15 cr)

**TRad 8450. Research: Radiation Biology.** (1-15 cr)

**TRad 8550. Research: Radiological Physics.** (1-15 cr)

## Toxicology (Txcl)

*College of Veterinary Medicine*

**Txcl 5000. Directed Research in Toxicology.** (1-4 cr [max 16 cr]; A-F only. Prereq-#)  
Special project that addresses specific issue in toxicology. Under guidance of faculty member.

**Txcl 5011. Principles of Toxicology.** (2 cr; A-F only. Prereq-Grad txcl major or #)  
Introduction to fundamentals of poisoning in individuals and the environment, assessment of potential health hazards, and application of toxicology in various professional careers.

**Txcl 5195. Veterinary Toxicology.** (3 cr; A-F only. Prereq-Grad student or #)  
Toxicology of minerals, pesticides, venoms, and various toxins. Identification of poisonous plants. Recognition, diagnosis, and treatment of animal poisons.

**Txcl 5545. Introduction to Regulatory Medicine.** (2-4 cr; A-F only. Prereq-Grad student or #)  
Explanation of products requiring pre-market approval and those that may be marketed without approval. Post-market surveillance. Adverse reactions, removal of product from market.

**Txcl 8012. Advanced Toxicology I.** (3 cr; A-F only. Prereq-[Duluth: 5011, Chem 4341 or #]; [TC: 5011 or BioC 4331, PubH 5104 or #])  
Absorption, distribution, metabolism, and excretion of xenobiotics; toxicokinetics; mechanisms of toxicity or specific classes of chemical agents.

**Txcl 8013. Advanced Toxicology II.** (3 cr; A-F only. Prereq-[Duluth: 8012, Chem 4342, Phsl 5601 or #]; [TC: 8012, BioC 4332, Phsl 5062 or Phsl 6101 or #])  
Kinetic and dynamic determinants of target organ toxicity; pathological alterations in structure/function relationships for major target organ systems; mechanisms of mutagenesis, carcinogenesis, and teratogenesis.

**Txcl 8100. Investigative Toxicology.** (1 cr [max 2 cr]; A-F only. Prereq-8013 or #)  
Evaluating toxicology research issues and literature.

**Txcl 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**Txcl 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**Txcl 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**Txcl 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**Txcl 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

## Translation and Interpreting (TrIn)

*Institute of Linguistics, ESL, and Slavic Languages and Literatures*

*College of Liberal Arts*

**TrIn 5900. Topics in Translation and Interpreting.** (1-4 cr [max 4 cr]. Prereq-#)  
Topics specified in *Class Schedule*.

**TrIn 5993. Directed Study.** (1-3 cr. Prereq-#, Δ, □)  
Directed study in translation and interpretation.

## Urban Studies (Urbs)

Department of Geography

College of Liberal Arts

**Urbs 5101. The City and the Metropolis: an Exploration.** (2 cr. Prereq—Grad student or [adv UrbS undergrad, #])

The City and the Metropolis as places that result from important acts of human creativity. Interdisciplinary/exploratory perspectives. Building/developing (North American) cities, construction of “urban culture.”

## Veterinary Diagnostic Medicine (VDM)

Department of Veterinary Diagnostic Medicine

College of Veterinary Medicine

**VDM 5000. Comparative Pathology Conference.**

(1-3 cr [max 99 cr]; A-F only. Prereq—#)  
Discussions/demonstrations of contemporary aspects of diseases of animals. Emphasizes disease diagnosis, clinical outcomes, pathogenesis, and molecular mechanisms.

**VDM 5100. Clinical Pathology Conference.** (1 cr; S-N only. Prereq—[CVM resident or grad student], #)  
Topics involving cytology, hematology, clinical chemistry, and hemostasis. May be addressed from clinical path perspective.

**VDM 5532. Hematology, Cytology, and Microbiology.** (2-4 cr [max 40 cr]; S-N only. Prereq—Grad student or #)  
Hematology/cytology lab emphasizes microscopic aspects in dog, cat, cow, horse, sheep, goat, pig, and llama; case oriented approach to pathophysiologic aspects of disease. Diagnostic/clinical microbiology lab uses clinical diagnostic materials: students cultivate specimens, identify bacteria and fungi, and determine susceptibility; student presentations discuss cases and outline therapy/control.

**VDM 5533. Hematology and Cytology.** (2 cr [max 98 cr]; S-N only. Prereq—Grad student or #)  
Microscopic aspects of hematology/cytology in dog, cat, cow, horse, sheep, goat, pig, and llama. Case oriented approach is used to develop pathophysiologic aspects of disease. One week rotation.

## Veterinary Medicine, Graduate (VMed)

College of Veterinary Medicine

**VMed 5080. Problems in Veterinary Epidemiology and Public Health.** (1-3 cr; A-F only. Prereq—#)  
Individual study on problem of interest to epidemiology or public health student.

**VMed 5090. Seminar: Veterinary Epidemiology.** (1 cr [max 3 cr]; S-N only. Prereq—Veterinary medicine grad student)  
Each student leads at least one seminar. Reviews of current research, literature reviews, and technique development. Students and participating faculty participate in presentation, discussion, and administration of the seminars.

**VMed 5093. Directed Studies in Population Medicine.** (1-4 cr [max 8 cr]; A-F only. Prereq—Grad student, #)  
Directed studies arranged between student and instructor.

**VMed 5165. Monitoring and Surveillance of Disease and Production.** (2 cr; A-F only. Prereq—#)  
Seminars and discussion on techniques used to monitor animal disease and production.

**VMed 5193. Dairy Decision Making in a Financial Context.** (2 cr; A-F only. Prereq—Earned DVM, #)  
Economic/decision making principles applied to commercial dairy farms in North America. Economic techniques, decision making under financially constrained conditions. Financial evaluation of a dairy operation. Modules assignments, written work submitted via the Internet, discussions at online course site.

**VMed 5210. Advanced Large Animal Physiology I.** (1-3 cr [max 6 cr])  
Review of large animal physiology at level needed for specialty board certification or beginning research. Students present topics in physiology and supplement reading with clinical case material or journal articles.

**VMed 5211. Advanced Large Animal Physiology II.** (1-3 cr [max 6 cr]; A-F only. Prereq—5210 recommended)  
Review of large animal physiology at level needed for specialty board certification or beginning research. Students present topics in physiology and supplement reading with clinical case material or journal articles.

**VMed 5232. Comparative Clinical Veterinary Dermatologic Pathology.** (1 cr; A-F only. Prereq—Grad student, #)  
Microscopic pathology of basic dermatologic reactions and of variable disease states.

**VMed 5274. Diseases of the Urinary System.** (1 cr; A-F only. Prereq—#)  
Expands on disorders of small animal urinary system. Introduction to core and to additional disorders.

**VMed 5291. Independent Study in Veterinary Medicine.** (2 cr. Prereq—DVM, #)  
Arranged independent study in a clinical area of veterinary medicine.

**VMed 5293. Directed Studies in Comparative Medicine and Pathology.** (1-4 cr [max 8 cr]; A-F only. Prereq—Grad student, #)  
Directed studies arranged between student and instructor.

**VMed 5295. Problems in Large Animal Clinical Medicine/Surgery and Theriogenology.** (1 cr [max 3 cr]; A-F only. Prereq—VMed grad student, possess DVM)  
Hospital cases using standardized format, audio/visual aids. Review literature pertaining to case. One or two cases presented by enrolled participants per month.

**VMed 5493. Directed Studies in Infectious Disease.** (1-4 cr [max 8 cr]; A-F only. Prereq—Grad student, #)  
Directed studies arranged between student and instructor.

**VMed 5596. Swine Diseases and Diagnostics.** (2-3 cr)  
Review of recent advances in swine diseases; farm visits for on-farm disease diagnostics and control programs.

**VMed 5610. Companion Animal Oncology.** (2 cr; S-N only. Prereq—DVM, #)  
Principles of veterinary oncology. Biologic behaviors, treatments, and prognosis of neoplastic disorders.

**VMed 5691. Independent Research in Veterinary Anesthesiology.** (1-6 cr; A-F only. Prereq—[Biology major or prevet or vet or grad student], #)  
Independent research supervised by faculty member.

**VMed 5693. Directed Studies in Surgery/Radiology/Anesthesiology.** (1-4 cr [max 8 cr]; A-F only. Prereq—Grad student, #)  
Directed studies arranged between student and instructor.

**VMed 5720. Small Animal Orthopedic Radiology.** (2 cr. Prereq—#)  
Roentgen signs of common bone diseases of small animals.

**VMed 5722. Large Animal Orthopedic Radiology.** (1-2 cr. Prereq—#)  
Roentgen signs of common bone diseases of large animals. Emphasizes the horse.

**VMed 5893. Directed Studies in Theriogenology.** (1-4 cr [max 8 cr]; A-F only. Prereq—Grad student, #)  
Directed studies arranged between student and instructor.

**VMed 8090. Epidemiology of Zoonoses and Diseases Common to Animals and Humans.** (1-4 cr; A-F only. Prereq—Epidemiology and infectious disease course or #)  
Major human zoonotic diseases, methods of transmission, diagnosis, control, and prevention.

**VMed 8134. Ethical Conduct of Animal Research.** (2 cr; A-F only. Prereq—[Grad or professional school] student or #)  
Ethical considerations in use of animal subjects in agricultural, veterinary, and biomedical research. Federal, state, and University guidelines relating to proper conduct for acquisition/use of animals for laboratory, observational, epidemiological, and clinical research. Regulatory requirements. Bases for proper conduct. Societal impact on scientific investigations utilizing animal subjects.

**VMed 8195. Pre-Harvest Food Safety and Public Health Aspects of Food Animal Production.** (1-3 cr. Prereq—#)  
Includes presentations and discussions on on-farm HACCP principles and prudent use of antibiotics.

**VMed 8201. Advanced Small Animal Veterinary Medicine.** (1-5 cr; A-F only. Prereq—#)  
Discussions of diseases of organs or systems in animals, including degenerative, psychological, anomalous, metabolic, nutritional, neoplastic, immune, inflammatory, toxic, and traumatic disorders.

**VMed 8202. Internal Medicine in Small Companion Animals.** (1-3 cr; A-F only. Prereq—#)  
Lectures, assigned readings, and discussions on internal medical problems of dogs and cats.

**VMed 8203. Advanced Diagnosis and Therapeutics of Animal Disease.** (1-2 cr; A-F only. Prereq—#)  
Detailed examination, treatment, and discussions of naturally occurring disease in patients admitted to Veterinary Teaching Hospital.

**VMed 8210. Seminar: Veterinary Medicine.** (1 cr. Prereq—#)  
Participation and presentations of regularly scheduled seminars about internal medicine.

**VMed 8220. Advanced Nephrology/Urology Clinics.** (1-3 cr. Prereq—#)  
Clinical investigation of naturally occurring urinary diseases in patients admitted to Veterinary Teaching Hospital.

**VMed 8230. Medical Conference.** (1-3 cr. Prereq—#)  
Participation in weekly conference about internal medical disorders.

**VMed 8250. Problems in Acid-base, Electrolyte, and Fluid Metabolism.** (2-4 cr; A-F only)  
Clinical problems and physiology of acid-base, electrolyte, and fluid disorders of dogs and cats.

**VMed 8293. Advanced Studies in Nephrology and Urology.** (1-3 cr; A-F only)  
Studies of urinary tract disease with goal of generating new knowledge.

**VMed 8294. Research Studies in Nephrology and Urology.** (1-3 cr. Prereq—#)  
Individual research on selected problems

**VMed 8296. Advanced Large Animal Veterinary Medicine.** (1-3 cr [max 6 cr]; A-F only. Prereq—DVM, grad vet med major, CAPS 7801, #)  
Discussions of diseases of organs or systems in animals in a clinical setting.

**VMed 8333. FTE: Master's.** (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

**VMed 8360. Evidence-based Medicine.** (2 cr; A-F only)  
Use of medicine literature in clinical problem solving.

**VMed 8393. Medical Conference.** (1-3 cr [max 6 cr]; A-F only. Prereq—#)  
Medical, surgical, or obstetrical cases supported by anatomic, bacteriologic, pathologic, physiologic, pharmacologic, and radiologic evaluations whenever applicable.

**VMed 8394. Research in Veterinary Medicine.** (1-3 cr. Prereq-#)

Research problems relating to any aspect of internal medicine or to the various systems in animals.

**VMed 8396. Diagnostic and Therapeutic Techniques of Animal Diseases.** (1-3 cr [max 6 cr]. Prereq-CAPS 7801, DVM, grad vet med major, #)

Detailed examination, discussions, and treatments of cases of animal diseases in a clinical setting.

**VMed 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**VMed 8492. Seminar: Infectious Diseases and Swine Medicine.** (1-2 cr)

Students, faculty, and guest speakers present seminars on current research in diagnosis, control, and treatment of infectious diseases.

**VMed 8494. Research in Infectious Diseases.** (1-3 cr) Directed research.

**VMed 8495. Problems in Infectious Diseases.** (1-3 cr) In-depth discussion on specific problems for various infectious diseases of farm animals.

**VMed 8520. Advanced Immunology.** (2 cr) Lectures and case presentations.

**VMed 8530. Advanced Swine Diseases.** (2 cr) Lectures and discussion on advances.

**VMed 8592. Infectious Disease Journals: Critical Thinking.** (1 cr) Reading and critical discussion of journal articles.

**VMed 8593. Advanced Veterinary Virology and Serology.** (1-3 cr) Discussion and laboratory practice.

**VMed 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**VMed 8681. Advanced Small Animal Surgery.** (1-3 cr) Advanced techniques and procedures.

**VMed 8682. Advanced Large Animal Surgery.** (1-3 cr [max 6 cr]; A-F only. Prereq-DVM or equiv degree, #) Surgery of various systems in large animals, with preoperative and postoperative evaluation and management.

**VMed 8685. Neurosurgery.** (2-3 cr; A-F only) Advanced neurosurgical diseases of small animals amenable to surgical treatment.

**VMed 8686. Thoracic and Cardiovascular Surgery.** (2-4 cr; A-F only) Advanced thoracic and cardiovascular diseases of small animals amenable to surgical treatment.

**VMed 8687. Plastic and Reconstructive Surgery.** (2-3 cr; A-F only) Advanced techniques in conditions of small animals.

**VMed 8688. New Techniques in Large Animal Surgery.** (1-6 cr [max 6 cr]; A-F only. Prereq-DVM or equiv degree, #)

**VMed 8689. Urogenital Surgery.** (2-3 cr) Advanced techniques in treatment of small animals.

**VMed 8691. Research in Large Animal Surgery.** (1-6 cr; A-F only. Prereq-DVM or equiv degree, #) Independent research projects.

**VMed 8692. Seminar: Small Animal Surgery.** (1 cr; A-F only) Discussions of problems and case analysis.

**VMed 8693. Seminar: Large Animal Surgery.** (1 cr [max 6 cr]; A-F only. Prereq-DVM or equiv degree, #) Discussion of current literature and surgery board preparation.

**VMed 8694. Research in Small Animal Surgery.** (1-3 cr; S-N only)

**VMed 8695. Problems in Large Animal Surgery.** (1-3 cr [max 6 cr]; A-F only. Prereq-DVM or equiv degree, #) New techniques and procedures in large animal orthopedic surgery.

**VMed 8696. Research in Critical Care/Emergency Medicine.** (1-3 cr. Prereq-DVM or equiv degree) Special problems course. Controlled study; prospective and retrospective models of evaluation are defined, critiqued, and used for experimental design and data collection to validate research methods.

**VMed 8777. Thesis Credits: Master's.** (1-18 cr [max 50 cr]; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**VMed 8780. Advanced Avian Critical Care: Principles and Procedures.** (2 cr; A-F only. Prereq-Course each in vet pathology, physiology, pharmacology, anatomy, small animal anesthesiology and critical care) Procedures and protocols for managing avian medical emergencies such as starvation, toxicities, respiratory failure, and massive trauma.

**VMed 8781. Seminar: Advanced Veterinary Anesthesiology.** (1-3 cr; A-F only. Prereq-[[CVM 6321, CVM 6322] or equiv], grad student) Active interaction around topics of advanced anesthesiology in veterinary species.

**VMed 8782. Advanced Veterinary Abdominal Imaging.** (1-3 cr) Applications and discussion of basic principles through emerging techniques.

**VMed 8783. Advanced Veterinary Thoracic Imaging.** (1-3 cr) Application and discussion of basic principles through emerging techniques.

**VMed 8784. Veterinary Therapeutic Radiology.** (2-3 cr [max 6 cr]) In-depth discussion of principles, practice, techniques, and complications.

**VMed 8785. Veterinary Nuclear Medicine.** (1-3 cr [max 6 cr]) In-depth discussion of principles, practice, techniques, and complications.

**VMed 8788. Seminar: Veterinary Critical Care/Emergency Medicine.** (1 cr; A-F only. Prereq-DVM or equiv degree) Current topics.

**VMed 8789. Research in Avian Clinical Problems and Procedures.** (1-3 cr; A-F only. Prereq-5330, 8780, 8796, DVM) Students conduct medical and surgical procedures involved in management of avian trauma and critical care patients.

**VMed 8791. Research in Veterinary Anesthesia.** (1-3 cr; A-F only. Prereq-8781 or equiv, SACS 5380 or equiv) Research methodology; controlled prospective and retrospective research studies. Collection and analysis of scientific data.

**VMed 8792. Seminar: Veterinary Radiology.** (1 cr [max 6 cr]) Current topics in veterinary imaging, veterinary radiation therapy, or specific applications.

**VMed 8793. Seminar: Veterinary Anesthesiology.** (1-2 cr; A-F only. Prereq-CVM 6321, CVM 6322 or equiv, DVM degree) Discussion and presentations; for veterinary anesthesiology and surgery residents and graduate students.

**VMed 8794. Research in Veterinary Radiology.** (1-3 cr) Research into an application, development of an application, or prospective/retrospective study of any aspect of veterinary imaging or veterinary radiotherapy.

**VMed 8795. Problems: Veterinary Radiology.** (1-3 cr [max 6 cr]) Discussion of problems associated with veterinary imaging or radiation therapy.

**VMed 8796. Avian Anesthesia and Orthopedic Surgery.** (1-3 cr; A-F only. Prereq-Courses in vet anesthesia, vet small animal orthopedics) Current methods for anesthetizing raptors, psittacine birds, and waterfowl. Lecture and lab on current methods for avian fracture bone fixation.

**VMed 8882. Theriogenology Journals: Critical Evaluation.** (1 cr [max 1 cr]) Reading and presentation of selected current research journal articles; critical evaluation of experimental design, methods, and results.

**VMed 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

**VMed 8891. Seminar: Theriogenology.** (1 cr)

**VMed 8893. Advanced Diagnostic Methods in Theriogenology.** (1-3 cr. Prereq-CAPS 5570) Directed research in methods for studying fertility factors affecting female and male animal reproduction.

## Veterinary Pathobiology (VPB)

*Department of Veterinary Pathobiology  
College of Veterinary Medicine*

**VPB 5601. Veterinary Parasitology.** (4 cr)

**VPB 8333. FTE: Master's.** (1 cr; NGA. Prereq-Master's student, adviser and DGS consent)

**VPB 8444. FTE: Doctoral.** (1 cr; NGA. Prereq-Doctoral student, adviser and DGS consent)

**VPB 8501. Advanced Veterinary Basic Pathology.** (2-3 cr. Prereq-#) Basic mechanisms and concepts relating to reaction of tissue to injury. Gross and microscopic interpretation of retrogressive cellular changes, cellular infiltrations, inflammation, and neoplasia. Students complete a special project selected in conjunction with instructor.

**VPB 8502. Advanced Systemic Pathology.** (3-4 cr. Prereq-5501 or 8501, #) Reaction of specific systems to injury emphasizing basic response capabilities of tissue or organ, with materials illustrating gross and microscopic changes. Students complete a special project selected in conjunction with instructor.

**VPB 8504. Advanced Veterinary Histopathology.** (1 cr. Prereq-5502, 5503, #) Discussion and study of selected case materials from veterinary anatomic, diagnostic, and surgical pathology programs.

**VPB 8531. Hospital Pathology.** (1-2 cr. Prereq-5501, 5502, 5503, #) Necropsy and surgical pathology techniques, examination of tissue for diagnosis, and preparation of reports and records.

**VPB 8540. Problems: Veterinary Pathology.** (2-6 cr [max 12 cr]. Prereq-#) Independent study.

**VPB 8550. Problems: Veterinary Clinical Pathology.** (2-6 cr [max 12 cr]. Prereq-#) Independent study.

**VPB 8666. Doctoral Pre-Thesis Credits.** (1-18 cr; NGA. Prereq-Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**VPB 8700. Seminar: Veterinary Pathobiology.** (1 cr [max 5 cr]. Prereq-#)

**VPB 8724. Advanced Veterinary Diagnostic Microbiology.** (3 cr. Prereq-#) Lectures and laboratory in techniques of diagnostic mycology, bacteriology, virology, and serology.

**VPB 8777. Thesis Credits: Master's.** (1-18 cr; NGA. Prereq-Max 18 cr per semester or summer; 10 cr total required [Plan A only])

**VPB 8888. Thesis Credits: Doctoral.** (1-24 cr; NGA. Prereq-Max 18 cr per semester or summer; 24 cr required)

## Water Resources Science (WRS)

### College of Natural Resources

#### WRS 5001. Introduction to Field Research in Water Resources. (2 cr. Prereq—Grad WRS major or #)

Introduction to field research techniques and opportunities during two-week summer excursion to regional sites. Data acquisition in large/small lakes, streams, and wetlands for biota and chemical/physical water quality; surface and groundwater hydrologic measurements and sampling.

#### WRS 5101. Water Resources: Individuals and Institutions. (3 cr. Prereq—Grad student or #)

Socio-cultural, legal, and economic forces that affect use of water resources by individuals/institutions. Historical trends in water policy, resulting water laws in the United States. Institutional structures whereby water resources are managed at federal, state, and local levels.

#### WRS 5241. Ecological Risk Assessment. (3 cr. Prereq—#)

Evaluating current/potential impact of physical, chemical, and biological agents on ecosystems. Identifying ecological stressors, assessing level of exposure, measuring ecological responses, communicating/managing risks. Class participation, two reaction papers, final exam, small-group project.

#### WRS 8050. Special Topics in Water Resources Science. (1-3 cr [max 6 cr]; A-F only. Prereq—#)

#### WRS 8060. Directed Studies in Water Resources Science. (1-3 cr [max 6 cr]; A-F only. Prereq—#)

#### WRS 8095. Plan B Project. (3 cr; S-N only. Prereq—#)

Satisfies Plan B project requirement. May appear on master's program, but does not count toward credit minimum in major. Project topic arranged between student and adviser. Written report required.

#### WRS 8100. Interdisciplinary Seminar in Water Resources. (1-3 cr [max 3 cr])

#### WRS 8333. FTE: Master's. (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

#### WRS 8444. FTE: Doctoral. (1 cr; NGA. Prereq—Doctoral student, adviser and DGS consent)

#### WRS 8666. Doctoral Pre-Thesis Credits. (1-18 cr [max 60 cr]; NGA. Prereq—Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

#### WRS 8777. Thesis Credits: Master's. (1-18 cr [max 50 cr]; NGA. Prereq—Max 18 cr per semester or summer; 10 cr total required [Plan A only])

#### WRS 8888. Thesis Credits: Doctoral. (1-24 cr [max 100 cr]; NGA. Prereq—Max 18 cr per semester or summer; 24 cr required)

## Women's Studies (WoSt)

### Department of Women's Studies

### College of Liberal Arts

#### WoSt 5101. Feminist Approaches to Ethnography. (3 cr)

Preparation for feminist ethnographic research in the social sciences. Using recent works by feminist ethnographers, focus is on the methods, politics, and ethics, as well as gender, race, class, and cross-cultural issues pertaining to fieldwork.

#### WoSt 5102. Feminist Approaches to History. (3 cr. Prereq—8 cr WoSt or grad or #)

Analysis and practice of feminist history. Theories, methods, and sources that address the interrelationship of gender, race, class, and sexuality.

#### WoSt 5103. Feminist Pedagogies. (3 cr. Prereq—Grad or #)

Theory and practice of feminist pedagogies by comparing and evaluating various multicultural feminist theories of education/teaching and the application of specific theories, techniques, and teaching strategies.

#### WoSt 5105W. Gendered Rhetoric of Science and Technology. (3 cr. Prereq—8 cr WoSt or grad or #)

How cultural gender roles are affected by science and technology as well as influence scientific and technological thinking and communication strategies.

#### WoSt 5106. The Cultural Construction of Sex, Gender, and Sexuality. (3 cr. Prereq—Feminist studies grad or 12 cr WoSt or #)

Investigation of Euro-American concepts of sex, gender, sexuality in representative texts and images from the 17th century to the present. Critical and source materials from literary and cultural studies, history, biology, anthropology, psychology, and sociology.

#### WoSt 5107. Gender, Culture, and Science. (3 cr)

Critical study of some of the major papers concerning the relations of gender and scientific inquiry produced in the past 20 years.

#### WoSt 5190. Topics: Methods of Inquiry. (3 cr)

Topics specified in *Class Schedule*.

#### WoSt 5201. Global Processes and the Politics of Sexuality. (3 cr. Prereq—12 cr WoSt or feminist studies grad student or #)

Comparative examination of the social construction of sexuality. Formal/informal norms/regulations, categories of deviance, representation of sex in the media/arts, role of sexuality in relation to agency/subjectivity.

#### WoSt 5202. Feminist Therapies. (3 cr)

Feminist and multicultural perspectives regarding therapy and other helping forms for women, including philosophy of feminist theory; feminist ethics in therapy; gender, sexual identity, race and class in therapy, and related topics.

#### WoSt 5203. Women and Madness in History and Literature. (3 cr. \$3206. Prereq—Jr, 4 cr WoSt or #)

The representation of madness and how it intersects with gender as well as class, race, sexual orientation, and nationality.

#### WoSt 5290. Topics: Biology, Psychology, and Social Perspectives. (3 cr)

Topics specified in *Class Schedule*.

#### WoSt 5300. Communication and Gender. (3 cr; A-F only. Prereq—One women's studies course or #)

How gender affects verbal communication. Development of analytical skills through readings, exercises, research that raise awareness of the power of language and the influence of gender prescriptions.

#### WoSt 5390. Topics: Literature, Film, and Other Arts. (3 cr)

Topics specified in *Class Schedule*.

#### WoSt 5403. Chicana/Latina Feminisms. (3 cr. Prereq—8 cr WoSt and/or Chic or grad or #)

The historical and social development of Chicana and Latina feminisms in general and their various specific types.

#### WoSt 5404. Working Class Women's Cultures. (3 cr. Prereq—12 cr WoSt or #)

Myths and realities surrounding working class women and their cultures. Use sociological and literary material in an effort to learn about working class women and to hear their own voices.

#### WoSt 5405. Chicanas: Women and Work. (3 cr. Prereq—#)

Chicanas, their various relationships to family/community. Local, national, and global work forces. Questions/issues related to growing integration of world's systems of production.

#### WoSt 5490. Topics: Comparative and Global Studies. (3 cr [max 12 cr])

Topics specified in *Class Schedule*.

#### WoSt 5501. Women and the Law. (3 cr. Prereq—9 cr [WoSt or pre-law grad] or #)

Legal system as it relates to women: historical legal approach to issues related to constitutional rights of women.

#### WoSt 5505. Women and Indigenous Land Struggles. (3 cr. Prereq—8 cr WoSt and/or Chic and/or Amln or #)

Representative land struggles by indigenous women from a critical race and gender perspective.

#### WoSt 5590. Topics: Civic and Community Studies. (3 cr [max 12 cr])

Topics specified in *Class Schedule*.

#### WoSt 5993. Directed Study. (1-12 cr [max 12 cr]. Prereq—#)

#### WoSt 5994. Directed Instruction. (1-12 cr [max 36 cr])

#### WoSt 5995. Directed Research. (1-8 cr [max 36 cr])

#### WoSt 8101. Intellectual History of Feminism. (3 cr)

Major trends in feminist intellectual history from 14th century to the present, especially in the United States and Europe.

#### WoSt 8102. Advanced Studies in Sexuality. (3 cr)

Contemporary theoretical scholarship and research on selected issues related to sexuality, gender, and the body.

#### WoSt 8103. Feminist Theories of Knowledge. (3 cr)

Interdisciplinary seminar; feminist approaches to knowledge and to criticism of paradigms of knowledge operative in the disciplines. Feminists' use of concepts of subjectivity, objectivity, and intersubjectivity; feminist empiricism, standpoint theory, and contextualism, and postmodern and postcolonial theorizing.

#### WoSt 8108. Feminist Theories and Methods I. (3 cr. Prereq—Feminist studies PhD or grad minor student)

Two-semester interdisciplinary seminar. First term: current debates in gender theory; intersections of gender theory with critical race theory, post-colonial theory, sexuality theory, and social class analysis. Second term: inter- and multi-disciplinary feminist research frameworks and methodologies from humanities and social sciences.

#### WoSt 8109. Feminist Theories and Methods II. (3 cr. Prereq—8108, feminist studies PhD or grad minor student)

Two-semester interdisciplinary seminar. First term: current debates in gender theory; intersections of gender theory with critical race theory, post-colonial theory, sexuality theory, and social class analysis. Second term: inter- and multi-disciplinary feminist research frameworks and methodologies from humanities and social sciences.

#### WoSt 8190. Topics: Feminist Theory. (1-3 cr [max 12 cr])

#### WoSt 8201. Feminist Theory and Methods in the Social Sciences. (3 cr)

Seminar on recent theories, including feminist versions of positivist, interpretivist, critical theoretical, and postmodernist models of social science knowledge. Methodologies congenial to feminist practices of inquiry, including use of narrative in theory, feminist ethnography, discourse analysis, and comparative methods in history.

#### WoSt 8202. Sociology of Gender. (3 cr)

Organization, culture, dynamics of gender relations and gendered social structures. Gender, race, and class inequalities in the workplace; the women's movement; social welfare and politics of gender inequality; gender and science; theoretical debates in gender theory and methods; sexuality; cultural studies of gender; sociology of emotions.

#### WoSt 8290. Topics: Social Sciences and Public Policy. (1-3 cr)

#### WoSt 8301. Feminist Literary Criticism. (3 cr)

Recent developments and major issues in feminist studies of literature. Introduction to array of scholars and scholarship in field of feminist literary theory and criticism, emphasizing broad range of feminist textual analysis taking place in various University departments.

#### WoSt 8333. FTE: Master's. (1 cr; NGA. Prereq—Master's student, adviser and DGS consent)

#### WoSt 8390. Topics: Literary Studies. (1-3 cr)

**WoSt 8401. Gender, Space, and Resistance.** (3 cr)  
Identity politics, social movements, and development politics; complex interrelationships among gender, space, and resistance. Social nature of place and space; sociopolitical and economic processes by which gendered, raced, and classed differences are constituted, reinforced, and resisted in and through space, place, and social networks.

**WoSt 8444. FTE: Doctoral.** (1 cr; NGA. Prereq–Doctoral student, adviser and DGS consent)

**WoSt 8490. Topics: Comparative and Global Studies.** (1-3 cr)

**WoSt 8590. Topics: Historical Studies.** (1-3 cr)

**WoSt 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq–Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**WoSt 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer; 24 cr required)

**WoSt 8993. Directed Study.** (1-6 cr [max 9 cr])

**WoSt 8994. Directed Instruction.** (1-8 cr [max 36 cr])

**WoSt 8995. Directed Research.** (1-8 cr [max 36 cr])

**WoSt 8996. Women's Studies/CAFS Colloquium.** (1 cr [max 4 cr]; S-N only)  
Feminist studies Ph.D. students must register for 1 credit per semester. Credit available also to other graduate students.

**WoSt 8997. Feminist Research and Writing.** (3 cr. Prereq–8109, passed written prelims in degree granting program)  
Develops interdisciplinary feminist components of Ph.D. thesis or other major piece of writing. Facilitates research/writing.

## Wood and Paper Science (WPS)

*Department of Wood and Paper Science*

*College of Natural Resources*

**WPS 5402. Business Markets in the Forest Products Industry.** (3 cr [max 3 cr]; A-F only)  
How forest products companies sell to other businesses, how this differs from traditional consumer process. Emphasizes business marketing communications, sales force management, organizational buying, partnering, e-commerce, globalization of business markets. Case studies, discussion, daily readings from course text, academic/industry publications.

**WPS 8300. Research Problems.** (1-10 cr [max 10 cr]. Prereq–#)  
Independent research under faculty guidance.

**WPS 8303. Advanced Topics in Panel Products Technology.** (2 cr. Prereq–4307)  
Particle/fiber processing, additives, press cycle, design of panels for specific end uses.

**WPS 8304. Advanced Topics in Wood Drying.** (2 cr. Prereq–4304)  
Rheological behavior of first-dried solid wood. Significance of creep to stress-strain pattern, shrinkage, and degrade development in lumber drying. Interpretation/evaluation of schedules, processes, and primary/auxiliary equipment used in commercial drying processes. Energy consideration in drying processes.

**WPS 8306. Graduate Seminar.** (1 cr [max 3 cr])  
Communication of scientific knowledge related to wood and paper science through the media of poster sessions, oral presentations, and the Internet.

**WPS 8307. Advances and Methods in Forest Products Pathology and Preservation.** (2 cr. Prereq–4303)  
Principles of wood protection, methods of evaluating preservatives. Emphasizes international developments.

**WPS 8311. Mechanics of Wood and Wood Composites.** (2 cr. Prereq–#)  
Advanced topics on behavior of wood composites.

## Work, Community, and Family Education (WCFE)

*Department of Work, Community, and Family Education*

*College of Education and Human Development*

**WCFE 5002. Thinking, Learning, and Teaching in Work, Community, and Family.** (3 cr; A-F only)  
Nature of thinking/learning in everyday life contexts of family, work, community. Theory/practice relevant to stimulating/supporting thinking/learning in/for these contexts.

**WCFE 5011W. Technology and Public Ethics.** (3 cr; A-F only)  
Nature of technology. Values, ethical issues related to technology. Technology and transformation of workplace, family, community life. Critique of technology.

**WCFE 5021. Learning Through Service.** (3 cr)  
Service as both a philosophy and method of learning. Content covers both the theory and the practice of service in school-based and community-based organizations.

**WCFE 5031. Information Resources in Education.** (3 cr; S-N only)  
Sources of knowledge and search strategies for accessing library, electronic, institutional, and informal resources of interest to educators.

**WCFE 5101. Introduction to Leadership and Administration of WCFE.** (3 cr)  
Basic concepts of finance, public relations, communications, legal aspects, leadership, personnel policies and management, program planning and development, evaluation, and interinstitutional collaboration of work, community, and family education programs in school-based settings.

**WCFE 5102. Leadership in WCFE.** (2 cr)  
An introduction to the concepts of leadership, leadership roles and responsibilities, and application to work, community, and family education settings.

**WCFE 5121. Principles of Supervisory Management.** (3 cr)  
Introduction to the principles of supervision in education, business, industry, government, and service organizations.

**WCFE 5125. Critical Pedagogy.** (3 cr; S-N only)  
Examination of critical pedagogy; critique of power relations regarding race, culture, class, gender, and age in various educational settings; consideration of improved practice in education for children, youth, and adults.

**WCFE 5131. Planning WCFE.** (3 cr)  
Examination of educational planning and evaluation of work, community, and family education in formal and nonformal settings.

**WCFE 5141. Evaluation of WCFE.** (3 cr)  
Designing and conducting project, program, and systems evaluations in work, community, and family education contexts and settings.

**WCFE 5201. Family and Work Relationships.** (3 cr; A-F only)  
Examination of the interactions of work and family to prepare professionals to improve work and family relationships.

**WCFE 5301. Philosophy and Practice of Career and Technical Education: Advanced.** (2 cr; A-F only)  
Purposes/goals of contemporary career/technical education. Governance structure, historical perspectives, industry-education relationship, current education practices. Possible future trends and their implications. Development of a personal philosophy of career/technical education.

**WCFE 5331. Coordination Techniques for Work and Community Education.** (3 cr)  
Purposes of cooperative work and community education; responsibilities of instructor coordinator; guidance, selection, placement, supervision and evaluation of students; articulation of related instruction; training sponsor identification, orientation, development, and evaluation; management of the program.

**WCFE 5341. Global Program Delivery Techniques and Technology.** (2 cr; A-F only)  
Special educational activities and teaching and communications methods and techniques for youth and adults, ranging from outreach to extension services, with an emphasis on youth and adult education programs in different global settings.

**WCFE 5351. Methods for Change in Developing Countries.** (3 cr; A-F only)  
Sociological and cultural parameters as they pertain to promoting the adoption of improved practices in rural, community, and agricultural development, including formal and informal education institutions. Project planning, implementation, and evaluation related to actual change and development situations in developing countries.

**WCFE 5400. Special Topics in Youth Development Leadership.** (1-4 cr [4 cr max])  
An examination of important social and political topics of current interest to youth development practitioners with an emphasis on leadership implications for practice in youth agencies, congregations, schools, and other community settings. Content varies by offering.

**WCFE 5411. The Everyday Lives of Youth.** (3 cr; A-F only)  
Lived realities of body, time, space, other, and self from an existential and phenomenological perspective.

**WCFE 5412. Experiential Learning: Theory and Practice.** (3 cr; A-F only)  
Examines the theory and practices of learning by doing. Emphasis on the educator's personal engagement in the actual process to understand the technical, motivational, and evaluative aspects of experiential learning.

**WCFE 5413. Organizational Approaches to Youth Development.** (3 cr; A-F only. Prereq–YDL Med student or #)  
Language, historical influences, and educational philosophies fundamental to youth development work in organizations serving youth.

**WCFE 5414. Issues in Youth Development Leadership.** (3 cr; A-F only)  
An examination of issues that drive the professional practice of community-based youth work. Participants engage experts from the family, community, schools, and workplace to develop a deeper understanding of how public issues and policy affect the everyday lives of youth.

**WCFE 5451. Seminar: Youth Development Leadership.** (1-4 cr [max 4 cr]; S-N only. Prereq–YDL student or #)  
Applies principles of healthy youth development, nonformal learning venues, and experiential education to practice/policies of community-based youth work. Individual/group projects focus on applied research, community-based teaching/learning, and foundations of ethical practice. Four-course sequence.

**WCFE 5496. Leadership Field Experience: Youth Development.** (4 cr; S-N only)  
Leadership in support of healthy youth development. Work in agency dedicated to community-based youth programming, education, public policy; advocacy for children, youth, families.

**WCFE 5511. Education for Work.** (3 cr)  
Examination of contextual bases underlying education for work; implications for practice.

**WCFE 5521. School-to-Work Policies.** (3 cr)  
Examination of the aims and purposes, federal and state policies, educational reform, and issues and concepts relating to school-to-work education.

**WCFE 5522. School-to-Work Practices.** (3 cr)  
Examination of learning in context; curricular integration; educational system articulation; educational partnerships; best practices in school-based, work-based, service-based learning, and connecting activities; building community support; and leadership relating to school-to-work education.

**WCFE 5601. Student and Trainee Assessment: Advanced.** (2 cr; A-F only)  
Developing learning progress reporting systems and tests of knowledge, affect, and processes for programs focused on instruction of skills associated with business/industry. Evaluating instructional effectiveness. Applying tests and other evaluation instruments to assess/report learning in business/industry and career/technical education fields. Students develop each type of test and an overall evaluation plan for a course.

**WCFE 5629. Course Development for Business and Industry: Advanced.** (2 cr; A-F only)  
Designing instructional programs/courses that help learners develop desired competence. Designing instruction for performance based training and vocational/technical education. Developing course syllabus components that clarify course expectations. Developing academic/community-based elements that complement course goals. Reflect on and compare performance-based instruction with other curriculum models for the field.

**WCFE 5661. Instructional Methods for Business and Industry Education: Advanced.** (2 cr. \$BIE 5661, \$HRD 5661)  
Theory/practice in instructional methods for career/technical education (CTE) instructors and human resources/development (HRD) professionals. How to select various teaching methods and plan for their delivery. Preparing an instructional methods plan to clarify course content, teaching methods selected, rationale for their selection, and how a student organization might facilitate student learning.

**WCFE 5696. Teaching Internship: Introduction.** (1 cr; S-N only. Prereq–Admission to an init lic program)  
Initial experiences in the teaching profession provided through observations of school organization and administration, seminars, relationship building with cooperating teachers, and a reflection on personal involvement as a beginning student teacher.

**WCFE 5697. Teaching Internship: School and Classroom Settings.** (2 cr. Prereq–5696 for init lic program)  
Part-time supervised teaching experience in a school. Seminars on managing student’s learning in the context of work, community, and family education programs in contemporary schools and on becoming a reflective educator.

**WCFE 5698. Teaching Internship.** (3-8 cr [max 8 cr]. Prereq–Admission to an init lic program)  
Teaching experience in a school system that provides programs for grades 5-12.

**WCFE 5699. Teaching Internship: Extended Practice.** (1 cr. Prereq–5698)  
Extended student teaching experience in a school system that provides programs for grades 5-12.

**WCFE 5771. Teaching Entrepreneurship: Small Business Management.** (3 cr)  
Methods, organization, curriculum development and modification, and implementation of educational programs for entrepreneurs.

**WCFE 5801. Educating Special Populations in Work, Community, and Family Settings.** (3 cr)  
Identifying and accommodating educational traits of students with disabilities and disadvantaging conditions in work, community, and family settings.

**WCFE 5802. Interagency Collaboration for Special Populations in Work, Community, and Family Settings.** (2 cr)  
Interagency planning issues and practices relating to special populations for educational, business, and human service organization personnel, as well as family members and advocates.

**WCFE 5803. Developmental Writing and the College Student: Theory and Practice.** (3 cr. Prereq–Bachelor’s degree)  
Basic grounding in theory/practice of college-level developmental writing instruction. History of “basic writing,” development of notions of “academic discourse,” error/grammar in student writing, best classroom practices, current issues.

**WCFE 5804. Research in Postsecondary Developmental Education.** (3 cr. Prereq–Bachelor’s degree, courses in [intro psychology, basic statistics])  
Strategies for conducting three types of research that are central to developmental education: placement test validation, program evaluation, and classroom research. Students read examples and learn what constitutes best practices in each type.

**WCFE 5821. Diversity Issues and Practices in Work, Community, and Family Settings.** (3 cr)  
Examination of the nature of diverse populations and their unique learning and training needs, exemplary programs, and collaborative efforts among persons representing work, community, and family settings.

**WCFE 5822. Diversity and Organizational Transformation in Work, Community, and Family Education.** (2 cr)  
Developing models for understanding the impact of diversity on individual, organizational, and community outcomes; discussing organizational change in relation to diversity.

**WCFE 5823. Program Planning and Improvement for Special Populations in Work, Community, and Family Education.** (2 cr)  
Concepts, issues, and practices related to the design, implementation, and evaluation of efforts focused on developing new programs or modifying existing programs for individuals with special learning needs in work, community, and family settings.

**WCFE 5901. Using Research in Work, Community, and Family Education.** (3 cr)  
Introduction to the role of work, community, and family education research in professional practice, significant problems of practice for research, alternative modes of research, and synthesis and application of the results of research.

**WCFE 5990. Special Topics in Work, Community, and Family Education.** (1-4 cr [max 4 cr])  
Topics vary.

**WCFE 5993. Directed Study in WCFE.** (1-4 cr [max 4 cr]. Prereq–Δ)  
Self-directed study, with faculty advice, in areas not covered by regular courses.

**WCFE 8100. Work, Community, and Family Education Colloquium.** (1-3 cr [max 3 cr])  
Selected topics of significance to work, community, and family education professionals. Topics based on interest and demand.

**WCFE 8141. History and Philosophy of Work, Community, and Family Education.** (3 cr)  
Historical influences and philosophical views regarding ideas, research, practice, and continuing issues in work, community, and family education.

**WCFE 8142. Work, Community, and Family Education Comparative Systems.** (3 cr. Prereq–8141)  
Comparison of work, community, and family education systems within the United States and between the United States and other countries.

**WCFE 8444. FTE: Doctoral.** (1 cr; NGA. Prereq–Doctoral student, adviser and DGS consent)

**WCFE 8666. Doctoral Pre-Thesis Credits.** (1-18 cr [max 60 cr]; NGA. Prereq–Max 18 cr per semester or summer; doctoral student who has not passed prelim oral)

**WCFE 8888. Thesis Credits: Doctoral.** (1-24 cr [max 100 cr]; NGA. Prereq–Max 18 cr per semester or summer; 24 cr required)

**WCFE 8896. Internship.** (1-10 cr [max 10 cr]; S-N only. Prereq–Δ)  
Student applies for position in professional practice; individual arrangements describe specific responsibilities during internship. Ed.D. program requirement.

**WCFE 8911. Foundations of Inquiry.** (2 cr; A-F only)  
Practice of inquiry in work, community, and family education. Historical/philosophical origins/influences. Scientific/political nature of inquiry. Alternative inquiry perspectives. Central concepts. Positivist, interpretive, and critical science research perspectives.

**WCFE 8912. Quantitative Research.** (3 cr. Prereq–8911)  
Assumptions, procedures for, and considerations in planning/conducting quantitative research in work, community, and family education.

**WCFE 8913. Interpretive Research.** (3 cr; A-F only. Prereq–8911)  
Hermeneutic, ethnomethodological, and phenomenological research methodologies. Consideration of ethics, evaluation, and usefulness of interpretive research. Practice in conducting interpretive research in work, community, and family education.

**WCFE 8914. Critical Science Research.** (3 cr; A-F only. Prereq–8911)  
Origins, influences, characteristics, and central concepts; distinction between critical science and other action research; requisite skills and knowledge for conducting critical science research and using that knowledge in a project.

**WCFE 8915. Ethics and Responsible Research.** (1 cr; A-F only)  
Introduction to ethical and legal issues involved in practicing responsible educational research. Key issues, formal and informal codes of conduct, and ethical reasoning skills.

**WCFE 8990. Research Seminar.** (1 cr [max 6 cr]; S-N only. Prereq–8911, [8912 or 8913 or 8914] or Δ)  
Developing, reporting, and evaluating research. Participants make and react to presentations. (Two credits counted in doctoral program.)

## Youth Development and Research (YoSt)

### School of Social Work College of Human Ecology

**YoSt 5031. Youth in the World.** (3 cr. Prereq–Upper div AdPy course)  
Encourages critical thinking about how youth as ideal and as lived reality are understood in scholarship, public discourse, and professional practice. Larger framework includes building a basis for understanding youth and working with or on behalf of youth.

**YoSt 5032. Child and Adolescent Psychology for Practitioners.** (3 cr. Prereq–Courses in ed psych or child or adolescent psych)  
Application of theory and research about children and adolescents including how findings can be used and how theories facilitate understanding of behavior.

**YoSt 5101. Youth Work Practice I: Internship.** (3 cr. Prereq–3101, 5032 or equiv, #5111, #)  
First course of a sequential internship that includes 15 hours per week working with youth in a community youth-serving organization. Develop and enhance competence and identity as a youth worker, and reflect on and integrate knowledge about youth with on-going experience in youth work.

**YoSt 5102. Youth Work Practice II: Internship.** (3 cr. Prereq–5101, #5112, #)  
Second course of a sequential internship that includes 15 hours per week of work with youth in a community youth-serving organization. Develop and enhance competence and identity as a youth worker, and reflect on and integrate knowledge about youth with ongoing experience in youth work.

**YoSt 5111. Youth Work Methods I: Seminar.** (1 cr.  
Prereq–3101, 5032 or equiv, ¶5101, #)  
Weekly discussion seminar taken concurrently with 5101 to integrate theory and praxis with youth work experience. Written and experiential assignments to increase knowledge, competency, and skills related to working with youth.

**YoSt 5112. Youth Work Methods II: Seminar.** (1 cr.  
Prereq–5111, ¶5102, #)  
Weekly discussion seminar taken concurrently with 5102 to integrate theory and praxis with youth work experience. Written and experiential assignments to increase knowledge, competency, and skills related to working with youth.

**YoSt 5234. Youth Agencies, Organizations, and Youth Service System.** (2 cr. Prereq–Two soc/anth courses, work exper in a youth agency or org)  
Overview of major forms of youth agencies and organizations, sources of agency legitimacy, ideologies and values, and goals. Relations between and among agencies and organizations. Roles of adults and youth; professionals and nonprofessionals; paid staff and volunteers; youth participation; legal and ethical issues. Examples of existing and ideal agencies.

**YoSt 5235. Community Building for Healthy Youth Development.** (2 cr. Prereq–Two social sci courses, exper working with youth or #)  
Community is a major context of adolescence and youth life, and community-building is a major strategy for healthy development. Explore recent foundation and government reports that address issues and practical problems of community-building.

**YoSt 5240. Special Topics in Youth Studies.** (2-8 cr [max 10 cr]. Prereq–Two social sci courses, exper working with youth or #)  
In-depth investigation of one area of youth studies. Teaching procedure and approach determined by specific topic and student needs. Topic announced in advance.

**YoSt 5241. Experiential Learning.** (2 cr. Prereq–Two social sci courses, exper working with youth or #)  
Cover rationale for and purposes of experiential learning in schools and youth-serving agencies, development and implementation of experiential programs for adolescents, and evaluation of experiential-learning programs. Each student will develop a plan for an experiential program for teenagers.

**YoSt 5291. Independent Study in Youth Studies.** (1-8 cr [max 8 cr]. Prereq–#)  
Independent reading and/or research under faculty supervision.

**YoSt 5301. Communicating with Adolescents About Sexuality.** (2 cr. Prereq–Upper div AdPy course, exper working with youth or #)  
Sexual development and experiences emphasizing how adults can be comfortable in communicating more effectively with young people. Sexual patterns, variations, roles, power, exploration, and sex education.

**YoSt 5313. Direct Work with Adolescents.** (2 cr. Prereq–Two social sci courses, exper working with youth or #)  
Designed to give an understanding of direct work with troubled and at-risk adolescents in a wide range of settings where youth workers or social workers are typically involved. Emphasis on young people in groups in the “lifespace” in everyday life, rather than in one-to-one office-based interactions.

**YoSt 5321. Work with Youth—Individual.** (2 cr.  
Prereq–5032 or equiv or #)  
Examination of basic assumptions underlying individual work with youth. Attention to special issues and concerns of adolescents and of persons who work with them, especially those who work with youth in one-to-one interactions.

**YoSt 5322. Work with Youth—Families.** (2 cr.  
Prereq–5321 or upper div AdPy course, family theory course or #)  
Theories and techniques of working with youth and their families. Emphasis on practical methods of structural change, developing effective communication, decision-making and problem-solving systems, winning the family’s cooperation; the role of the professional to influence healthy family development.

**YoSt 5323. Work with Youth—Groups.** (2 cr.  
Prereq–5321 or upper div AdPy course or #)  
Increase knowledge and understanding of adolescent group needs and associations; increase knowledge of group process; and enhance skill in working with groups of adolescents in the community, in group living situations, and in group therapy.

**YoSt 5401. Young People’s Spirituality and Youthwork: an Introduction.** (3 cr; A-F only)  
Adolescent spirituality, its relation to working with young people. Faith/spirituality as actual/necessary aspects of healthy youth development. Research, active community-based programs. Knowledge, attitudes, and skills to meet adolescent needs/wants.

**YoSt 5402. Youth Policy: Enhancing Healthy Development in Everyday Life.** (3 cr. Prereq–Two social sci courses, exper working with youth or #)  
Youth policy is typically grounded to problems and risks and is specific to human services domains such as education, health, juvenile justice, employment, and the like. Create youth policy directed at enhancing healthy development through community building, program development, and other strategies.



*This is the Duluth Degree Programs, Campus Maps, Index, and Course Designators sections of the 2003-2005 Graduate School Catalog for the University of Minnesota.*

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# Duluth Degree Programs

## General Information

At the University of Minnesota Duluth, the Graduate School offers programs for the *master of arts* in communication sciences and disorders, counseling psychology (emphases in college counseling, community counseling, and school counseling), and English (emphases in literary studies for concentrated study of literature, English studies, and publishing and print culture). Programs for the *master of science* are offered in applied and computational mathematics, biology, chemistry, computer science, geological sciences, and physics. In addition, the *master of business administration*, *master of fine arts* in art (emphasis in graphic design), *master of electrical and computer engineering*, *master of engineering management*, *master of liberal studies*, *master of music*, and *master of social work* are offered.

All-University M.S./Ph.D. programs in toxicology and water resources science are offered jointly with the Twin Cities campus. In addition, several graduate programs operate at the University of Minnesota Duluth under the aegis of graduate programs on the Twin Cities campus. Cooperative

programs offered at both the master's and doctoral levels include biochemistry, molecular biology, and biophysics; microbiology, immunology and cancer biology; pharmacology; and cellular and integrative physiology. Students interested in these programs should see Degree Programs in this catalog.

All programs are under the jurisdiction of the Graduate School dean and have admission, candidacy, and degree requirements comparable to their counterpart programs on the Twin Cities campus. General Graduate School regulations, including those for minimum degree requirements, apply to programs offered on the Duluth campus (see General Information at the beginning of this catalog).

## Financial Aid and Other Assistance

Assistantships are normally granted through individual departments subject to stipulations described in General Information at the beginning of this catalog. Information about these assistantships can be obtained by writing to the department director of graduate

studies. With an assistantship appointment of 25 percent or more, hospitalization and medical insurance coverage is provided at no additional cost.

Some residence counseling positions may be available. For information, write to the Housing Office, 149 Lake Superior Hall, University of Minnesota Duluth, MN 55812.

Inquiries regarding loan funds, living accommodations, employment, and placement should be addressed to the Vice Chancellor for Academic Support and Student Life, 297 Darland Administration Building, University of Minnesota Duluth, MN 55812.

## Program Descriptions

Brief descriptions of the various degree programs are listed on the following pages. Course offerings are listed in the *University of Minnesota Duluth Catalog*. General information concerning graduate work on the Duluth campus may be obtained from the Graduate School Office—Duluth, 431 Darland Administration Building, University of Minnesota Duluth, MN 55812. Information is also available at <[www.d.umn.edu/grad](http://www.d.umn.edu/grad)>.

## Key to Abbreviations

### Faculty

Graduate faculty are listed at the beginning of each degree program. After the faculty name, the home department will be listed (unless the department is the same as the program name), followed by the graduate faculty status in the program. Professors emeriti are identified by "(emeritus)."

### Membership Categories

**Senior Member (SM)**—Authorization to advise students at all levels, including the doctorate; to serve as a thesis reviewer and as an examiner on student examining committees, including service as chair of doctoral committees; to teach courses for graduate credit; and to participate in governance. In fields that also offer a professional doctorate, some senior member appointments may be restricted to the supervision of students seeking the professional degree.

**Affiliate Senior Member (ASM)**—Authorization to assume the same responsibilities as senior member, but not to participate in governance. In fields that also offer a professional doctorate, some affiliate senior member appointments may be restricted to the supervision of students seeking the professional degree.

**Member/Advising (M2)**—Authorization to advise students at the master's level; to serve as a thesis reviewer at the master's level and as an examiner on student

examining committees at the master's and postbaccalaureate certificate levels; to teach courses for graduate credit; and to participate in governance. At the discretion of the appointing program, may also include authorization to co-advise doctoral students with a senior member or affiliate senior member of the graduate faculty, and to serve as a thesis reviewer and examining committee member for doctoral students, but not as chair.

**Affiliate Member/Advising (AM2)**—Authorization to assume the same responsibilities as member/advising, but not to participate in governance.

**Member (M)**—Authorization to serve as a thesis reviewer at the master's level and as an examiner on student examining committees at the master's and postbaccalaureate certificate levels; to teach courses for graduate credit; and to participate in governance. At the discretion of the appointing program, may also include authorization to serve as a thesis reviewer and examining committee member for doctoral students, but not as chair.

**Affiliate Member (AM)**—Authorization to assume the same responsibilities as member, but not to participate in governance.

**Examining Status (E)**—Authorization to serve as a thesis reviewer and as an examiner on student examining committees at all levels, but not as chair, and to teach courses for graduate credit. Examining status does not include membership on the graduate faculty and does not confer governance privileges.

### Tests

The following test abbreviations appear throughout graduate program listings.

**ECFMG**—Educational Commission Foreign Medical Graduates

**GMAT**—Graduate Management Admission Test

**GRE**—Graduate Record Examination

**IELTS**—International English Language Testing System

**MELAB**—Michigan English Language Assessment Battery

**SPEAK**—Speaking Proficiency English Assessment Kit

**TOEFL**—Test of English as a Foreign Language

**TSE**—Test of Spoken English

**USMLE**—United States Medical Licensing Examination

For more information about these individual tests, see page 8 in the General Information section.

## Applied and Computational Mathematics

**Contact Information**—Department of Mathematics and Statistics, University of Minnesota Duluth, 140 Solon Campus Center, 1117 University Drive, Duluth, MN 55812 (218-726-8747; fax 218-726-8399; [math@d.umn.edu](mailto:math@d.umn.edu); <[www.d.umn.edu/math](http://www.d.umn.edu/math)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Sabra S. Anderson, M2  
Joseph A. Gallian, M2  
Richard F. Green, M2  
Barry R. James, M2  
Kang Ling James, M2  
Zhuangyi Liu, M2  
John Pastor, M2  
Ronald R. Regal, M2  
Marian S. Stachowicz, M2  
Harlan W. Stech, M2  
Jiann Shiou Yang, Electrical and Computer Engineering, M2

### Associate Professor

Richard A. Davis, Chemical Engineering, M2  
Linda L. Deneen, Computer Science, M2  
Douglas J. Dunham, Computer Science, M2  
John R. Greene, M2  
Mohammed A. Hasan, M2  
Kathryn E. Lenz, M2  
Robert L. McFarland, M2  
Bruce B. L. Peckham, M2  
James W. Rowell, M2  
Gary M. Shute, Computer Science, M2  
Steven A. Trogdon, M2  
K. Karen Yin, M2

### Assistant Professor

Guihua Fei, AM  
Dalibor Froncek, M2  
Carmen M. Latterell, AM  
Yongcheng Qi, M2

**Curriculum**—This program is for those wishing to pursue careers that use applied mathematics and statistics in science, industry, business, and teaching, and for those wishing to go on for Ph.D. degrees in mathematics or statistics. It emphasizes the use of modern modeling techniques and computational methods, with areas of concentration available in continuous modeling, probability/statistics, and discrete mathematics. The faculty is drawn largely from the Department of Mathematics and Statistics, but includes members from the Departments of Computer Science, Electrical and Computer Engineering, and Chemical Engineering and Biology.

**Admission Requirements**—Applicants should have completed an undergraduate degree in mathematics or statistics. However, a student with a degree in another major, and with a substantial background in mathematics or statistics (e.g., computer science or engineering), may also qualify; students lacking certain prerequisites may make up deficiencies concurrently with graduate work.

Applicants must submit scores from the General Test of the GRE, three letters of recommendation from persons familiar with their scholarship and research potential, a complete set of official transcripts, and a clearly written statement of career interests, goals, and objectives. Students may apply at any time; however, submission of all applications materials by January 15 for fall semester is strongly encouraged to ensure priority consideration for university fellowships. The deadline for applying for assistantships awarded for the next academic year is March 1. Students can be admitted any term. Students whose native language is not English must submit their TOEFL scores.

**Use of 4xxx Courses**—Inclusion of 4xxx courses (maximum of 8 credits) on degree program forms is subject to program approval.

### M.S. Degree Requirements

The M.S. is offered under both Plan A (with thesis) and Plan B (without thesis). All students must complete at least 33 credits, of which at least 17 must be from approved mathematics or statistics courses or seminars (including a graduate seminar and two of the three core courses) and 6 must be from a minor or related field (statistics is a related field). Plan A also requires 10 thesis credits; Plan B requires a 2-credit project and an additional 8 credits from approved graduate-level mathematics, statistics, or related-field courses.

**Language Requirements**—None.

**Final Exam**—There is a written comprehensive exam and an oral final exam.

### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor requires 6 credits in approved Math or Stat courses.

## Art—Graphic Design

**Contact Information**—Department of Art and Design, University of Minnesota Duluth, 317 Humanities Building, 1201 Ordean Court, Duluth, MN 55812 (218-726-8225; fax 218-726-6532; [art@d.umn.edu](mailto:art@d.umn.edu); <[www.d.umn.edu/art/design/mfa/](http://www.d.umn.edu/art/design/mfa/)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Gloria Brush, M2  
James C. Klueg, M2  
Thomas G. Kovacs, M2  
Dean Lettenstrom, M2

### Associate Professor

Robert Appleton, M2  
Alyce L. Coker, M2  
Janice D. Kmetz, M2  
Robert A. Repinski, M2  
Robyn S. Roslak, M2

### Assistant Professor

Alison J. Aune-Hinkel, M2  
Sarah Bauer, M2  
Philip Choo, M2  
Stephen J. Hilyard, M2  
Catherine Jo Ishino, M2  
Victoria D. Lehman, M2  
Eun-Kyung Suh, M2  
Suzanne Szucs, AM

### Lecturer

Martin D. Dewitt, M2

**Curriculum**—Graphic design is the manipulation of type and image for communication. Traditionally, this has meant design for the print medium, but the same skill and understanding go into design for video, computer-based presentations, and an ever-widening range of applications. The Department of Art and Design strongly believes that even though many graphic design M.F.A. graduates choose to practice rather than teach, the M.F.A. is a primary prerequisite for teaching at the university level, and M.F.A. programs therefore have a responsibility to prepare students for academic as well as aesthetic rigor. Consequently, although the M.F.A. is largely a studio degree, the program includes a strong analytical and intellectual component.

The department also believes that such rigor is ultimately the best approach for training graphic design practitioners as well. The field is rapidly changing, and only by being versed in the traditional capacities of the area, the skills and knowledge of related fields, and the skills of critical thought can future designers hope to lead rather than merely react to changes.

**Admission Requirements**—Applicants should have an interest in art and design, and in the cultural and historical importance, and have a B.A., B.S., or B.F.A. in graphic design or art. Individuals with undergraduate degrees in other disciplines who have completed a substantial number of art design courses also may be considered for admission.

Applicants must have a minimum undergraduate GPA of 3.00. Those whose native language is not English must have a TOEFL score of at least 550 (213 on the computer-based test) or a MELAB score of 80. The GRE is not required.

A portfolio of at least 20 slides of design work (or work submitted on CD, videotape, or disk), a letter of intent, a sample of the applicant's writing (written in or translated into English), and three letters of recommendation are required as part of the application.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to program approval.

### M.F.A. Plan B Degree Requirements

The M.F.A. program requires at least two years in residence and 60 credits. The program may be completed on a part-time basis by first taking all requirements other than the Art 8901—Graduate Seminar/Art 8980—Graduate Studio series and Art 8990—M.F.A. Creative Thesis. The 8901/8980 series must be taken within a two-year period. A final project and minimum 15-page supporting paper are required. Although a gallery exhibition is typical, the project may take forms such as a book, video, Web site, or interactive project.

**Language Requirements**—None.

**Final Exam**—An oral exam based on the project and supporting paper is required.

## Biology

**Contact Information**—Department of Biology, University of Minnesota Duluth, 221 Life Science Building, 10 University Drive, Duluth, MN 55812 (218-726-6262; fax 218-726-8142; [biol@d.umn.edu](mailto:biol@d.umn.edu); [www.d.umn.edu/biology/gradprograms/gradprog.htm](http://www.d.umn.edu/biology/gradprograms/gradprog.htm)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Matthew Andrews, M2  
Lester R. Drewes, Biochemistry and Molecular Biology, M2  
Stephen C. Hedman, M2  
Muhammad R. Ul Karim, M2  
Andrew R. Klemer, M2  
Gerald J. Niemi, M2  
John Pastor, M2  
Arlen R. Severson, Anatomy and Cell Biology, M2  
George J. Trachte, Pharmacology, M2

### Associate Professor

Alice Adams, Medical Microbiology and Immunology, M2  
Benjamin L. Clarke, Medical Microbiology and Immunology, M2  
Timothy P. Craig, M2  
Stephen W. Downing, Anatomy and Cell Biology, M2  
Donna J. Forbes, Anatomy and Cell Biology, M2  
Cecilia Giulivi, Chemistry, M2  
Randall E. Hicks, M2  
Linda L. Holmstrand, M2  
Jon M. Holy, Anatomy and Cell Biology, M2  
Robert L. Lloyd, Psychology, M2  
Merry Jo Oursler, M2  
Lillian A. Repesh, Anatomy and Cell Biology, M2  
David J. Schimpf, M2

### Assistant Professor

Valerie J. Brady, M  
Donn K. Branstrator, M2  
Julie R. Etterson, M2  
Kent M. Froberg, Pathology and Laboratory Medicine, M2  
Thomas R. Hrabik, M2  
Arun Goyal, M2  
Allen Mensinger, M2  
Anna Rachinsky, M2

### Lecturer

Lyle J. Shannon, M

### Teaching Specialist

JoAnn M. Hanowski, Natural Resources Research Institute, M

### Post-Doctoral Associate

Malcolm T. Jones, Natural Resources Research Institute, M

### Research Associate

Richard P. Axler, Natural Resources Research Institute, M2  
Lucia P. Barker, Medical Microbiology and Immunology, M2  
Durba Ghosal, M  
Glenn R. Guntenspergen, Natural Resources Research Institute, M2  
George E. Host, Natural Resources Research Institute, M2  
Lucinda B. Johnson, Natural Resources Research Institute, M2  
Carol A. Johnston, Natural Resources Research Institute, M2

John C. Kingston, Natural Resources Research Institute, M2  
Richard L. Leino, Anatomy and Cell Biology, M2  
Anantharama S. Rishi, Natural Resources Research Institute, M

### Program Director

Thomas Malterer, Natural Resources Research Institute, M2  
Neil D. Nelson, Natural Resources Research Institute, M  
Carl R. Richards, Sea Grant, M2

**Curriculum**—The program offers study toward the M.S. under either Plan A or Plan B. Plan A students must select an area of concentration from among botany, cellular and physiological biology, environmental biology, or zoology.

**Admission Requirements**—A bachelor's degree or equivalent from an accredited department in the life sciences or a related degree field, *or* one year of general biology and a one year course sequence in the physical/mathematical sciences is required. Students with deficiencies may be admitted with the provision that equivalent coursework or approved substitutions be completed during the first year of graduate study.

As part of the their application materials, applicants must also submit recent GRE General Test scores.

Prior coursework and/or GRE scores are used to assess proficiency in the areas of general biology, genetics, cell biology, and ecology. Such proficiency is considered in the admission decision.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to program approval.

### M.S. Degree Requirements

Plan A students must complete at least 14 course credits in the major, including at least 10 credits in courses approved for the selected area of concentration; at least 6 credits of approved coursework in one or more related fields or a minor; and at least 10 thesis credits. Plan B students must complete at least 14 course credits in the major, at least 6 credits of approved coursework in one or more related fields or a minor, and at least 10 credits of other approved coursework. Plan A requires a thesis; Plan B requires one to three Plan B projects.

**Language Requirements**—None.

**Final Exam**—Students must present a department seminar and pass a final oral exam.

### Minor Requirements for Students

**Majoring in Other Fields**—Any course that may be used as credit for the major may be used as credit toward the minor to give a minimum total of 6 credits.

## Business Administration

**Contact Information**—M.B.A. Department, Labovitz School of Business and Economics, University of Minnesota Duluth, 21 School of Business and Economics Building, 10 University Drive, Duluth, MN 55812 (218-726-8986; fax 218-726-6789; [sbe@d.umn.edu](mailto:sbe@d.umn.edu); [www.d.umn.edu/sbe/degreetprogs/MBA/](http://www.d.umn.edu/sbe/degreetprogs/MBA/)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Curt L. Anderson, Economics, AM  
Stephen B. Castleberry, Management Studies, M2  
Tom Duff, Finance and Management Information Sciences, M2  
Ehsan H. Feroz, Accounting, M2  
Wayne A. Jesswein, Economics, AM  
Richard W. Lichty, Economics, M2  
Rodrigo J. Lievano, Finance and Management Information Sciences, M2  
Patricia A. Merrier, Finance and Management Information Sciences, M2  
John W. Newstrom, Management Studies, M2  
Jerold M. Peterson, Economics, AM  
Jon L. Pierce, Management Studies, M2  
Raymond L. Raab, Economics, M2  
Stephen A. Rubenfeld, Management Studies, AM  
Donald N. Steinnes, Economics, M2  
Shee Q. Wong, Finance and Management Information Sciences, AM

### Associate Professor

Praveen Aggarwal, Management Studies, M2  
Rodger L. Brannan, Accounting, AM  
Manjeet Dhaat, Finance and Management Information Sciences, M2  
Kjell R. Knudsen, Management Studies, M2  
June F. Li, Accounting, M2  
Jerry W. Lin, Accounting, M2  
A. Maureen O'Brien, Economics, M2  
Henry B. Person, Finance and Management Information Sciences, AM  
Linda Rochford, Management Studies, M2  
Alan C. Roline, Accounting, M2  
Rajiv Vaidyanathan, Management Studies, M2

### Assistant Professor

Geoffrey G. Bell, Management Studies, M2  
Jannifer G. David, Management Studies, M2  
Sanjay Goel, Management Studies, M2  
Nik R. Hassan, Finance and Management Information Sciences, AM  
Jarrod Johnston, Finance and Management Information Sciences, M2  
Mark B. Lautzenheiser, Economics, AM  
Seung C. Lee, Finance and Management Information Sciences, AM  
Dahui Li, Finance and Management Information Sciences, AM  
Randall K. Skalberg, Accounting, AM  
Joon S. Yang, Accounting, AM

**Curriculum**—The M.B.A. program meets the needs of those who are currently employed full-time in professional managerial careers and would like to pursue a graduate management education on a part-time basis. The program offers courses in both Duluth and Rochester, Minnesota. Most courses offered in Duluth meet one evening per week from 6:00 to 9:00 p.m. during the 15 weeks of the semester. Most courses offered in Rochester meet from 3:00 to 9:00 p.m. on Fridays and 8:00 a.m. to noon on Saturdays every other week over a period of seven weeks. It is possible to enroll in the program on a full-time basis by registering

for 6 or more credits per semester. However, only a relatively small number of domestic and international students are enrolled full-time.

**Admission Requirements**—Applicants must have a bachelor's degree from an accredited college or university; completed prerequisite or foundation courses in accounting, economics, finance, production/operations, marketing, organizational management, and human resource management *or* be able to demonstrate knowledge and proficiency in each of these areas; and have an acceptable score on the GMAT or GRE, passed the Certified Professional Accountant (CPA) examination, or completed a graduate degree from an accredited college or university. In addition, international students must have an acceptable score on the TOEFL.

The bachelor's degree may be in any field. However, students who have had little or no undergraduate or other education in business administration must complete prerequisite or foundation courses in the areas identified above before admission to the M.B.A. program. No graduate credit or credit toward M.B.A. program requirements is granted for prerequisite courses.

**Use of 4xxx Courses**—M.B.A. students may include 4xxx courses for electives in their degree programs subject to M.B.A. director approval.

### M.B.A. Plan B and Coursework Only Degree Requirements

The M.B.A. requires 32 credits. All students must complete six core and three support area courses, which provide exposure to financial reporting, analysis, and markets; the domestic and global environments of business and organizations; the creation and distribution of goods and services; and human behavior in organizations. Also required are a capstone strategic management course and a minimum of 2 credits of cross-functional experience selected from special topics, workshops, projects, or field study. Students then choose one of two options for completing an additional 6 credits of elective coursework: coursework only or field research (Plan B).

**Language Requirements**—None.

**Final Exam**—For Plan B, students meet with their faculty committee for a final review of their completed project. For coursework only, no final exam is required.

## Chemistry

**Contact Information**—Department of Chemistry, 246 Chemistry Building, 1039 University Drive, Duluth, MN 55812 (218-726-7212; fax 218-726-7394; [chem@d.umn.edu](mailto:chem@d.umn.edu); <[www.d.umn.edu/chem/graduate/index.html](http://www.d.umn.edu/chem/graduate/index.html)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Subhash C. Basak, Natural Resources Research Institute, M2  
Ronald Caple, M2  
Robert M. Carlson, M2  
Lester R. Drewes, Biochemistry and Molecular Biology, M2  
John F. Evans, M2  
Donald K. Harriss, M2  
Pavel A. Krasutsky, Natural Resources Research Institute, M2  
Vincent R. Magnuson, M2  
Donald P. Poe, M2  
Joseph R. Prohaska, Biochemistry and Molecular Biology, M2  
James P. Riehl, M2  
Larry C. Thompson, M2  
Bilin P. Tsai, M2  
Kendall B. Wallace, Biochemistry and Molecular Biology, M2  
Viktor Zhdankin M2

### Associate Professor

Benjamin L. Clarke, Medical Microbiology and Immunology, M2  
Cecilia Giulivi, M2  
Thomas E. Huntley, Biochemistry and Molecular Biology, M2  
Paul Kiprof, M2  
Keith B. Lodge, Chemical Engineering, M2  
Paul D. Siders, M2

### Assistant Professor

Annette L. Boman, Biochemistry and Molecular Biology, M2  
Robert T. Cormier, Biochemistry and Molecular Biology, M2  
Arun Goyal, Biology, M2  
Peter E. Kebbekus, M2  
Josef Werne, M2

**Curriculum**—The M.S. program offers a broad-based education in chemistry that is well suited to students going on to Ph.D. programs, careers in industry, or professional schools. Both Plan A (with thesis) and Plan B (without thesis) are available. For Plan A, emphases include analytical, biological, inorganic, organic, and physical chemistry. The faculty includes members from the Departments of Chemistry and Chemical Engineering in the College of Science and Engineering and from the Departments of Biochemistry and Molecular Biology, and Microbiology and Immunology in the School of Medicine.

**Admission Requirements**—Applicants must have completed an undergraduate chemistry major, including an upper division course in inorganic chemistry, one year of physical chemistry, mathematics through calculus, and one year of college physics, preferably taught using calculus. Students lacking some of these prerequisites may make up deficiencies concurrently with graduate work.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to program approval.

### M.S. Degree Requirements

All students must complete 30 credits, including a minimum of 14 credits in the major (including four core courses) and 6 credits in a related field or minor. Plan A students must also register for 10 thesis credits; Plan B students must complete an additional 10 course credits and prepare three papers. Attendance and presentation at the

chemistry seminar is required. Individual programs are designed to best serve the interests of the student

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor requires a minimum of 6 credits in chemistry courses. Individual programs must be approved by the director of graduate studies in chemistry.

## Communication Sciences and Disorders

**Contact Information**—Department of Communication Sciences and Disorders, University of Minnesota Duluth, 221 Bohannon Hall, 1207 Ordean Court, Duluth, MN 55812 (218-726-7974; fax 218-726-8693; [cd@d.umn.edu](mailto:cd@d.umn.edu); <[www.d.umn.edu/csd/general/csdgrad.html](http://www.d.umn.edu/csd/general/csdgrad.html)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Paul N. Deputy, M2  
Mark I. Mizuko, M2

### Associate Professor

Faith C. Loven, M2  
Cynthia S. Spillers, M2

### Assistant Professor

Kent R. Brorson, M2  
Amy Meredith, M2

**Curriculum**—The graduate program in communication sciences and disorders effectively combines academic and clinical endeavors to prepare students to become speech-language pathologists. The program places a major emphasis on the development of clinical skills, although students have the opportunity to engage in a wide variety of academic and research activities as well. The curriculum, which is based on five semesters of study, is accredited by the Council of Academic Accreditation (CAA) in speech-language pathology and also by the American Speech-Language Hearing Association (ASHA).

**Admission Requirements**—Applicants must have a bachelor's degree in communication sciences and disorders. Three letters of recommendation evaluating the applicant's scholarship and clinical potential are required. At least two letters should be from academic faculty familiar with the applicant. A personal statement of the applicant's short- and long-term goals is also required.

### M.A. Plan B Degree Requirements

The M.A. is offered under Plan B only. At least 43 credits are required, including 31 credits of required CSD courses, 2 credits of Plan B project (CSD 8099), 4 credits of internship, and at least 6 credits of approved courses (4xxx and higher) from related fields. All Plan B projects must be pre-approved by the student's examining committee, which also must give final approval.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

## Computer Science

**Contact Information**—Department of Computer Science, University of Minnesota Duluth, 320 Heller Hall, 1114 Kirby Drive, Duluth, MN 55812 (218-726-7678; fax 218-726-8240; [cs@d.umn.edu](mailto:cs@d.umn.edu); <[www.d.umn.edu/cs/grad](http://www.d.umn.edu/cs/grad)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Donald B. Crouch, M2  
Marian Stachowicz, Electrical and Computer Engineering, AM2

### Associate Professor

Carolyn C. Crouch, M2  
Douglas, J. Dunham, M2  
Richard F. Maclin, M2  
Gary M. Shute, M2  
Masha Sosonkina, M2

### Assistant Professor

Theodore D. Pedersen, M2  
Christopher G. Prince, M2  
C. Hudson Turner, M2  
Piotr Windyga, M2

**Curriculum**—Computer science is a discipline that involves understanding the design of computers and computational processes. The discipline ranges from the theoretical study of algorithms to the design and implementation of software at the systems and applications levels.

The M.S. is a two-year program that provides the necessary foundational studies for graduates planning to pursue either a Ph.D. in computer science or a career as a computer scientist in business or industry.

**Admission Requirements**—The program is designed for students with undergraduate degrees in computer science or computer engineering. These students should be able to enroll immediately in 8xxx computer science courses. Students with other backgrounds may be considered if they have completed the following courses or their equivalents: CS 1511-1521—Computer Science I-II; CS 2511—Software Analysis and Design; CS 2521—Computer Organization and Architecture; Math 1296-1297—Calculus I-II; and Stat 3611—Introduction to Probability and Statistics.

All students must have completed the following four courses:

CS 4511—Automata Theory and Formal Languages; CS 4521—Algorithms and Data Structures; CS 5621—Computer Architecture; and CS 5631—Operating Systems. Non-UMD graduates who fail to meet these requirements may be admitted provisionally and must complete specified courses before proceeding with their graduate work. The GRE General Test is required; the TOEFL is also required of international students.

**Use of 4xxx Courses**—4xxx computer science courses may not be included in degree programs.

### M.S. Degree Requirements

The M.S. is offered under Plan A (thesis) and Plan B (without thesis). At least 33 credits are required, including 16 credits from 8xxx courses in computer science, 1 credit of CS 8993, (seminar) and at least 6 credits from a minor or related field outside computer science. Plan A requires 10 thesis credits and Plan B requires a minimum of 10 credits in computer science at 5xxx or above. All courses are chosen in consultation with the student's adviser, subject to approval by the director of graduate studies.

**Language Requirements**—None.

**Final Exam**—Students present a department colloquium, followed by an oral exam.

### Minor Requirements for Students

**Majoring in Other Fields**—A minimum of 6 credits in computer science is required for a master's minor.

## Counseling Psychology

*Note: No new students are being accepted for the counseling psychology program.*

**Contact Information**—Department of Psychology, University of Minnesota Duluth, 320 Bohannon Hall, 10 University Drive, Duluth, MN 55812 (218-726-7117; fax 218-726-7186; [bmmclure@d.umn.edu](mailto:bmmclure@d.umn.edu); <[www.d.umn.edu/grad/educational.html](http://www.d.umn.edu/grad/educational.html)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Ajit K. Das, AM2  
Aydin Y. Durgunoglu, M2  
Randall A. Gordon, M2  
Bud A. McClure, M2  
Kristelle E. Miller, M2  
Uwe H. Stuecher, M2

### Associate Professor

Helen M. Doane, M2  
Eugene E. Grossman, M2  
Jane C. Hovland, M2  
Robert L. Lloyd, M2  
Sandy Woolum, M2

### Assistant Professor

Steve Giunta, M2  
Alexandra Luong, M2  
Paula J. Pedersen-Randall, M2  
Donald E. Streufert, M2

**Curriculum**—*Note: No new students are currently being accepted into this program. Contact the Graduate School for information on the status of the program.*

The M.A. in counseling psychology is based on a developmental philosophy that encourages academic learning and personal growth. A core curriculum provides theoretical frameworks and practice in counseling skills from which students can develop their unique strategies and pursue specialty training.

Three emphases for specialty training are offered: community counseling, college counseling, and school counseling. The community and school counseling emphases are accredited by the Council for Accreditation of Counseling and Related Educational Programs (CACREP). Students select an emphasis during their second semester.

Community counseling students may elect coursework that provides a foundation for pursuing licensure as a psychological practitioner in Minnesota or as a licensed professional counselor in many other states. The college counseling emphasis offers preparation for student support and development in colleges and universities. The school counseling emphasis allows for specialization in grades K-12.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to program approval.

### M.A. Plan B Degree Requirements

The M.A. requires 50 credits, including 31 counseling core credits, 13 professional emphasis credits, and 6 credits in a minor or related field. Counseling core credits include a 4-credit Plan B research paper (Psy 5061, 5062) with an oral exam; professional emphasis credits include a semester practicum (2 credits) and a nine-month internship (23 hours per week, 6 credits). Core credits must include Psy 5051, 5052, 5061, 5062, 5121, 5501, 5502, 5601, 5603, 5611, and 5651. Professional emphasis credits are as follows: community counseling—Psy 5125, 8001, 8101, 8197, 8297; college counseling—Psy 8003, 8101, 8397, 8497, 3-credit elective; school counseling—Psy 5201, 8005, 8101, 8597 or 8797, 8697 or 8897.

Students pursuing licensure in Minnesota as psychological practitioners or professional school counselors must complete specified courses, which can be completed as major or related field requirements. Students should consult with the program for current specified courses, as requirements are determined by state agencies and may change.

Students may also complete a national counselor exam, such as the National Counselor Examination for Licensure and Certification (NCE), before graduation.

**Language Requirements**—None.

**Final Exam**—A final oral exam on the Plan B paper is required. Students must also take a comprehensive exam.

### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor requires 8 credits of psychology and is structured to include a research component, counseling orientation, and an elective. Interested students should contact the director of graduate studies in counseling psychology.

# Electrical and Computer Engineering

**Contact Information**—Department of Electrical and Computer Engineering, University of Minnesota Duluth, 271 Marshall W. Alworth Hall, 1023 University Drive, Duluth, MN 55812 (218-726-6147; fax 218-726-7267; [ece@d.umn.edu](mailto:ece@d.umn.edu); <[www.d.umn.edu/ece/](http://www.d.umn.edu/ece/)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

## Professor

Stanley G. Burns, M2  
Taek Mu Kwon, M2  
Nazmi Shehadeh, M2  
Marian Stachowicz, M2  
Jiann-Shiou Yang, M2

## Associate Professor

Christopher R. Carroll, M2  
Mohammed Hasan, M2

## Assistant Professor

Rocio Alba-Flores, M2  
Fernando Rios-Gutierrez, M2  
Bassam Shaer, M2  
G. Lee Zimmerman, M2

**Curriculum**—The master of science in electrical and computer engineering (M.S.E.C.E.) degree combines scholarship and research for students and engineering practitioners in the private and public sectors who are interested in advanced coursework and applied research. The program focuses on core departmental strengths of design and implementation of computer hardware/software including digital circuits and VLSI, embedded controllers, computer networks, distributed computing, analog and digital circuit design and application, instrumentation, communication systems, soft computing, robotics, and control systems.

**Admission Requirements**—Applicants should have completed an undergraduate degree in electrical, computer, electrical and computer engineering, or related discipline, and must meet the general admission requirements to the Graduate School of the University of Minnesota. A minimum 3.00 GPA from an accredited U.S. institution or foreign equivalent is required together with two letters of recommendation concerning the student's academic abilities and readiness for graduate education. International students must submit a TOEFL score of at least 550, or 231 on the computer-based test. Industrial experience and professional licensure will also be considered. Previous graduate-level coursework completed after receiving a baccalaureate degree may qualify for transfer credit upon recommendation and approval by the director of graduate studies.

## M.S.E.C.E. Degree Requirements

Plan A students must complete a minimum of 31 credits in graduate courses. At least 15 credits must be electrical and computer engineering (ECE) courses with at least six in courses numbered 4xxx or higher, six in courses at 5xxx or higher, and three courses

at 8xxx. An additional 6 credits must be in a related field or minor, and 10 thesis credits. The director of graduate studies must approve all programs.

Plan B students must complete a minimum of 31 credits in graduate courses. At least 9 credits must be ECE courses numbered 5xxx and higher with at least 3 of those credits numbered 8xxx, excluding colloquium and Plan B project credits. An additional 6 credits must be in a related field or minor. The remaining 16 credits must be ECE courses numbered 4xxx or higher. The director of graduate studies must approve all programs.

**Language Requirements**—None.

**Final Exam**—A formal defense of the thesis is required for Plan A students. The final exam for Plan B is a formal report and oral presentation.

## Minor Requirements for Students

**Majoring in Other Fields**—A master's minor requires 6 ECE courses. Individual programs must be approved by the director of graduate studies in electrical and computer engineering.

# Engineering Management

**Contact Information**—Department of Mechanical and Industrial Engineering, University of Minnesota Duluth, 229 Voss-Kovach Hall, 1305 Ordean Court, Duluth, MN 55812 (218-726-8117; fax 218-726-8581; [msem@d.umn.edu](mailto:msem@d.umn.edu); <<http://ie.d.umn.edu/MSEM/>>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

## Professor

Bernard DeRubeis, M2  
Mark A. Fugelso, M2  
Thys B. Johnson, AM2  
L. Alden Kendall, M2  
Richard R. Lindeke, M2  
David A. Wyrick, M2

## Associate Professor

Hamid Fonooni-Fard, M2  
Ryan G. Rosandich, M2

## Assistant Professor

Emmanuel Enemouh, M2  
Dale Allen Krageschmidt, M2  
John Voss, M2  
Martha Caudill Wilson, AM2

## Adjunct Professor

Richard Hansen, AM

**Curriculum**—The master of science in engineering management (M.S.E.M.) program provides engineers with tools to more effectively manage people, projects, technology, and information in their careers to promote economic growth, competitiveness, ethical decision-making, and environmental responsibility. As people in engineering positions often manage technical projects of varying size and complexity, the M.S.E.M. provides an excellent foundation. To meet the needs of practitioners, courses are offered in the evening and are available to remote sites by

interactive television. Full-time enrollment is possible and the course structure allows for unique research opportunities.

**Admission Requirements**—All applicants must meet the general admission requirements of the Graduate School.

Applicants should have completed an undergraduate degree in an engineering discipline. However, an applicant with a degree in another technical major and with a substantial background in engineering may qualify. Such students may be admitted on a case-by-case basis and are asked to submit documentation that substantiates their engineering and technology experience and responsibilities.

Applicants must provide two letters of recommendation concerning their academic ability and readiness for graduate education. A minimum 3.00 GPA from an accredited U.S. institution or foreign equivalent is required. International students must submit a score of at least 550 on the paper-based or 213 on the computer-based TOEFL.

**Use of 4xxx Courses**—Upon the advice and approval of the director of graduate studies, students may use 4xxx courses in related fields as appropriate.

## M.S.E.M. Degree Requirements

Plan A students must complete at least 31 credits, including a minimum of 12 credits in the major, 3 credits from courses required for an M.B.A., 3 credits from a related program or from the M.B.A., 3 credits of electives from EMgt or a related field, and 10 thesis credits. Individual programs are designed to best serve the interests of the student. The director of graduate studies must approve all programs.

Plan B students must complete 30 credits, including a minimum of 15 credits in the major, a 3-credit capstone project course, and 6 credits in a related field or minor (business administration). Students must complete an additional 6 credits in engineering management or other electives, whichever best fits the needs of the student. The capstone project course requires a formal report and oral presentation. Individual programs are designed to best serve the interest of the student. The director of graduate studies must approve all programs.

**Language Requirements**—None.

**Final Exam**—A formal defense of the thesis is required for Plan A students. The final exam is a formal report and oral presentation in EMgt 8310 for Plan B students.

## Minor Requirements for Students

**Majoring in Other Fields**—A master's minor requires 6 credits in engineering management courses. Individual programs must be approved by the director of graduate studies in engineering management.

## English

**Contact Information**—Department of English, University of Minnesota Duluth, 412 Humanities Building, 10 University Drive, Duluth, MN 55812 (218-726-8228; fax 218-726-6882; [engl@d.umn.edu](mailto:engl@d.umn.edu); [www.d.umn.edu/eng/englishgrad](http://www.d.umn.edu/eng/englishgrad)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

Stephen J. Adams, M2  
Thomas D. Bacig, Sociology-Anthropology, M2  
Michael D. Linn, Composition, M2  
Joseph C. Maiolo, M2  
Linda Miller-Cleary, M2  
Kathryn L. Riley, Composition, M2

### Associate Professor

Katherine L. Basham, M2  
Carol A. Bock, M2  
Martin F. Bock, M2  
Thomas J. Farrell, Composition, M2  
Roger C. Lips, M2  
Kenneth C. Risdon, Composition, M2

### Assistant Professor

Paul D. Cannan, M2  
Jill D. Jenson, Composition, M2  
Jo M. Mackiewicz, Composition, M2  
Kathleen Maurer, Composition, M2  
John Schwetman, M2  
Carolyn Sigler, M2  
Craig Stroupe, Composition, M2  
Krista Sue-Lo Twu, M2

**Curriculum**—The M.A. program offers courses in English, Irish, and American literature; creative writing; linguistics; composition and rhetorical theory; book history; publishing; and English education. The program has three master's emphases: a literary studies emphasis for concentrated study of literature, an interdisciplinary emphasis in English studies, and an emphasis in publishing and print culture.

**Admission Requirements**—Students applying to this program must submit GRE General Test scores, two writing samples such as course papers, and three letters of recommendation. International applicants must submit TOEFL scores of at least 600 (written test). Entering students should have completed at least 30 semester credits in English (these may include credits in literature, language, and advanced composition), including 20 credits of upper division English courses that offer broad coverage of English and American literature and at least one course in English language or English linguistics. Any deficiencies will be determined by the director of graduate studies in consultation with the graduate committee. Certain course prerequisites may be taken concurrently with graduate work and may be applied toward degree requirements.

**Use of 4xxx Courses**—Use of 4xxx courses is permitted for courses taken to satisfy requirements in a related field. 4xxx courses in English, composition, and linguistics may not be included on degree program forms in English.

## M.A. Plan B Degree Requirements

Literary Studies Emphasis: a minimum of 30 credits, including at least 24 credits in the major, 6-8 credits in a related field, and two Plan B projects.

English Studies Emphasis: a minimum of 31 credits, including at least 25 credits in the major distributed in literature, linguistics, and composition/rhetoric; 6-8 credits in a related field; and two Plan B projects.

Publishing and Print Culture: a minimum of 31 credits, including at least 25 credits in the major distributed in literature, publishing, and print culture; 6-8 credits in a related field; and two Plan B projects.

**Language Requirements**—The emphases in literary studies and publishing and print culture require a reading knowledge of Latin, Greek, French, Italian, Spanish, Russian, or another approved language.

The English studies emphasis requires certification of a reading knowledge of a foreign language appropriate to the candidate's area of study and approved by the English graduate committee or completion of at least 6 course credits beyond the 31 required credits. Candidates, whose professional objectives are best served by completing the additional 6 credits, select courses from literature and literary analysis, linguistics, composition/rhetoric, print culture, publishing, or courses closely related to the field of concentration.

**Final Exam**—The final exams are written and oral. Students must submit two Plan B projects totaling 120 hours of effort before taking the exam. The projects normally are completed in connection with courses in English or in a related field. A completed project must be approved by a graduate faculty member.

### Minor Requirements for Students

**Majoring in Other Fields**—At least 8 credits in English, composition, and/or linguistics are required for a master's minor.

## Geological Sciences

**Contact Information**—Department of Geological Sciences, University of Minnesota Duluth, 229 Heller Hall, 10 University Drive, Duluth, MN 55812 (218-726-7238; fax 218-726-8275; [geol@d.umn.edu](mailto:geol@d.umn.edu); [www.d.umn.edu/geology/main/gprogram.html](http://www.d.umn.edu/geology/main/gprogram.html)).

For up-to-date graduate faculty listings, see [www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp).

### Professor

James A. Grant, M2  
Vicki L. Hansen, M2  
Timothy B. Holst, M2  
Thomas C. Johnson, M2  
Charles L. Matsch (emeritus), AM2  
James D. Miller, Jr., AM2  
Ronald L. Morton, M2  
Richard W. Ojakangas (emeritus), AM2

### Associate Professor

Erik T. Brown, M2  
John W. Goodge, M2  
Howard D. Mooers, M2  
Penelope Morton, M2  
Nigel J. Wattrus, M2

### Assistant Professor

Keith A. Brugger, AM2  
Christian D. Gallup, M2  
George J. Hudak III, M2  
Richard D. Ricketts, AM2  
John B. Swenson, M2

**Curriculum**—The M.S. program in geological sciences offers custom-made opportunities for study in Precambrian and Quaternary geology, limnology, paleoclimatology, stratigraphy and sedimentation, geochemistry, tectonics, petrology, planetary studies, hydrogeology, economic geology, geomorphology and geophysics, and more. See the geology Web site at [www.d.umn.edu/geology](http://www.d.umn.edu/geology).

**Admission Requirements**—Applicants must have completed an undergraduate major in geology, geophysics, or related earth science with one year each of college mathematics (including calculus), chemistry, and physics. A full-time geological field course of at least five weeks is also required, as are GRE General Test scores.

**Research Facilities**—Research facilities include those for microscopy, XRD, isotope and trace element analysis, digital imagery, ground-penetrating radar, and near-surface seismic profiling. There is a departmental computer lab and ready access to the main-frame system. Additional facilities are available at the Large Lakes Observatory (including an 87' research vessel) and at the Natural Resources Research Institute (including a GIS system), both affiliated with UMD, and the Department of Geology and Geophysics in Minneapolis (particularly an electron microprobe lab).

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### M.S. Degree Requirements

The M.S. is offered under Plan A (thesis) and Plan B (without thesis). Courses are selected with approval of the student's adviser and the director of graduate studies; no more than 25 percent of the courses may be 4xxx except by their approval. For both plans, a written candidacy exam during the second semester of residency is required.

Plan A requires 30 credits, including 14 course credits in the major, 6 course credits in a minor or related field (which may be taken within geology if the courses are in an area different from the student's principal area), and 10 thesis credits. All courses must be 4xxx or 5xxx. Plan B requires 30 credits in approved courses, including three Plan B papers.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor requires a minimum of 6 credits and is decided in consultation with the student's adviser and the director of graduate studies in geology.

## Liberal Studies

**Contact Information**—College of Liberal Arts, M.L.S. Program, University of Minnesota Duluth, 494 Humanities Building, 10 University Drive, Duluth, MN 55812 (218-726-8149; fax 218-726-6386; [caker@d.umn.edu](mailto:caker@d.umn.edu); <[www.d.umn.edu/ce/program\\_guide/mls/mls.html](http://www.d.umn.edu/ce/program_guide/mls/mls.html)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Stephen Adams, English, M2  
Thomas D. Bacig, Sociology-Anthropology, M2  
Elizabeth Bartlett, Women's Studies, M2  
James H. Fetzer, Philosophy, M2  
William Fleischman, Sociology-Anthropology, M2  
Thomas F. Hedin, Art, M2  
Thomas F. Jordan, Physics, M2  
Andrew R. Klemer, Biology, M2  
Lawrence Knopp, Geography, M2  
Joseph C. Maiolo, English M2  
Jerrold M. Peterson, Economics, M2  
Kathryn Riley, Composition, M2  
Fred E. Schroeder (emeritus), Humanities, M2  
Richard A. Seybalt, Foreign Languages and Literatures, M2  
David M. Smith, Sociology-Anthropology, M2  
Neil T. Storch, History, M2  
Judith Ann Trolander, History, M2

### Associate Professor

Eve Browning, Philosophy, M2  
Stephen P. Chilton, Political Science, M2  
Scott Freundsuh, Geography, M2  
Tom K. Isbell, Theatre, M2  
Robyn S. Roslak, Art, M2

### Assistant Professor

John Bower, Sociology-Anthropology M2  
Thomas F. Powers, Political Science, M2  
AnnaMarie E. Roos, History, M2  
Steven J. Vanderheiden, Philosophy and Political Science, M2

**Curriculum**—The interdisciplinary M.L.S. is a community outreach program that provides citizens with the opportunity to return to higher education to broaden their intellectual horizons without having to focus on specific professional goals. Two emphases include the traditional M.L.S. or an ecology, economics, and ethics emphasis. In both emphases, students write one to three papers exploring in depth an interdisciplinary topic.

**Admission Requirements**—Applicants must have a bachelor's degree from a recognized college or university with a 3.00 GPA. The application should include three letters of recommendation and a thoughtfully composed letter stating, in narrative form, reasons for wishing to pursue the M.L.S. and describing education and career experiences. This letter should be addressed to the director of graduate studies in the UMD Graduate School Office.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### M.L.S. Plan B Degree Requirements

The M.L.S. is offered under Plan B only. Students in either emphasis must complete 32 credits, including at least 4 credits of IS 8001—Introduction to Liberal Studies. Those students electing the traditional emphasis

must also take 4 credits of IS 8501—Seminar: Ethics and the Human Condition and 24 elective credits. Students selecting the ecology, economics, and ethics emphasis must also take 4 credits of IS 8250—Ecological Economics, 4 credits of IS 8502—Ecology, Economics, and Ethics, and an additional 20 credits of electives. One to three Plan B papers are required in both emphases.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

## Linguistics

### Minor Only

**Contact Information**—Program in Linguistics, University of Minnesota Duluth, 457 Humanities Building, 10 University Drive, Duluth, MN 55812 (218-726-6281; fax 218-726-6882; [kriley@d.umn.edu](mailto:kriley@d.umn.edu); <[www.d.umn.edu/ling](http://www.d.umn.edu/ling)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Michael D. Linn, Composition, E  
Kathryn L. Riley, Composition, E

### Associate Professor

Jonathan B. Conant, Foreign Languages and Literatures, E  
Milan Kovacovic, Foreign Languages and Literatures, E

### Assistant Professor

Jo Mackiewica, Composition, E

**Curriculum**—Linguistics, offered interdepartmentally and through the Department of Interdisciplinary Programs, may be elected by graduate students as a related field, or with approval of the director of graduate studies of the major, as a designated minor.

### Minor Only Requirements

The minor in linguistics requires a minimum of 6 credits selected from Anth 4628—Language and Culture (3 cr), Engl 5811—Introduction to Modern English (4 cr), Engl 5821—History of the English Language (4 cr), Ling 5195—Special Topics (3 cr), Ling 5802—Applied Linguistics (4 cr), Ling 5852—Practicum in Teaching Linguistics (3 cr), Ling 8500—Graduate Seminar (3 cr), and Ling 8591—Independent Study (1-3 cr).

## Music

**Contact Information**—Department of Music, University of Minnesota Duluth, 231 Humanities Building, 1201 Ordean Court, Duluth, MN 55812 (218-726-8207; fax 218-726-8210; [mu@d.umn.edu](mailto:mu@d.umn.edu); <[www.d.umn.edu/music/degrees/](http://www.d.umn.edu/music/degrees/)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Ann C. Anderson, AM  
Judith Ann Kritzmire, M2  
Thomas J. Wegren, M  
Stanley R. Wold, M2

### Associate Professor

David J. Schmalenberger, M2  
Mark E. Whitlock, M2

### Assistant Professor

Jeanne A. Doty, M2  
Ryan J. Frane, M  
Rachel L. Inselman, AM  
Daniel G. Lipori, M2  
Jean R. Perrault, AM  
Justin H. Rubin, M2  
Theodore A. Schoen, M  
Joseph S. Spann, AM  
Tina L. Thielen-Gaffey, AM  
Ramon F. Vasquez, AM

### Other

Maria T. Annoni, AM

**Curriculum**—The M.M. program offers students an opportunity to acquire advanced understandings and skills in music education theory and practice or in musical performance. A course of study is designed to meet the interests and objectives of the student.

**Admission Requirements**—Applicants must have an undergraduate degree in music and have applied to the University of Minnesota Graduate School. In addition, the following must be submitted for review by the music graduate committee: 1) Department of Music Graduate Study Application; 2) sample of professional writing (a three- to five- page paper addressing current issues in music or music education); 3) two letters of reference from professional colleagues and/or supervisors describing the candidate's potential for success in the graduate music program; and 4) an entrance performance audition on the major instrument or a videotape of classroom teaching or conducting.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### M.M. Plan B Degree Requirements

The M.M. in music education and performance emphases each requires 30 credits. The music education emphasis requires 14 credits in music education/education, 8 credits in the related field of music, 6 credits for the Plan B paper, and 2 elective credits. The performance emphasis requires 14 credits in performance/pedagogy, 8 credits in music theory and literature, 6 credits in research/foundations courses, 2 elective credits and a solo recital.

**Language Requirements**—None.

**Final Exam**—A comprehensive written and oral final are required.

## Physics

**Contact Information**—Department of Physics, University of Minnesota Duluth, 371 Marshall W. Alworth Hall, 10 University Drive, Duluth, MN 55812 (218-726-7124; fax 218-726-6942; [phys@d.umn.edu](mailto:phys@d.umn.edu); <[www.d.umn.edu/~jmaps/gradpgm.html](http://www.d.umn.edu/~jmaps/gradpgm.html)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

John R. Hiller, M2  
Thomas F. Jordan (emeritus), AM2  
Michael Sydor, M2

### Associate Professor

Bo R. Casserberg, M2

### Assistant Professor

Alec T. Habig, M2  
Jonathan Maps, M2  
Brian D. May, M2  
Elise A. Ralph, M2

**Curriculum**—The M.S. program provides grounding in the fundamentals of physics combined with significant research involvement. The primary areas of research include computational physics, experimental work in condensed-matter physics, high-energy neutrino physics, and observational and theoretical work in physical limnology.

**Admission Requirements**—An undergraduate degree in physics or the equivalent is required.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### M.S. Degree Requirements

The M.S. is offered under both Plan A and Plan B. All students take 11 credits in a common core of courses (Phys 5501, 5511, 5521, 5522, and 2 credits in 5090), 3 credits from Phys 5052, 5053, or 5051, and 6 credits in a minor or in related fields. Plan A also requires 10 thesis credits; Plan B requires one or more projects requiring a minimum of 120 hours work total, preparation of a written report for each project, and 10 additional course credits in physics. 4xxx courses may be included if appropriate and if approved for graduate credit; for distinctly interdisciplinary programs, the courses may be outside physics. In all cases, the overall plan of study and selection of elective courses must form a coherent program and be approved by the director of graduate studies.

**Language Requirements**—None.

**Final Exam**—The final exam is oral.

### Minor Requirements for Students

**Majoring in Other Fields**—A master's minor requires 6 credits, of which no more than 1 credit can be from Phys 5090.

## Social Work

**Contact Information**—Department of Social Work, University of Minnesota Duluth, 220 Bohannon Hall, 10 University Drive, Duluth, MN 55812 (218-726-7245; fax 218-726-7185; [sw@d.umn.edu](mailto:sw@d.umn.edu); <[www.d.umn.edu/sw/msw.html](http://www.d.umn.edu/sw/msw.html)>).

For up-to-date graduate faculty listings, see <[www.grad.umn.edu/faculty\\_rosters/step1.asp](http://www.grad.umn.edu/faculty_rosters/step1.asp)>.

### Professor

Dennis R. Falk, M2  
Joyce M. Kramer, M2  
Melanie F. Shepard, M2

### Associate Professor

Priscilla A. Day, M2  
Kathleen E. Nuccio, M2  
R. Michael Raschick, M2

### Assistant Professor

Lynn Ellen H. Bye, M2  
Donald Carpenter, M2

### Instructor

Lila George, M2  
Kathleen V. Heltzer, M2

**Curriculum**—The M.S.W. program offers a concentration in advanced generalist practice. The curriculum prepares students to practice at the direct service, program, and community levels of intervention. Graduates undertake a variety of professional social work functions, including counselor, community organizer, case manager, educator, and administrator. The curriculum has a special focus on services to American Indians and their communities. The M.S.W. program is accredited by the Council on Social Work Education.

**Admission Requirements**—A bachelor's degree from a regionally accredited college or university is required. The bachelor's degree should include a solid background in the liberal arts, as evidenced on the transcript by courses in the arts, humanities, and behavioral and social sciences. Applicants should be knowledgeable about diverse cultures, social problems, social conditions, and the social, psychological, and biological determinants of human behavior. Applicants with undergraduate majors in social work or a related field or discipline are given preference over applicants with other majors.

Completion of at least 18 credits in two or more social science disciplines (e.g., sociology, psychology, economics, anthropology, political science); strong academic preparation as demonstrated by undergraduate GPA; and demonstrated interest in becoming a social worker is also required. Preference is given to applicants with professional experience in human service settings, particularly when this experience involves working with underrepresented and protected classes.

**Enrollment Prerequisites**—Admitted applicants must complete a college-level biology course with content on human anatomical and physiological development and a college-level statistics course. The biology course must be completed before registering for the first semester in the

M.S.W. program, and the statistics course must be completed before registering for the first research course. Interested persons can apply and be admitted before completing the enrollment prerequisites.

**Advanced Standing**—Applicants with a bachelor of social work degree from a program accredited by the Council on Social Work Education may apply for admission to the advanced standing program. All other applicants are ineligible for this program.

**Use of 4xxx Courses**—Inclusion of 4xxx courses on degree program forms is subject to adviser and director of graduate studies approval.

### M.S.W. Coursework Only Degree Requirements

The M.S.W. requires 51 credits (34 credits for students admitted with advanced standing), including a minimum of 41 credits in social work courses (28 for students with advanced standing), at least 2 credits in a related field, and a master's research project. The program requires two field placements in human service agencies (one field placement for students with advanced standing). A minimum GPA of 3.00 for courses included in the degree program is required. A level of personal and professional competence, as indicated by course and field placement evaluations, is required.

**Language Requirements**—None.

**Final Exam**—None.

## Related Fields

Graduate degree programs do not exist in the following fields. However, students may earn graduate credit in courses related to their program and use faculty members on their examining committees from these fields. For graduate courses, see the Courses section of this catalog.

## American Indian Studies

### Professor

John G. Red Horse, E

## Anthropology

### Professor

Linda S. Belote, E  
Michael D. Linn, Composition, E  
Timothy G. Roufs, E  
David M. Smith, E

### Associate Professor

Sharon R. Kemp, E

## Art History

### Professor

Thomas F. Hedin, E

### Associate Professor

Robyn S. Roslak, E

## Behavioral Sciences

### *Professor*

Barbara A. Elliott, E  
Frederic W. Hafferty, E

### *Associate Professor*

James G. Boulger, E  
Gary L. Davis, E  
Richard Hoffman, E

### *Assistant Professor*

Mustafa al'Absi, E

## Chemical Engineering

### *Associate Professor*

Richard A. Davis, E  
Keith B. Lodge, E

### *Assistant Professor*

Gerardine G. Botte, E

## Communication

### *Professor*

Mike Sunnafrank, E

### *Associate Professor*

Virginia T. Katz, E  
Linda T. Krug, E  
Elizabeth J. Nelson, E  
Gerald L. Pepper, E  
Deborah Petersen-Perlman, E

### *Assistant Professor*

Gregory S. Larson, E  
Artemio Ramirez, E

## Cultural Studies

### *Professor*

Thomas D. Bacig, Sociology-Anthropology, E  
Ronald T. Marchese, History, E

### *Associate Professor*

Thomas J. Farrell, Composition, E

## Education

### *Professor*

Thomas D. Bacig, Sociology-Anthropology, E  
Thomas G. Boman, E  
Helen L. Carlson, E  
Ajit K. Das, Psychology, E  
Dennis R. Falk, Social Work, E  
Linda Miller-Cleary, English, E

### *Associate Professor*

Francis Guldbrandsen, E  
Donald Haynes, Health, Physical Education, and Recreation, E  
Nedra A. Hazareesingh, E  
John R. Keener, Health, Physical Education, and Recreation, E  
Georgia L. Keeney, Health, Physical Education, and Recreation, E  
June E. Kreutzkamp, E  
Edmond F. Lundstrom, Health, Physical Education, and Recreation, E  
Bruce H. Munson, E  
Thomas D. Peacock, E  
Elizabeth P. Quintero, E  
Helen Rallis, E  
Mary Kay Rummel, E

### *Assistant Professor*

Kenneth Gilbertson, Health, Physical Education, and Recreation, E  
Noell W. Reinhillier, E

## Family Life

### *Associate Professor*

Terrie M. Shannon, Education, E

## French

### *Associate Professor*

Yolande J. Jenny, Foreign Languages and Literatures, E

## Geography

### *Professor*

Lawrence M. Knopp, E

### *Associate Professor*

Scott M. Freundsuh, E

### *Assistant Professor*

Patrice Farrell, E  
Gordon L. Levine, E  
Maureen Kim L. Sioh, E  
Tongxin Zhu, E

## German

### *Associate Professor*

Jonathan B. Conant, Foreign Languages and Literatures, E

## Health Education

### *Professor*

Eugene S. Ley, Health, Physical Education, and Recreation, E

### *Associate Professor*

Donald K. Haynes, Health, Physical Education, and Recreation, E  
Georgia L. Keeney, Health, Physical Education, and Recreation, E  
Edmond F. Lundstrom, Health, Physical Education, and Recreation, E

## History

### *Professor*

Ronald T. Marchese, E  
Neil T. Storch, E  
Judith A. Trolander, E

### *Associate Professor*

Alexis E. Pogorelskin, E  
Nkasa T. Yelengi, E

### *Other*

Dennis L. Anderson, E

## Philosophy

### *Professor*

James H. Fetzer, E  
David J. Mayo, E

### *Associate Professor*

David J. Cole, E  
Eve Browning Cole, E  
Robert H. Evans, E  
Richard H. Hudelson, E

## Physical Education

### *Professor*

Joann M. Johnson, E  
Eugene S. Ley, E

### *Associate Professor*

John R. Keener, E  
Mark Nierengarten, E

## Political Science

### *Professor*

Elizabeth Bartlett, Women's Studies, E  
Geoffrey Paul Sharp, E

### *Associate Professor*

Stephen P. Chilton, E  
Craig H. Grau, E

### *Assistant Professor*

Martin A. Nie, E  
Bradley A. Thayer, E

## Recreation

### *Associate Professor*

Edmond F. Lundstrom, Health, Physical Education, and Recreation, E

## Sociology

### *Professor*

John A. Arthur, E  
William Fleischman, E  
J. Clark Laundergan, E

### *Associate Professor*

Sheryl J. Grana, E  
John E. Hamlin, E  
Janelle L. Wilson, E

### *Assistant Professor*

Mitra C. Emad, E

## Spanish

### *Professor*

Richard A. Seybolt, Foreign Languages and Literatures, E  
Eileen M. Zeitz, Foreign Languages and Literatures, E

## Special Education

### *Professor*

Uwe H. Stuecher, Psychology, E

## Theatre

### *Associate Professor*

Ann A. Bergeron, E  
Jon M. Berry, E  
Patricia Dennis, E  
Mark A. Harvey, E  
Thomas K. Isbell, E  
Cathryn F. Ufema, E  
Arden W. Weaver, E

## Women's Studies

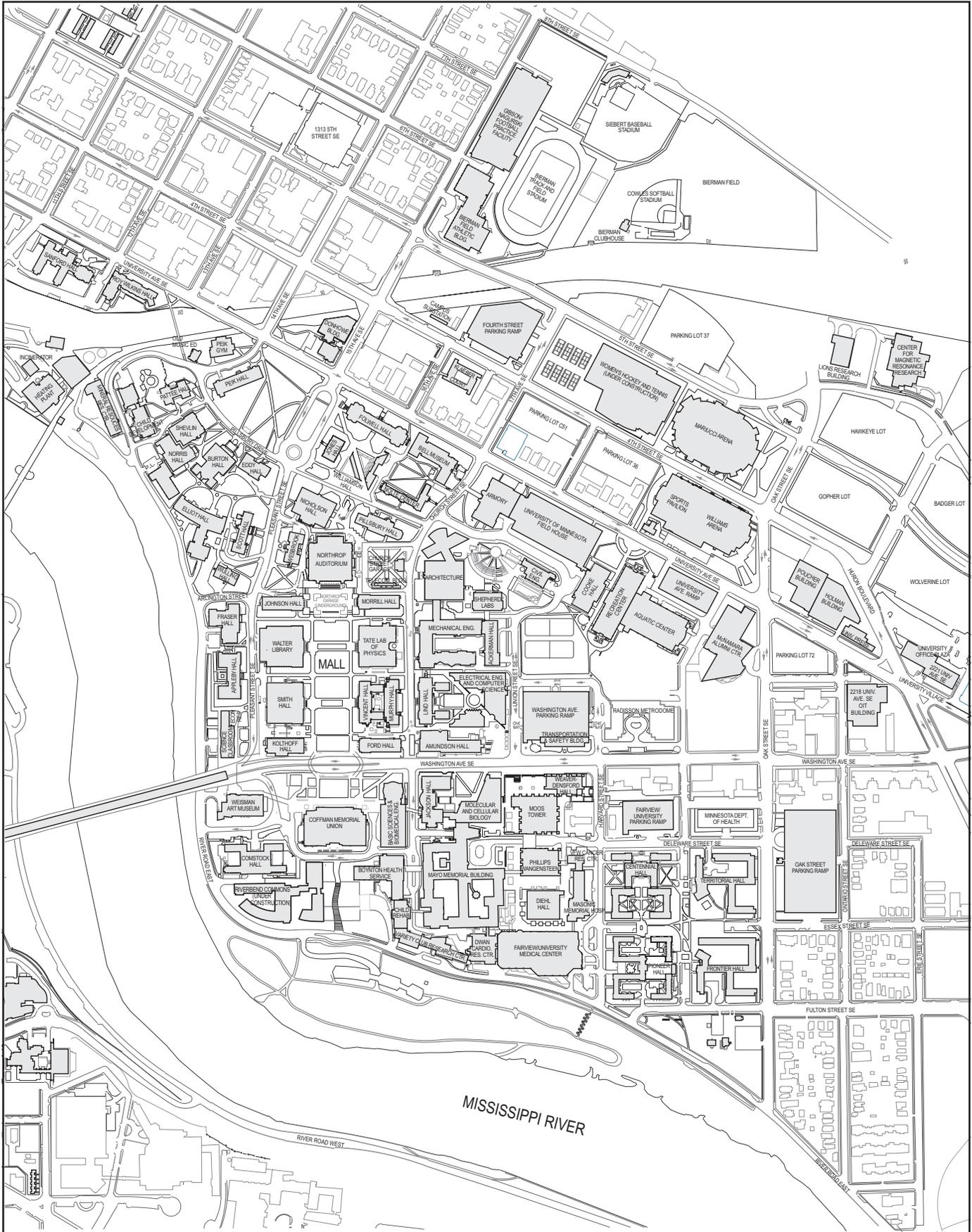
### *Professor*

Elizabeth A. Bartlett E

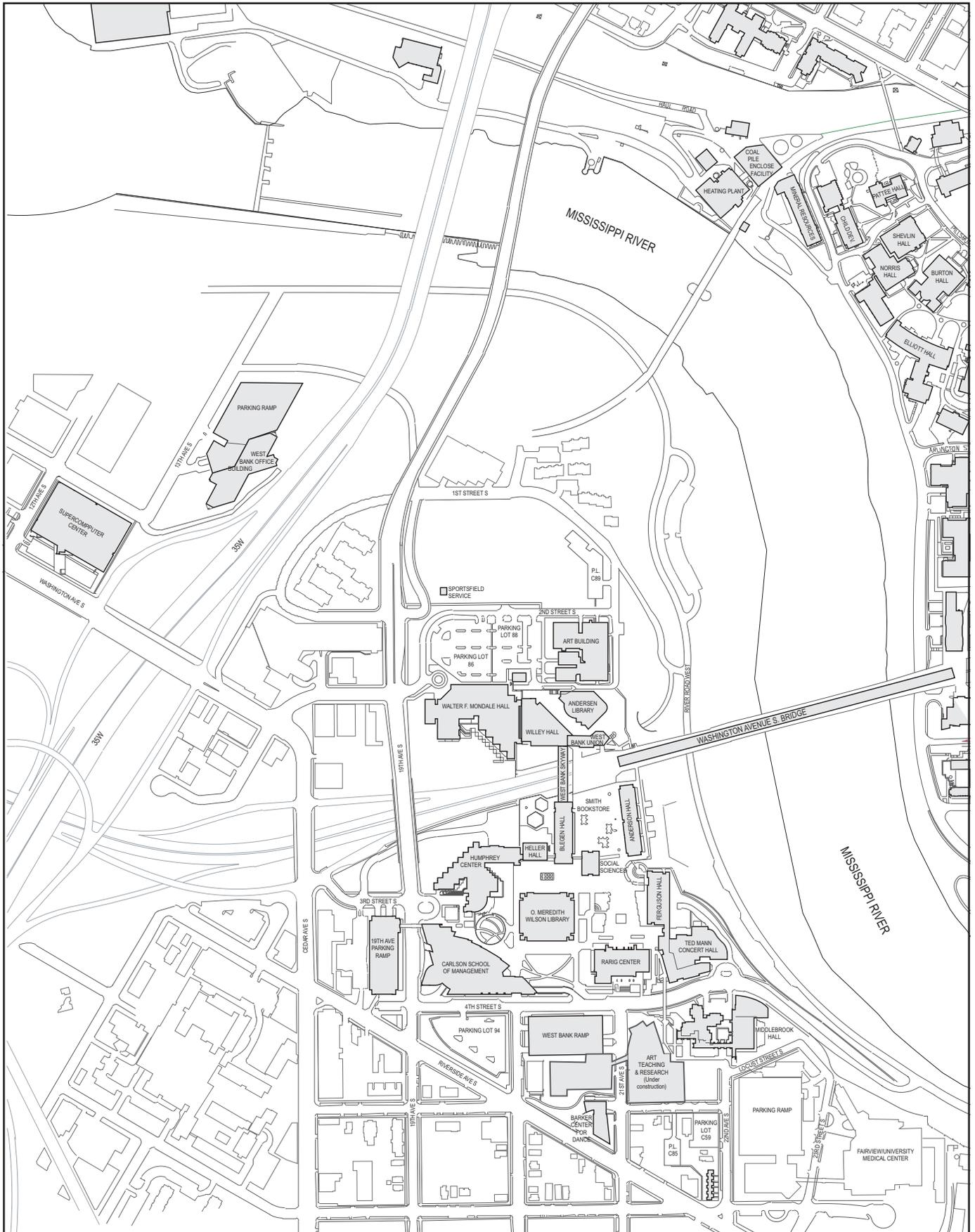
### *Associate Professor*

Helen M. Doane, Psychology, E  
Margaret N. Kamau, E  
Tineke A. Ritmeester, E

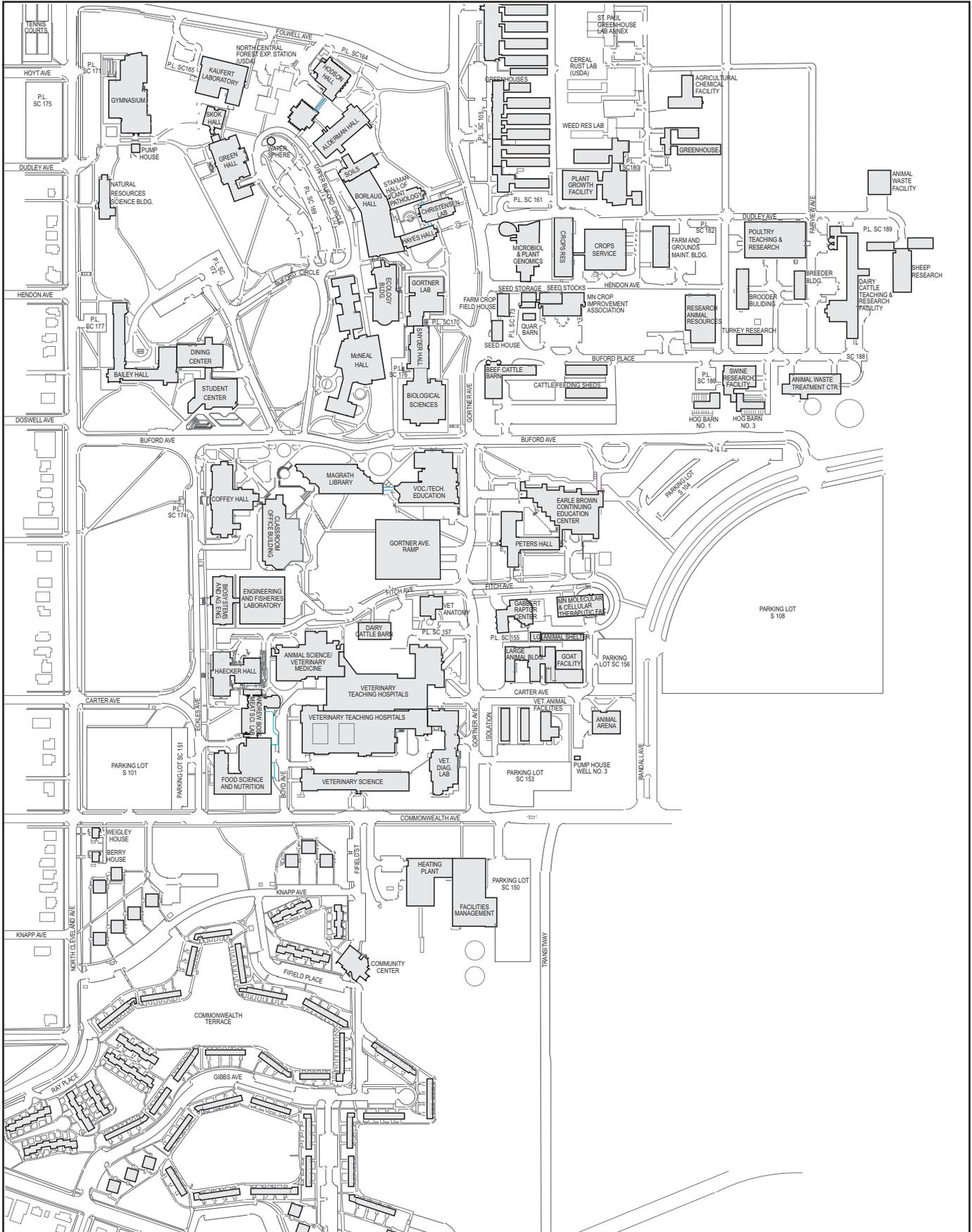
# University of Minnesota, Twin Cities East Bank



# University of Minnesota, Twin Cities West Bank



# University of Minnesota, Twin Cities St. Paul



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# Course Designators

Below is an alphabetical list of course designators and their referents under which courses are organized within the Courses section of this catalog. The list is provided to help students find the full description of prerequisite courses and identify the programs to which the courses apply.

Directly following each designator and its referent is a “see” note in cases where the program name or names differ from the

referent. For example, courses in physiology (Phsl) pertain to the cellular and integrative physiology program.

Courses in fields that do not offer graduate programs, but which may be taken for graduate credit if related to a student’s program, also appear in the course section; their designators and referents below are followed by “related courses.”

Acct	Accounting—see Business Administration; Business Taxation	Dent	Dentistry
AdEd	Adult Education—see Education—Work, Community, and Family Education; Work, Community, and Family Education	Derm	Dermatology
AdPy	Adult Psychiatry—related courses	DesI	Design Institute—See Architecture and Landscape Architecture
AEM	Aerospace Engineering and Mechanics—see Aerospace Engineering; Mechanics	DHA	Design, Housing, and Apparel
Afro	African and African American Studies—see Studies in Africa and the African Diaspora	Dnce	Dance—see Theatre Arts
AFEE	Agricultural, Food, and Environmental Education—see Education—Work, Community, and Family Education; Work, Community, and Family Education	DSSC	Development Studies and Social Change
AgET	Agricultural Engineering Technology—see Biosystems and Agricultural Engineering	Dtch	Dutch—see Germanic Studies
Agro	Agronomy and Plant Genetics—see Applied Plant Sciences	EAS	East Asian Studies
Akka	Akkadian—see Classical and Near Eastern Studies	Econ	Economics
ALL	Asian Languages and Literatures	ECP	Experimental and Clinical Pharmacology
AmIn	American Indian Studies	EdHD	Education and Human Development
AmSt	American Studies	EdPA	Educational Policy and Administration
ANE	Ancient Near Eastern—see Classical and Near Eastern Studies	Educ	Education—see Art Education; Education—Curriculum and Instruction; Education—Recreation, Park, and Leisure Studies; Education—Work, Community, and Family Education
Anes	Anesthesiology	EE	Electrical Engineering—see also Computer Engineering
AnSc	Animal Science	EEB	Ecology, Evolution, and Behavior
Anth	Anthropology	EngC	English: Writing, Rhetoric, and Language—see Creative Writing; English
ApEc	Applied Economics—see Agricultural and Applied Economics	EngL	English: Literature—see Creative Writing; English
APSc	Applied Plant Sciences	EngW	English: Creative and Professional Writing—see Creative Writing; English
Arab	Arabic	Ent	Entomology
Arch	Architecture	Entr	Entrepreneurship—see Business Administration
Arm	Aramaic—see Classical and Near Eastern Studies	EPsy	Educational Psychology
ArtH	Art History	ES	Environmental Science
ArtS	Art	ESL	English as a Second Language
ASL	American Sign Language	FE	Family Education—see Education—Work, Community, and Family Education; Work, Community, and Family Education
Ast	Astronomy—see Astrophysics	Fina	Finance—see Business Administration; Business Taxation
BA	Business Administration	FPCH	Family Practice and Community Health
BAE	Biosystems and Agricultural Engineering	FR	Forest Resources—see Natural Resources and Science Management
BIE	Business and Industry Education—see Education—Work, Community, and Family Education; Work, Community, and Family Education	Fren	French
Binf	Bioinformatics	FrIt	French and Italian—see French; Italian
BioC	Biochemistry—see Biochemistry, Molecular Biology, and Biophysics	FScN	Food Science and Nutrition—see Food Science; Nutrition
Biol	Biology	FSoS	Family Social Science
BLaw	Business Law—see Business Administration; Business Taxation	FW	Fisheries and Wildlife—see Wildlife Conservation
BMEn	Biomedical Engineering	GCD	Genetics, Cell Biology, and Development—see Molecular, Cellular, Developmental Biology and Genetics
BMSc	Biomedical Science	Geo	Geology and Geophysics—see Geology; Geophysics
BPhy	Biophysical Sciences—see Biophysical Sciences and Medical Physics	GeoE	Geological Engineering
CAPy	Child and Adolescent Psychiatry—related courses	Geog	Geography
CAS	Central Asian Studies—see Russian Area Studies	Ger	German—see Germanic Studies
CBio	Conservation Biology	Gero	Gerontology
CDis	Communication Disorders	GIS	Geographic Information Science
CE	Civil Engineering	GloS	Global Studies—see East Asian Studies; Russian Area Studies
CgSc	Cognitive Science	Grad	Graduate School
Chem	Chemistry	Grk	Greek—see Classical and Near Eastern Studies
ChEn	Chemical Engineering—see also Materials Science and Engineering	GSD	German, Scandinavian, and Dutch—see Germanic Studies
Chic	Chicano Studies—related courses	Hebr	Hebrew—see Classical and Near Eastern Studies
Chn	Chinese—see East Asian Studies	HInf	Health Informatics
ChPh	Chemical Physics	Hist	History
CI	Curriculum and Instruction—see Education—Curriculum and Instruction	HMed	History of Medicine—see History of Medicine and Biological Sciences
Clas	Classics—see Classical and Near Eastern Studies	Hndi	Hindi—see South Asian Languages
CLCv	Classical Civilization—see Classical and Near Eastern Studies	Hort	Horticultural Science—see Applied Plant Sciences
CLit	Comparative Literature	HRD	Human Resource Development—see Education—Work, Community, and Family Education; Work, Community, and Family Education
CLS	Clinical Laboratory Science	HRIR	Human Resources and Industrial Relations
CmpE	Computer Engineering	HSci	History of Science and Technology
Comm	Communication Studies	HumF	Human Factors—see Human Factors/Ergonomics
Copt	Coptic—see Classical and Near Eastern Studies		
CPsy	Child Psychology		
CSci	Computer Science—see Computer and Information Sciences; Computer Engineering		
CSCL	Cultural Studies and Comparative Literature—related courses		
CSDS	Comparative Studies in Discourse and Society		
CSDy	Control Science and Dynamical Systems		
CSpH	Center for Spirituality and Healing—See Complementary Therapies and Healing Practices		

IDSc	Information and Decision Sciences—see Business Administration; Business Taxation	PA	Public Affairs—see also Public Policy; Science, Technology, and Environmental Policy; Urban and Regional Planning
IE	Industrial Engineering—see also Mechanical Engineering	PBio	Plant Biology—see Plant Biological Sciences
InAr	Interdisciplinary Archaeological Studies	Phcl	Pharmacology
Ins	Insurance—see Business Administration; Business Taxation	Phil	Philosophy
IntR	International Relations—related courses	Phm	Pharmaceutics
IRel	Interpersonal Relationships Research	Phsl	Physiology—see Cellular and Integrative Physiology
ISE	Infrastructure Systems Engineering	Phys	Physics
Ital	Italian	PlPa	Plant Pathology
Jour	Journalism and Mass Communication—see Mass Communication	Plsh	Polish—see Russian Area Studies
Jpn	Japanese	PMed	Physical Medicine and Rehabilitation—see Occupational Therapy; Physical Therapy; Rehabilitation Science
JwSt	Jewish Studies—related courses	Pol	Political Science
Kin	Kinesiology	Port	Portuguese—see Hispanic and Luso-Brazilian Literatures and Linguistics; Hispanic Linguistics; Hispanic Literature; Luso-Brazilian Literature
LA	Landscape Architecture	Psy	Psychology
LaMP	Laboratory Medicine and Pathology	PT	Physical Therapy
LASK	Learning and Academic Skills—related courses	PubH	Public Health—see also Biostatistics; Environmental Health; Epidemiology; Health Services Research, Policy and Administration
Lat	Latin—see Ancient and Medieval Art and Archaeology; Classical and Near Eastern Studies; Classics	Rad	Radiology
LgTT	Language, Teaching, and Technology—related courses	RAS	Russian Area Studies
Ling	Linguistics	Rec	Recreation, Park, and Leisure Studies—see also Education—Recreation, Park, and Leisure Studies
LM	Logistics Management—see Business Administration; Business Taxation	RelA	Religions in Antiquity—see Classical and Near Eastern Studies
LS	Liberal Studies	RelS	Religious Studies
Mar	Marathi—see South Asian Languages	Rhet	Rhetoric—see Rhetoric and Scientific and Technical Communication; Scientific and Technical Communication
Math	Mathematics	RRM	Recreation Resource Management
MatS	Materials Science—see Chemical Engineering; Materials Science and Engineering	RSc	Rehabilitation Science
MBT	Master of Business Taxation—see Business Taxation	Russ	Russian—see Russian Area Studies
MCDG	Molecular, Cellular, Developmental Biology and Genetics	SACP	Social, Administrative, and Clinical Pharmacy
MCom	Managerial Communications	SAgr	Sustainable Agricultural Systems
ME	Mechanical Engineering—see also Industrial Engineering	SALC	South Asian Languages and Cultures—see South Asian Languages
MedC	Medicinal Chemistry	SAPh	Social and Administrative Pharmacy—see Social, Administrative, and Clinical Pharmacy
MELC	Middle Eastern Languages and Cultures—see South Asian Languages	Scan	Scandinavian—see Germanic Studies
MeSt	Medieval Studies	SciC	Scientific Computation
Mgmt	Management—see Business Administration; Business Taxation	SCMC	Studies in Cinema and Media Culture
MHA	Master of Healthcare Administration—related courses	SEng	Software Engineering
MICa	Microbiology, Immunology, and Cancer Biology	Skt	Sanskrit—see South Asian Languages
MicB	Microbiology	Slav	Slavic—see Russian Area Studies
MicE	Microbial Engineering	Soc	Sociology
Mktg	Marketing—see Business Administration; Business Taxation	Soil	Soil Science
MOT	Management of Technology	Span	Spanish—see Hispanic and Luso-Brazilian Literatures and Linguistics; Hispanic Linguistics; Hispanic Literature; Luso-Brazilian Literature
MS	Manufacturing Systems	SpPt	Spanish-Portuguese—see Hispanic and Luso-Brazilian Literatures and Linguistics; Hispanic Linguistics; Hispanic Literature; Luso-Brazilian Literature
MSt	Museum Studies	SST	Studies of Science and Technology
MthE	Mathematics Education	Stat	Statistics
MuEd	Music Education—see also Music	Sum	Sumerian—see Classical and Near Eastern Studies
Mus	Music—see also Music Education	Surg	Surgery—see also Experimental Surgery
MusA	Music Applied—see Music; Music Education	SW	Social Work
MVB	Molecular Veterinary Biosciences	TESL	Teaching English as a Second Language—see English as a Second Language
NpSE	Nanoparticle Science and Engineering	Th	Theatre Arts
NR	Natural Resources Science and Management	TRad	Therapeutic Radiology—related courses
NRES	Natural Resources and Environmental Studies—see Natural Resources Science and Management	TrIn	Translation and Interpreting—see English as a Second Language
NSc	Neuroscience	Txcl	Toxicology
NSci	Neuroscience Department	UrbS	Urban Studies—see Urban and Regional Planning
NSu	Neurosurgery	VDM	Veterinary Diagnostic Medicine
Nurs	Nursing	VMed	Veterinary Medicine
Nutr	Nutrition	VPB	Veterinary Pathobiology—see Veterinary Medicine
OBio	Oral Biology	WCFE	Work, Community, and Family Education—see also Education—Work, Community, and Family Education
OMS	Operations and Management Science—see Business Administration; Business Taxation	WoSt	Women's Studies—see Feminist Studies
OT	Occupational Therapy	WPS	Wood and Paper Science—see Natural Resources Science and Management
Otol	Otolaryngology	WRS	Water Resources Science
		YoSt	Youth Development and Research—see Social Work