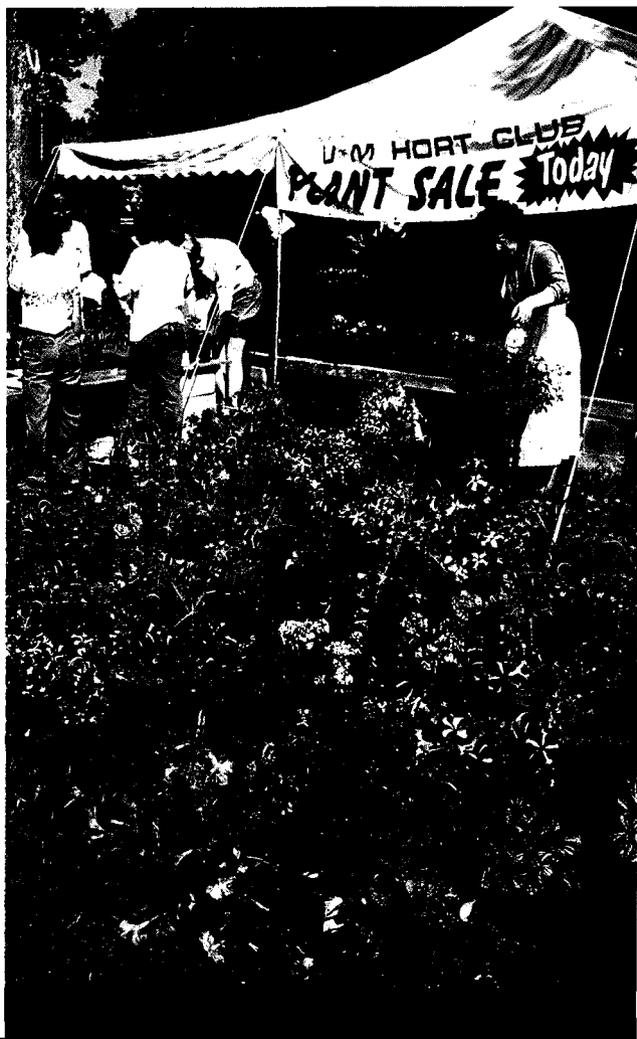


Agriculture

University of Minnesota Bulletin

1987-89



Agriculture

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Introduction

Resources

This biennial bulletin, the official source of information about the College of Agriculture, should be kept handy for repeated reference. In addition, students are expected to be aware of the following resources:

College Office—For more information about policies and program requirements, check with the College of Agriculture Office, 277 Coffey Hall, 1420 Eckles Avenue, St. Paul, MN 55108 (612/624-3009).

Adviser—At your first registration, you will be assigned an adviser, who will be your guide in planning a course of study.

Class Schedule—Each quarter you may pick up a *Class Schedule* with other registration materials in the College of Agriculture Office. This publication lists University day school courses complete with hours, rooms, instructors, prerequisites, registration instructions, fees, maps, final exam schedules, grading definitions, and other valuable information.

Other Bulletins—The annual *General Information Bulletin* provides a brief overview of the University and its basic costs and regulations. Evening and summer courses are featured in the *Continuing Education and Extension Classes Bulletin* and *Summer Session Bulletin*, respectively. Separate bulletins are also published for other University colleges. Most may be obtained from the Office of Admissions and Records, 130 Coffey Hall.

Policies

Bulletin Use—The contents of this bulletin and other University bulletins, publications, or announcements are subject to change without notice. University offices can provide current information about possible changes.

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, religion, color, sex, national origin, handicap, age, veteran

status, or sexual orientation. In adhering to this policy, the University abides by the requirements of Title IX of the Education Amendments of 1972; by Sections 503 and 504 of the Rehabilitation Act of 1973; by Executive Order 11246, as amended: 38 U.S.C. 2012; by the Vietnam Era Veterans Readjustment Act of 1972, as amended; and by other applicable statutes and regulations relating to equality of opportunity.

Inquiries regarding compliance may be addressed to Patricia A. Mullen, Director, Office of Equal Opportunity and Affirmative Action, 419 Morrill Hall, University of Minnesota, 100 Church Street S.E., Minneapolis, MN 55455 (612/624-9547); to the Director of the Office of Civil Rights, Department of Education, Washington, DC 20202; or to the Director of the Office of Federal Contract Compliance Programs, Department of Labor, Washington, DC 20210.

Postal Statement

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Cover Photo: The annual College of Agriculture plant sale is organized by student members of the Horticulture Club.

Cover photo by Jeff Christensen. Black and white photos by Jeff Christensen and Tim Rummelhoff.

Directory

Administrative Offices

College of Agriculture Office

University of Minnesota

277 Coffey Hall

1420 Eckles Avenue

St. Paul, MN 55108

Student Services

612/624-3009

Career Services

612/624-2710

Prospective Student Services

612/624-3045

Office of Admissions

University of Minnesota

240 Williamson Hall

231 Pillsbury Drive S.E.

Minneapolis, MN 55455

612/624-5555

Office of Admissions and Records

University of Minnesota

130 Coffey Hall

1420 Eckles Avenue

St. Paul, MN 55108

612/624-3731

Office of Student Financial Aid

University of Minnesota

199 Coffey Hall

1420 Eckles Avenue

St. Paul, MN 55108

612/624-2756

Department Offices

Agricultural and Applied Economics

Michael Boehlje, head

231 Classroom Office Building

1994 Buford Avenue

St. Paul, MN 55108

612/625-0231

Agricultural Education

Edgar A. Persons, head

320 Vocational-Technical Education

Building

1954 Buford Avenue

St. Paul, MN 55108

612/624-2221

Agricultural Engineering

Frederick G. Bergsrud, head

213 Agricultural Engineering

1390 Eckles Avenue

St. Paul, MN 55108

612/625-7734

Agronomy and Plant Genetics

Orvin C. Burnside, head

411 Borlaug Hall

1991 Buford Circle

St. Paul, MN 55108

612/625-8761

Animal Science

Richard D. Goodrich, head

120 Peters Hall

1404 Gortner Avenue

St. Paul, MN 55108

612/624-1205

Entomology

Richard L. Jones, head

219 Hodson Hall

1980 Folwell Avenue

St. Paul, MN 55108

612/624-3278

Food Science and Nutrition

Francis F. Busta, head

225 Food Science and Nutrition

1334 Eckles Avenue

St. Paul, MN 55108

612/624-3086

Horticultural Science

and Landscape Architecture

James F. Bartz, head

305 Alderman Hall

1970 Folwell Avenue

St. Paul, MN 55108

612/624-3606

Plant Pathology

Philip O. Larsen, head

495 Borlaug Hall

1991 Buford Circle

St. Paul, MN 55108

612/625-8299

Rhetoric

Thomas E. Pearsall, head

202 Haecker Hall

1364 Eckles Avenue

St. Paul, MN 55108

612/624-7750

Soil Science

William E. Larson, head

125 Soils

1529 Gortner Avenue

St. Paul, MN 55108

612/625-9734

Checklist of Procedures

Checklist of Procedures

Application for Admission

For appropriate forms and instructions, contact Prospective Student Services, College of Agriculture, University of Minnesota, 277 Coffey Hall, 1420 Eckles Avenue, St. Paul, MN 55108 (612/624-3045).

See Admission and Financial Aid in this bulletin.



Acceptance

The material sent to you when you are accepted contains information on orientation and initial registration plus application forms for housing and financial aid.



Orientation Procedures

Before classes begin, you will be invited to an orientation-registration program. Please plan to attend.

See Orientation-Registration.



Registration Procedures

You must register before each quarter. You will be notified of the scheduled times. See Orientation-Registration.



Changes in Registration

See Cancel-Add Procedures (for individual course changes); Cancellation of Entire Registration (for withdrawal from the University; and Petition Procedures (for exemptions from requirements).



Application for Graduation

You must apply for graduation at least *two quarters before* you expect to complete your degree requirements.

See Graduation Requirements.



Career Development and Placement

The Career Services Office provides assistance with all aspects of career planning. See Career Services Office.

General Information



General Information

As a science and an industry, agriculture is a dynamic profession that presents challenging opportunities in a variety of areas. The following curricula and majors offered by the College of Agriculture accommodate students with diverse personal and professional goals. For complete information, see the alphabetical listings in the Programs section.

Agricultural Business Administration Curriculum

Agricultural Business Administration

Agricultural Science and Industries Curriculum

Agricultural Economics

Agricultural Education

Agronomy

Animal Science

Horticultural Science

Integrated Pest Management

Soil Science

Communication Science Curriculum

Technical Communication

Food Science and Nutrition Curriculum

Consumer Food Science

Food Science and Technology

Nutrition and Dietetics

Resource and Community Development Curriculum

Economics of Public Resource Management

Landscape Architecture

Soil and Water Resource Management

Degrees Offered

Baccalaureate Degrees—Most of the curricula of the College of Agriculture lead to a *bachelor of science* degree.

Several degrees are offered jointly or in cooperation with other colleges in the University:

- *bachelor of science* (agricultural education major—College of Education)
- *bachelor of landscape architecture* (landscape architecture major—Institute of Technology)

In addition, the college offers a *bachelor of agricultural business administration* degree (B.A.B.A.).

The college's general philosophy is that students who wish to develop two or more areas of specialization in programs offered by the college should receive only one bachelor of science degree. Recognition for accomplishments in other areas should be made through the minor or a second major. (See Double Major below.)

Master of Agriculture Degree—In addition to the above, the College of Agriculture offers the *master of agriculture* degree, a professional, non-research-oriented degree designed for those who seek postbaccalaureate education to further advance their professional competence in agriculture. For more information, see the alphabetical listings in the Programs section. Obtain the brochure *The Master of Agriculture* from the College of Agriculture Office, 277 Coffey Hall, University of Minnesota, 1420 Eckles Avenue, St. Paul, MN 55108 (612/624-3009).

Graduate Degrees—The departments in the College of Agriculture, through the Graduate School, also offer the *master of science* and the *doctor of philosophy* degrees. For information about these programs, see the *Graduate School Bulletin*.

Admission

Requirements for admission to the College of Agriculture for high school graduates and transfer students are explained below. Information for adult special students, international and minority students, and senior citizens is also included. For more information, consult the Office of Admissions, 240 Williamson Hall, 231 Pillsbury Dr. S.E., Minneapolis, MN 55455, (612/625-2008).

You should apply by July 15 for fall quarter admission, November 15 for winter quarter, and February 15 for spring quarter. Applications received after these dates may be considered but cannot be assured of action in time for enrollment in the quarter you request. A nonrefundable application fee, payable to the University, must accompany your application.

Send requests for information to the College of Agriculture Office, 277 Coffey Hall, University of Minnesota, 1420 Eckles Avenue, St. Paul, MN 55108, or call 612/624-3045.

High School Graduates—If you are a high school graduate in the upper 60% of your class, you may enter the college if you have completed 12 units (roughly defined as year-long courses) in grades 10 through 12. For those 12 units you should choose from offerings in English, social studies and history, mathematics, the natural sciences, and foreign languages. At least 1 unit must be in natural science or agriculture, and 3 must be in mathematics, including the following: 1 unit in elementary algebra, 1 unit in plane geometry, and 1 unit in higher algebra or its equivalent.

Participation in high school vocational agriculture activities is recognized as excellent preparation for the study of agriculture at the college level. Rural background and experience, however, are not required for admission to the college.

You may seek exception to the above requirements if you can provide information indicating promise of academic success.

Transfer Students—You may apply for admission to the College of Agriculture from other colleges or universities. You may be accepted if you meet the entrance requirements of the college and of the major you wish to enter. General requirements for entrance by transfer include a minimum cumulative grade point average of 2.00 (where A = 4.00, B = 3.00, C = 2.00, D = 1.00, N or no credit = 0.00) and a mathematics background at least equal to that required of high school graduates (see above).

You may seek exception to these requirements if you can provide information indicating promise of academic success.

After you have applied for and been accepted as a transfer student, the Office of Admissions and the College of Agriculture Office (College Office) will evaluate all previous college work according to the

standards of the University and the College of Agriculture. You will then be provided with a Transfer Credit Evaluation showing how your previous work has been evaluated.

As a transfer student, you must complete all specific course and area distribution requirements of the college regardless of the number of credits accepted for transfer. Therefore, if you begin your degree work elsewhere intending to transfer later, you should carefully plan your pretransfer program to meet as many College of Agriculture requirements as possible. See the requirements for the various curricula in the Programs section and take special note of All-College Requirements near the end of the section.

Transfer of Credit in Agricultural Courses Taken at Minnesota Non-Land-Grant Institutions—Credit for courses in agriculture taken at Minnesota non-land-grant institutions is evaluated by the College Office on a course by course basis.

Transfer of Credit From Continuing Education and Extension—If you wish to transfer credits and grades for Continuing Education and Extension (CEE) courses before you are admitted to the College of Agriculture, then submit a transcript of these courses to the Office of Admissions; if you wish to transfer CEE credits and grades after you have been admitted to the College of Agriculture and have registered for courses, then submit your CEE transcript to the Office of the Registrar. Both the Admissions Office and Registrar's Office will evaluate your CEE transcript and determine which credits and grades will be included on your record in the College of Agriculture.

Change of College Within the University—To transfer to the College of Agriculture from another college unit of the University, you must meet the entrance requirements of the College of Agriculture. Apply for transfer at the Office of Admissions on the campus where you are currently registered or where you last attended classes.

General Information

International Students—International students must demonstrate competency in the English language by achieving an acceptable score on an English proficiency test. In addition, they must present evidence that they have met all admission requirements applicable to United States students and maintained a good academic record at their previous schools.

Minority Admission—The College of Agriculture seeks applications from minority students.

Adult Special Students—If you wish to register for courses to meet particular needs and are not interested in working toward a degree, you may enter the college as an adult special. College approval is required. Normally, adult special students are not enrolled for a long time, but only as necessary to acquire the specific training desired.

If you enter the college as an adult special student with the intention of transferring later to the Graduate School, you should be aware that there are restrictions on the number of credits that may be transferred to a graduate program while you are registered as an adult special. Consult the *Graduate School Bulletin*. For enrollment information and deadlines, contact the College of Agriculture Office, 277 Coffey Hall, University of Minnesota, 1420 Eckles Avenue, St. Paul, MN 55108 (612/624-3009).

Senior Citizens—Minnesota residents 62 years or older are admitted to all University of Minnesota classes on a space-available basis, provided they have completed specified prerequisites. If a course is taken without credit, there is no fee unless materials or other special charges are involved. If a course is taken for credit, students must pay \$6 per credit and any materials or special charges. Eligible persons should check with the Office of Admissions and Records, 130 Coffey Hall.

Financial Aid

Financial aid for students is available in the form of grants, loans, scholarships,

and work-study. Major resources are described below:

"Bright Future Minnesota," Agricultural Merit Scholarships are awarded to qualified College of Agriculture students selected by a review committee including faculty, staff, academic administration, and donor representatives. Inquiries regarding gifts, nominations, and applications should be made to the Agricultural Merit Scholars Program, 277 Coffey Hall, 1420 Eckles Avenue, St. Paul, MN 55108 (612/624-4212).

The federal *Pell Grant Program* is designed to help students from low- and middle-income families meet the cost of tuition and fees. While need is determined by the Pell program, the University's Office of Student Financial Aid (OSFA) disburses the funds.

The *Minnesota State Scholarship and Grant-in-Aid Program*, administered by the State of Minnesota, sponsors awards based on need. All Minnesota residents are eligible to apply. Although OSFA may include an estimated award amount in a Financial Aid Notification to a student, the state makes the final decision about the amount of award.

The *College Work-Study Program* helps students find part-time and temporary jobs, both on and off campus. Eligibility to participate in this program depends on the extent of the student's and parents' ability to pay educational costs. OSFA certifies students for a variety of jobs. Hours are between 10 and 20 hours a week, depending on individual schedules.

The *Perkins Loan Program* (formerly the National Direct Student Loan Program) enables students to borrow funds for undergraduate programs. Eligibility and loan amounts are based on the student's and parents' ability to pay educational costs. The interest rate is 5%, and repayment with interest starts six months after the recipient ceases to be at least a half-time student.

The outside loan program offers a number of student loans: *Guaranteed Student Loans* (G.S.L.), *Supplemental Loans*

for Students (S.L.S.), Loans for Parents (P.L.U.S.), and the Student Educational Loan Fund (S.E.L.F.). For further information regarding student loans, contact the Office of Student Financial Aid.

University scholarships, grants, and loans are supported by business foundations, fraternal groups, alumni, and friends of the University. All full-time undergraduate students with a B average or better are eligible to apply. Academic achievement is an important factor, although need may also be a criterion. For more information, see the OSFA application packet.

The *Office for Minority Student Affairs (OMSA)* offers financial counseling as well as tutorial, academic, and personal counseling to students who meet eligibility requirements. For more information, contact OMSA, 1901 University Avenue S.E., Suite 301.

Part-time work, either on campus or off, is available through the OSFA Student Employment Center, 120 Fraser Hall. To be eligible, students must have registered and paid for at least 6 credits (except during the summer).

A number of *scholarships to support study abroad* are offered through the International Reciprocal Student Exchange Program, Office of International Education, 719 East River Road, Minneapolis, MN 55455 (625-8922).

Small short-term loans to students who face acute emergencies may be obtained from OSFA.

To apply for financial aid through OSFA, students must obtain an application packet and complete the American College Testing Program's Family Financial Statement (FFS) and all other required documents. Although applications are accepted throughout the academic year, priority consideration for the following fall is given to applications that are complete and in OSFA by April. Exact deadlines are in the application packet.

For an application packet and more information, contact the Office of Student Financial Aid. The St. Paul campus office is in 197 Coffey Hall, 1420 Eckles Avenue,

St. Paul, MN 55108 (612/624-2756). The Minneapolis campus office is in 210 Fraser Hall, 106 Pleasant Street S.E., Minneapolis, MN 55455 (612/624-1665).

Handicapped Students

Wherever possible, special consideration is given to handicapped students to minimize any problems. Through the college office, help is available to arrange for early registration, adviser accessibility and classroom locations for students using a wheelchair, and specific resource aids. Other services are available through the University's Office for Students with Disabilities, 12 Johnston Hall (624-4037).

Orientation-Registration

As a new College of Agriculture student, whether an entering freshman or a transfer student, you will be mailed an invitation to an orientation-registration program. At this program, in addition to becoming acquainted with the campus, you will receive general information about the college and the University and have an opportunity to meet with a faculty adviser in the major you have chosen. He or she will help you select and register for your courses. Although attendance at the orientation program is voluntary, you are urged to participate because failure to attend may result in a late registration date and difficulty obtaining desired courses.

Registration

Each quarter you and the University complete a contract through the registration and payment process. The University agrees to provide certain instruction and facilities; you agree to attend and pay tuition and fees for the classes you have chosen. Although changes sometimes occur in course listings, the responsibility for accurate, timely registration and payment rests primarily with you. Copying errors, excessive changes, failure to observe procedures, and late registration and payment can create an imposition on

General Information

University personnel and can also be costly and time consuming for you.

Special Registration Procedures—

Certain special registration procedures allow you to audit courses, to take them as independent study or reading courses, or to take them for extra credit.

Auditing—Auditors attend and complete all work for a course, but do not take the final examination or receive credit. As an auditor, you must enroll officially in a course and pay regular tuition and fees. Both your adviser and the course instructor must approve your registration. Enter a course you are going to audit on your registration card with a V after the course number (e.g., Rhet 3280V).

Independent Study—You have two options for obtaining credit through independent study. In some University courses, you may request an examination (or other evaluation) after preparing for it in any way you choose. If you pass the examination, you will receive credit for the course. You must pay a fee for each examination attempted. Check with the College Office for further information and for Request for Special Examination application forms.

A second method of independent study is to take a course without attending classes. Under this method, you pay the usual tuition and fees for the course, meet all deadlines, and take the final examination at the regular time. All usual regulations concerning grades, incompletes, and cancellations apply to students taking independent study in this manner. A course completed under independent study counts as part of the total credit load for the quarter. Check with the department offering the course concerning permission to take it for independent study. You will need approval from the course instructor on a registration override permit. Return the completed override to the Office of Admissions and Records, 130 Coffey Hall. Enter the course you are going to take by independent study on your course request form with a Y after the course number (e.g., Rhet 3280Y).

Extra Credit—With the course instructor's approval, you may earn 1 to 3 additional credits for a course you are taking or have taken. You may, for example, explore a course topic intensively or extend it to a related topic. You will do the extra work on your own according to standards set by the instructor.

You will need approval from the course instructor on a registration override permit. Submit the completed override along with your course enrollment request form with an X after the course number (e.g., Rhet 3280X). The usual regulations concerning tuition and fees, grades, and cancellations apply.

Cancel-Add Procedures—Use a course request form, available from the Office of Admissions and Records or the College Office, to change registration. Make all such changes as early as possible in the quarter.

Cancel—When you cancel a course, you are subject to the following procedures and requirements:

- Cancellations during the first two weeks of a quarter require your adviser's signature on the course request form; the course is deleted from your record.
- Cancellations during the third through sixth weeks of a quarter require your adviser's *and* instructor's signatures on the course request form. A bracketed W is assigned.
- Withdrawal from a course after the sixth week of a quarter is strongly discouraged unless there are extenuating circumstances. Cancellations after the sixth week require the signatures of the adviser, instructor, and Scholastic Standing Committee representative on the course request form. (See Scholastic Requirements below for information on the honor point deficiency incurred with cancellation.) *Cancellations during the ninth and tenth week of a quarter are seldom approved by the Scholastic Standing Committee.* If a cancellation is approved, a W is assigned.

Add—You must have your adviser's signature to add a class during the first week

of a quarter. You must have *both* your adviser's and instructor's signatures during the second through eighth weeks of the quarter. After the eighth week of the quarter, adding a course requires the signatures of your adviser, instructor, and the Scholastic Standing Committee representative. *Approval after the eighth week of the quarter is rarely granted.*

Grading Change—A change from one grading system selected for a course to another (e.g., from A-F to S-N or Audit) must be made during the *first two weeks of a quarter* and requires your adviser's signature on the form. The choice of grading system *may not be changed after the end of the second week.*

Cancellation of Entire Registration—If you leave the University before the end of a quarter, you must cancel your registration when you stop attending classes. Submit a course request form to the Office of Admissions and Records, 130 Coffey Hall. Cancellations are effective the day they are processed. Refunds are based on the date you officially cancel. You are entitled to a full refund if you cancel before the first day of classes. Contact Admissions and Records, 130 Coffey Hall, for current refund information.

Petition Procedures

Petitions are required for departures from either college or major requirements. Submit petitions for departures from college requirements to the College Office, and for major requirements to the department.

If you wish to substitute another course for a requirement, have your petition approved *before* you register for the course. Do not assume that it will be approved; find out for sure.

Credits and Class Attendance

Advanced Placement—The Advanced Placement (AP) program of the College Board provides a way for high schools to offer college-level studies to their more advanced students and for such students to demonstrate satisfactory achievement

in those studies. Through this program students may earn college credit, exemption from requirements, or placement in advanced courses when they enroll in college. For more information, contact the Admissions Office, 240 Williamson Hall, 231 Pillsbury Drive S.E., University of Minnesota, Minneapolis, MN 55455 (612/625-2008).

Course Load—The typical course load per quarter is 14 to 18 credits. A credit requires an average of three hours of work each week. To carry more than 18 credits, a C average (that is, a cumulative grade point average of not less than 2.00) is required. To carry more than 21 credits, a B average (3.00 GPA) in work of the previous quarter and permission from the Scholastic Standing Committee are required. Undergraduates must carry at least 12 credits each quarter to be considered full-time students.

Class Attendance—Attendance for certain classes in the College of Agriculture is compulsory because of the nature of such classes. If you miss a class for a valid reason, you may request the instructor's assistance in making up the work missed. Instructors are under no obligation to give assistance if the absence is not justifiable.

The following four situations are accepted by instructors as justifiable reasons for absence from class and for a request for assistance in making up work: (a) illnesses certified by the University Health Service or by your family physician; (b) emergencies caused by a death or serious illness in your immediate family; (c) absences approved by the Scholastic Standing Committee; and (d) participation, certified by the Office of Student Affairs, in University-approved, cocurricular activities.

To make up classwork, you should confer directly with instructors concerning the reason for the absence and the possibility and ways of completing work missed. The Scholastic Standing Committee intervenes as an appeal agency only when emergencies (items b and c above) are involved.

General Information

College Level Examination Program—

An alternative method of earning credit is through the College Level Examination Program (CLEP). Inquire at the college office for details.

Use of Elective Credits—Students who wish to use excess credits earned as an *undergraduate for credit in the Graduate School* should consult the *Graduate School Bulletin* for current policies or the Graduate School Office, 316 Johnston Hall, University of Minnesota, 101 Pleasant Street S.E., Minneapolis, MN 55455.

With the approval of your adviser and the Scholastic Standing Committee, you may request that some *elective courses you have completed be omitted from the list of courses counted toward your degree*. A maximum of 10 credits of elective courses may be withheld to raise your grade point average, but only to satisfy the graduation requirement of a 2.00 grade point average. When a course is withheld from the undergraduate record, it can be reinstated only by an examination for credit or by repeating the course.

Students in agriculture are not required to take courses in physical education or music. *A maximum of 9 credits in physical education and a maximum of 6 credits in chorus or concert band may be counted as elective credits toward graduation*. Note that Mus 1001 is not an acceptable course for area D.

The Scholastic Standing Committee has ruled that *typing or basic business skills courses may not be given elective credit* in any College of Agriculture program.

Special Study Opportunities

Several study opportunities that allow you to earn credits in special ways are described below. In addition to the programs described, many majors offer internship or work-study opportunities. Check with your adviser.

Academic Enrichment and Honors Program—Students are encouraged to include a foreign study-travel experience

in their undergraduate curriculum. Scholarships are available to help defray costs. A written report is required. Preference is given to proposals for overseas study-travel in non-English speaking countries. Check with the College Office for more information.

Agriculture Minor for Non-College of Agriculture Students—This minor is for non-College of Agriculture students who wish to explore some technical aspects of agriculture so they are better prepared as future leaders. The minor will help prepare them to:

- Understand the interdependence of rural and urban societies
- Better manage the natural resources used by agriculture for the benefit of humanity
- Understand the factors regulating supply and demand and the policies which determine the economics of food and fiber production
- Understand the production practices used by agricultural producers and the environmental and social consequences of these practices
- Understand the scientific basis of modern agriculture

Core Courses

Soil 1122—Introduction to Soil Science (4)

AgEc 3810—Principles of Farm Management (4)

Agro 1010—Principles of Agronomy (5)

or Hort 1100—Biology of Horticultural Production (4)

AnSc 1100—Introductory Animal Science (5)

or FSci 1102—Technology of Food Processing (4)

Besides completing the required core courses, students choose an area of emphasis from among the following: Food and Agriculture, Agricultural Resources and Environmental Management, Ethics and Values in Agriculture, International Agriculture, and Agricultural Production. For specific course listings to fulfill these areas, consult the College Office, 277 Coffey Hall.

International Agriculture Minor—The international agriculture minor is an

interdisciplinary program combining coursework, a seminar, and either a field experience or an in-depth study of the agricultural literature in one area. The minor deals with the political, social, and cultural background against which agriculture and agricultural technology must operate throughout the world. Students gain insight into the problems of production, distribution, and consumption of food, feed, fiber, and domestic animals and attempted solutions in specific geographical areas. At least 30 credits are required, of which 5 must be for either an approved work/study experience or a major literature review, and 1 for a seminar in international agriculture. Students must develop their course of study in cooperation with an adviser in one of the departments of the College of Agriculture.

Required Courses—24 credits minimum
 Courses in agriculture outside the major—14 credits
 Courses in language, cultural aspects, geography, and history of an area of special interest—10 credits
 These courses should form a planned, coherent program that develops competencies in a geographical area of interest to the student.

Research Paper—5 credits minimum
 Select *one* of the following:

1. Field experience including work/study in some area of international agriculture. Students should keep a log book.
2. Extensive literature review in some area of international agriculture. Students should work with a faculty member who has international experience in an area of interest to them.

Seminar
 Seminar in International Agriculture—1 credit (Agri 3000)

"Bright Future Minnesota," Agricultural Merit Scholars Program—This program seeks out and nurtures outstanding students interested in pursuing a career in agriculture. Scholarships ranging from \$1,000 to \$3,000 are awarded to students who meet the academic and leadership requirements. Enrichment opportunities such as seminars, workshops, individual research projects, and travel-study experiences are offered.

Study-Travel Opportunity Program—This program offers financial assistance to undergraduate agriculture students. If you plan a study-travel project, it should

complement your academic program but provide a different experience from course field trips. You must initiate and plan the project yourself with the aid of a faculty sponsor. Money is not granted for trips to professional meetings, seminars, short courses, conventions, job interviews, or similar events. For more information, check with the College Office.

Professional Experience Program (PEP)—Junior and senior students enrolled in curricula offered by the College of Agriculture may participate in the Professional Experience Program (PEP). This program is designed for students who wish to reinforce their academic experience by working in an area related to their course of study. Students work full time for 12 weeks during fall, winter, or spring quarter or during the summer. They earn 4 credits for satisfactory completion of a PEP program and may enroll in two PEP programs for a total of 8 credits. Salaries are paid by the cooperating businesses, industries, producers, and agencies participating in the program. For more information, consult your adviser or the Career Services Office, 272 Coffey Hall (624-2710).

Reserve Officers' Training Corps—The ROTC, through its three services—Army, Navy, and Air Force—gives you an opportunity to combine military or naval training with your academic work. You are eligible for ROTC enrollment if you are a U.S. citizen and if you meet certain physical and other qualifications. The general requirements of the programs of the three services and their special characteristics are described in the *Army-Navy-Air Force ROTC Bulletin*. Inquiries may also be made in person or by letter at the following offices in the Armory Building, University of Minnesota, 15 Church Street S.E., Minneapolis, MN 55455: Military Science, room 108; Naval Science, room 203; Aerospace Studies, room 3.

Double Major

You may find it advantageous to complete the requirements for a second major as

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part of your undergraduate program. Often this can be done by concentrating electives in the second area, thus permitting you to earn a second major without having to take more than the minimum number of credits required for the bachelor's degree. If you are interested in completing a double major, come to the College Office for further information and an application form. You must file the form before you complete the required coursework for your second major.

Minor

The College of Agriculture offers minor concentrations in many areas. These minors are listed alphabetically with the major programs. For more information on a specific minor, contact the sponsoring department or the College Office.

Grading

Academic progress in the College of Agriculture is evaluated by one of two grading systems: the letter grade (A-F) system or the satisfactory-no credit (S-N) system.

A-F System—Under the A-F (A-B-C-D-F) system, each letter grade carries the following meaning:

- A— Represents achievement that is outstanding relative to the level necessary to meet course requirements.
- B— Represents achievement that is significantly above the level necessary to meet course requirements.
- C— Represents achievement that meets the basic course requirements in every respect.
- D— Represents achievement that is worthy of credit even though it does not fully meet the basic course requirements in every respect.
- F— Represents performance that fails to meet basic course requirements. No credit is earned.

The grade point average is determined by dividing the sum of the grade points earned (A = 4.00, B = 3.00, C = 2.00, D = 1.00) by the sum of the credits com-

pleted. (Credits of F received prior to fall quarter 1972 are included in the sum of the credits.) A cumulative average of 2.00 (C) is required for graduation. Additional grade point average requirements may be found under the individual curricular listings in the second section.

S-N System—The S-N system is an alternative to the traditional grading system and is designed to encourage students to seek greater breadth in their educational experience.

Under the S-N system, the grade S stands for satisfactory and the grade N for no credit. The S represents achievement that is satisfactory to the instructor, for the program in which you are registered. This definition is intended to imply that the standards for S may vary from one program to another. The instructor is obligated to define to a class in its early meetings, as explicitly as possible, the performance necessary to earn an S. An N is assigned if you do not earn an S.

The following principles have been adopted as a guide for use of the S-N grading system by College of Agriculture students:

- All courses open to undergraduate students (those numbered below 8000) may be taken on the S-N or A-F basis, except where specifically restricted by the department offering the course or by the college, in the case of distribution requirements. Consult the course descriptions section for courses with restricted grading.
- Candidates for the baccalaureate degree from the college may present a maximum of 25% of the residence credits offered for graduation in courses in which they received grades of S.
- S-N grading may be selected by students of the college regardless of their academic standing.
- The choice of S-N grading must be declared at the time of registration and may be changed only up to the opening day of the third week of classes.
- Courses identified by number and title as being required must be taken under

the A-F system. Prerequisites for required courses and courses in the major must also be taken under the A-F system, unless exceptions are established. Generally, you may take under S-N grading only elective courses and courses used to satisfy all-college requirements that are not specified by number and title for your major requirements.

Your adviser or staff members in the College Office can answer questions concerning the use of the S-N system.

Other Symbols—The following symbols may be assigned under either grading system:

I— Assigned by an instructor to indicate incomplete work, in accordance with provisions announced in class at the beginning of the quarter, when in the instructor's opinion there is a reasonable expectation that the student can complete successfully the work of the course. An I that is not made up by the end of the next quarter in residence becomes an F; instructors may set dates within the quarter for make up of examinations or work. When an I is changed to a grade, the I or F is removed from the record.

W—Indicates official withdrawal from a course without grade. The W is assigned in all cases of official cancellation during the first six weeks of a quarter. After the second week, the approval of the instructor and adviser are required for withdrawal. Withdrawal from a course after the sixth week is strongly discouraged unless extenuating circumstances exist. Cancellations after the eighth week of a quarter are seldom approved. *Note: Unbracketed W's are counted in the honor point total as an N or F.*

V— Indicates registration as an auditor or visitor, a noncredit, nongrade registration.

T— Posted on the transcript as a preceding supplement to the original grade to indicate credits transferred from

another institution or from one college or campus to another within the University when reevaluation is required.

X— Reported in a two- or three-quarter continuing course in which a grade cannot be determined until the full sequence is completed. The instructor submits a grade for each X when the student has completed the sequence.

Dean's List—The Dean's List, published at the end of fall, winter, and spring quarters, is one way that the College of Agriculture recognizes outstanding academic performance by its students. To qualify, you must complete at least 12 day school credits for the quarter with a grade point average of 3.70 or better. It is noted on your transcript when you qualify.

Scholastic Requirements

Honor Point System—College of Agriculture students are expected to maintain an academic standing that will enable them to meet minimum requirements for graduation upon completion of the required number of credits in the major that they have selected. To aid in the early identification of students who are not making satisfactory progress so that appropriate assistance can be provided, the following system has been developed.

An honor point total (HPT) is calculated for each student at the end of each quarter based on points assigned to the letter grades earned (A = 2 honor points per credit, B = 1, C or S = 0, D = -1, F = -2, N = -2, W [after sixth week of quarter] = -2).

Students whose cumulative honor point total is negative are referred to an adviser, a departmental scholastic committee, or the College Scholastic Standing Committee for action. If a student's honor point deficiency is low enough to remedy within a quarter, the student is placed on the first level of academic probation and the matter is handled by the academic adviser. If the honor point deficiency is too great to remedy within a quarter, the stu-

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dent is placed on a strict academic probation by the College Scholastic Standing Committee as well as referred to the departmental adviser for academic counseling. Students remain on academic probation until any honor point deficiency has been remedied.

Students who have been placed on academic probation will not be permitted to register in the college until they have received permission to do so from the Scholastic Standing Committee. If this approval is granted, specific goals may be established and the student will be expected to meet them. Students who do not meet these goals may be suspended from the college.

Students who entered the College of Agriculture for the first time in or after fall quarter 1977 will not be permitted to graduate with an overall negative honor point total. Students who entered the college for the first time in or after fall quarter 1981 will not be permitted to graduate with a negative honor point total either overall or in the major.

Appeal System—Decisions by the adviser, department scholastic standing committee, and subcommittees of the college Scholastic Standing Committee may be appealed to the college Scholastic Standing Committee, whose decisions in turn may be appealed to the dean of the College of Agriculture.

Repeating Courses—Students may repeat, for credit, courses in which they have received grades of N or F, and the first passing grade will be counted toward graduation. (The grades previously earned, however, will remain on the transcript.) Students who want to repeat courses in which they received grades of D, C, or S must petition the Scholastic Standing Committee for approval to do so. Repeating for credit courses in which grades of A or B have been received is not permitted.

Scholastic Conduct

The college has defined scholastic dishonesty broadly as any act that violates the

rights of another student in academic work or that involves misrepresentation of a student's own work. Scholastic dishonesty includes (but is not necessarily limited to) cheating on assignments or examinations; plagiarizing, which means misrepresenting as a student's own work any part of work done by another; submitting the same paper, or substantially similar papers, to meet the requirements of more than one course without the approval and consent of all instructors concerned; depriving another of necessary course materials; or interfering with another student's work.

When a case of scholastic dishonesty arises, the College of Agriculture faculty member who is the instructor for the course may modify the grade for the exam or piece of work in question or the course grade, or refer the incident to the Scholastic Standing Committee for disposition. In any case, the instructor must report the incident and the action taken by the instructor to the college Scholastic Standing Committee. At the time of the action, the student is informed by the instructor of his or her right to ask for a hearing by the Scholastic Standing Committee. Information on this process is available from the College of Agriculture Office.

The Scholastic Standing Committee reviews all reports of academic dishonesty filed with it by faculty members. The committee maintains confidential records of such reports for five years. These records are separate from students' academic records and are used only by the committee and in consideration of cases of scholastic dishonesty.

If the student involved is a College of Agriculture student, then the Scholastic Standing Committee may also, in addition to the actions available to the instructor, place the student on disciplinary probation or suspend the student from the college. If the case involves students or faculty from another college, the committee refers the matter to the Campus Committee on Student Behavior.

The student may appeal the decision of the instructor to the Scholastic Standing

Committee, and may appeal the decision of the Scholastic Standing Committee to the Campus Committee on Student Behavior. This may lead to the President's Student Behavior Review Panel, which has final jurisdiction.

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. The policy also permits students to review their educational records and to challenge the contents of those records.

Some student information—name, address, telephone number, dates of enrollment and enrollment termination, college and class, major, adviser, and degrees earned—is considered public or directory information. To prevent release of such information outside the University while in attendance at the University, students must notify the records office on their campus.

Students are notified annually of their right to review their educational records. The regents' policy, including a directory of student records, is available for review at the Williamson Hall Information Center, Minneapolis, and at records offices on other campuses of the University. Questions may be directed to the Office of Registration, Student Records, and Scheduling, 150 Williamson Hall (612/625-5333)

Graduation Requirements

Bachelor's Degrees—Candidates are recommended for graduation after they:

1. Complete the prescribed curriculum, including required and elective courses to meet the total number of credits required;
2. Earn a minimum cumulative grade point average of 2.00 overall and in the major; (GPA requirement of 2.00 in the major is effective for students who enter the college for the first time in or after fall quarter 1981); and
3. Meet the honor point total requirements as stated under Scholastic Requirements above.

Graduation application deadlines are set by the College Office and are *two quarters before your expected graduation*. The deadline will be published in the college *Kiosk*, an information sheet that you will receive each quarter with your registration materials. You will be responsible for knowing these deadlines. *Extensions of deadlines are rarely granted*. You may turn in your application and fee to the Office of Admissions and Records, 130 Coffey Hall.

Residency Requirements—In addition to meeting University residency requirements as outlined in the *General Information Bulletin*, baccalaureate degree candidates in the College of Agriculture must earn 30 of their last 45 credits while enrolled in the College of Agriculture as a student in good standing.

Graduation With Distinction and High Distinction—Graduation "with high distinction" is limited to the top 3% (usually 3.80 GPA or above) of the graduating class; "with distinction" to the next 7% (usually 3.50 GPA or above) of the graduating class.

The calculation of the grade point average to determine the class rank is based on the last 90 credits taken prior to graduation. Only graduating students who have completed at least 90 credits as a student in the College of Agriculture are eligible for honors designations, regardless of the level of their academic performance.

Career Services Office

To help you secure employment after graduation, the Career Services Office, 272 Coffey Hall, announces job opportunities and assists in arranging interviews with employer representatives. Although the Career Services Office concentrates on full-time jobs for graduates, the Professional Experience Program—an internship program—is also offered to juniors and seniors currently enrolled in the college. Students are encouraged to take advantage of the Career Services Office for career information beginning their freshman year. Many workshops on career development are offered by this office.

Student Organizations

College of Agriculture Student Board

—The College of Agriculture Student Board promotes student involvement in issues related to the quality and content of education both in and out of the classroom. This purpose is achieved through channels of communication created by the board between the students, faculty, and administration of the College of Agriculture. Through the board, students participate in such matters as consideration of proposed curricula, questions related to instruction, improvement of educational facilities, development of administrative policy, and establishment of the goals of the College of Agriculture. Further information related to the board and its operation may be obtained in 277 Coffey Hall.

St. Paul Campus Board of Colleges

—The St. Paul Campus Board of Colleges directs and coordinates student activities and encourages student leadership throughout the St. Paul campus. Its membership is drawn from the colleges of Agriculture, Biological Sciences, Forestry, Home Economics, and Veterinary Medicine. The board brings questions from the student bodies to the administration of the colleges and discusses problems and reaches decisions on matters of general interest. The board cooperates with the Twin Cities Student Association (TCSA) and the Senate Committee on Student Affairs.

As a student in the College of Agriculture, you may file for election to this board. Inquire at the Office for Student Affairs, 190 Coffey Hall, for more information.

Student Center Board of Governors

—The St. Paul Student Center provides a varied program of social, cultural, and recreational activities and contributes in many ways to the educational objectives of the campus. The St. Paul Student Center Board of Governors, composed of students elected to represent the academic units on the St. Paul campus, formulates policies for operation of the student center and establishes its budget. For information about the St. Paul Student Center, its operation, and opportunities to serve on

its various planning and programming committees, inquire at the information desk on the first floor of the student center.

Freshman Board—This group, which meets in the homes of St. Paul campus faculty members, gives you an opportunity to learn about the University—its organization and administration, its governance procedures, and students' roles in decision making. Freshman students may apply for membership during the two-week orientation-registration program in August or during Welcome Week in September. For further information, inquire at the Office for Student Affairs, 190 Coffey Hall.

Agricultural Ambassadors—This group of selected undergraduate students from the College of Agriculture volunteer their time to serve as goodwill ambassadors for the college and its students. They foster communications among the college, prospective students, and the community at large. Each ambassador gains experience in public relations and recruitment and develops valuable communications skills through public speaking engagements and small group discussions with prospective students. Agricultural Ambassadors develop leadership/management talents by participating on the executive board and special committees. For more information, contact the College Office, 277 Coffey Hall.

Student Representation on College and University Committees—All College of Agriculture committees and most all-University committees have student representatives. For college committees, selection is made by the College of Agriculture Student Board. For all-University committees, watch for announcements in the *Minnesota Daily* and on bulletin boards around the campuses about filing for positions.

Other College of Agriculture Student Organizations—Many of the undergraduate programs sponsor student clubs. Membership and participation in these organizations can add a valuable dimension to your academic program and contribute a great deal to your professional development. Check with your adviser for further information.

Distribution Requirements



Distribution Requirements

All-College Requirements

(These requirements apply to all College of Agriculture students; see individual major in Programs section for additional requirements.)

The University of Minnesota believes that all of its students, whatever their area of specialization or professional goals, should hold in common the search for a liberal education. A liberal education frees individuals from the limitations that ignorance places on their power of judgment and choice. More specifically, a liberal education asks individuals to seek control over the intellectual instruments for acquiring and communicating knowledge, to seek understanding of the ways in which scientists contribute to our knowledge of ourselves and our environment, to seek historical and philosophic perspective on the nature of our lives and our world, and to seek appreciation of the creative insights into life and nature provided by literature and the arts.

To help you achieve the goal of a liberal education, the College of Agriculture has set minimum requirements for the four major categories of knowledge listed below. These college distribution requirements meet or exceed the University requirements. They are firmly fixed, and you should not expect to petition out of even 1 credit in any category.

Because of the numerous changes that occur in course numbers, titles, and content, a complete list of courses that fulfill each of the four categories below is difficult to maintain. For approval of courses not listed below, consult the College Office. Current or prospective transfer students should refer to Transfer Students under Admission in the General Information section.

A. Communication, Language, Symbolic Systems—17 credits (A-F)

To graduate from the College of Agriculture, you must complete at least 17 credits in communication skills courses in English and rhetoric, foreign language, lin-

guistics, logic, philosophic analysis, or mathematics, including the following courses or their equivalent:

- Rhet 1101—Writing to Inform and Persuade (4)
- Rhet 1104—Library Research Methods (1)
- Rhet 1151—Writing in Your Major (4)
- Rhet 1222—Public Speaking (4)
- Rhet 3562—Writing in Your Profession (4)

Suggested courses for additional work in category A include:

- Clas 1045, 1048, 3046
- CSci 3102, 3104
- Foreign languages—all beginning courses
- Ling 1001, 3001
- Math—all courses except 0006, 0009, 1001, 1002, 1005, 1006
- Phil 1001, 3201, 3231
- Rhet 1147, 1220, 1251, 1500, 3254, 3266, 3572, 3700, 5147, 5165, 5170, 5257, 5400, 5500, 5600
- Stat—all courses

You may offer transfer credits in freshman communication and public speaking from other colleges and universities to satisfy these requirements.

You may take Rhet 3562 only in your junior or senior year. Upper division (junior or senior year) courses in professional or technical writing completed at a four-year college may be considered in lieu of Rhet 3562 and will be evaluated on a case by case basis.

If you demonstrate high ability in the proficiency tests in freshman communication, public speaking, or professional writing offered by the Department of Rhetoric, you may be excused from these course requirements. However, you must still meet the minimum requirement of 17 credits by completing other courses in category A.

B. Physical and Biological Sciences—15 credits (A-F)

To graduate from the College of Agriculture, you must complete a minimum of 15 credits in the physical and biological sciences. All category B requirements listed for the individual curricula meet or exceed the college requirements. Therefore, a suggested list of courses is not included here. For additional work in this category, consult your adviser.

C. The Individual and Society—14 credits (specific requirements must be taken A-F; electives may be taken S-N)

To graduate from the College of Agriculture, you must complete a minimum of 14 credits in this category. *At least one course must be taken in subcategory 2, Development of Civilization: Historical and Philosophical Studies.* A maximum of 10 credits in any one discipline (e.g., history, economics, psychology) may be counted toward the requirements. Technical courses (e.g., accounting, statistics, psychology of learning) may not be applied toward this category.

The listing below represents a sampling of courses that will meet the intent of category C, parts one and two. For information regarding applicability of courses not noted here, check with the College Office, 277 Coffey Hall, 624-2746.

(1) Analysis of Human Behavior and Institutions

Afro 1011, 1025, 1334, 3013, 3061, 3072, 3091, 5072
 AgEc 1020, 1030, 3070, 5720

Anth 1102, 3131, 3211, 3222, 3223, 3241, 3251, 3261,
 3281, 3293, 3501, 3511, 3512, 3521, 3533, 5112,
 5115, 5118, 5121, 5131, 5141, 5151, 5152, 5153,
 5154, 5155, 5161, 5162, 5258

Chic 1105, 1106, 1107, 3115

Clas 3071, 3072, 3073

EAS 1032, 3281

Econ 1001, 1002, 1004, 1005, 3001, 3002

Fren 3511, 3512, 3513

FSoS 1001, 1002, 1025, 3015

Geog 1301, 3101, 3131, 3141, 3161, 3165, 3181, 3211,
 3212, 3213, 3221, 3321, 3331, 3344, 3345, 3351,
 3371, 3378, 3381

Ger 3501, 3511, 3512, 3513

Ital 3501, 3502, 3555

Intr—all courses except 3091, 5831, 5900, 5910, 5920,
 5930

Jour 5601, 5721

JwSt 1034, 3126, 3142, 3143, 3521

Ling 1001, 1005, 3111

Pol 1001, 1025, 1026, 1027, 1041, 1054, 1061, 3306,
 3307, 3308, 3309, 3321, 3331, 3659, 3661, 3765,
 3766

Psy 1001, 1004, 1005, 3101, 3201

RelS—all courses except 5890, 5960

Russ 3106

Scan 1504, 3501

Soc 1001, 1002, 1003, 1651, 3102, 3352, 3401, 3501,
 3503, 3601, 3937

Span 1501, 1502, 1503, 3501, 3502

Spch 5611, 5616, 5617, 5618

WoSt 3102, 3200, 3203, 3204, 3300, 3305, 5107, 5108

(2) Development of Civilization: Historical and Philosophical Studies

(You must complete at least one course from this area.)

Afro 1011, 1021, 1441, 3001, 3002, 3011, 3013, 3061,
 3324, 3421, 3864, 3865, 5145

AgEc 3040



Distribution Requirements

AgEd 1010

AmIn 3026, 3027, 3111, 3112, 3121, 3161

AmSt—all courses

Chic 3212, 3427, 3428, 3441, 3442

Clas 1001, 1002, 1003, 1004, 1005, 1006

EAS 1063, 1461, 1462, 1463, 3464, 3465, 3467, 3468

Fren 3599

Hist—all courses listed under the heading "Introductory" in the *CLA Bulletin* plus 3200, 3434, 3707, 3708, 3821, 3822, 3823, 5171, 5172, 5173, 5281, 5282, 5283

HSci—all courses except 5970, 5990

Hum—all courses except 3755, 3910, 3970, 3980, 5910

SOAS 1506, 3411, 3501, 3502

Phil 1002, 1003, 1004, 3001, 3002, 3003, 3004, 3005, 3105, 3302, 3304

Rhet 1301, 1302, 1303, 1310, 1311, 3370, 3374, 3375, 3381

Russ 3511, 3512

WoSt 3103, 3402, 3403, 5101, 5401, 5402

D. Literature, Humanities, and Fine Arts—8 credits (may be taken S-N)

To graduate from the College of Agriculture, you must complete a minimum of 8 credits in the humanities, art, literature, music, or theatre arts. You may not apply technical courses, performance courses, or studio courses toward this category.

Therefore, you may *not* apply such courses as Mus 1001, Fundamentals of Music;

Mus 1161, Voice: Class Lessons; Mus 1410, Band; LA 1025, Basic Visualization; ArtS 1102, Drawing II; Dsgn 3536, Metal-smithing: Enameling; or Comp 1111, Introduction to Creative Writing.

The listing below represents a sampling of courses that will meet the intent of category D. For information regarding applicability of courses not noted here, check with the College Office, 277 Coffey Hall, 624-2746.

Afro 1301, 3105, 3108, 3301, 3591, 3592, 3601, 5201, 5301, 5551, 5593, 5595, 5597

AmIn 3116, 3221, 3242, 5251

AmSt 1001, 1002, 1003

ArtH—all courses except 5895, 5950, 5960, 5970, 5990, 5591

ArtS 1401 only

Chic 3212, 3213, 3507, 3508, 3510, 3511

Clas 1001, 1002, 1003, 1004, 1005, 1006, 1042, 3081, 3082, 3083, 3088, 3145, 3152, 3181, 3282, 3383, 5002, 5102, 5103

CLit—all courses

Dsgn 1501, 5505

EAS 3201, 3202

Engl—all courses except 3851, 3852, 3910, 3920, 3931, 3932, 3940, 3950, 3963, 3970, 3980, 5815, 5821, 5831, 5843, 5851, 5860, 5871, 5910, 5920, 5940, 5950

Foreign languages—all advanced courses that deal directly with literature and that are not listed under category C may be used

Hum—all courses except 39xx, 59xx

LA 1022

MESA 3211, 3213, 3601, 3602, 5201, 5202, 5203, 5601, 5602

Mus 1021, 1602, 1603, 1604, 1605, 1606, 1804, 3021, 3027, 3028, 3029, 3708, 3709, 3791, 3807, 3808, 5601, 5602, 5603, 5634, 5635, 5637, 5638, 5639, 5641, 5642, 5643, 5661, 5662, 5665, 5666, 5667, 5701, 5702, 5708, 5757, 5758, 5804, 5810, 5811

Rhet—humanities courses: 1301, 1302, 1303, 1310, 1311, 3370, 3375

Th 1101, 1102, 1405, 3171, 3172, 5171, 5172, 5173, 5177, 5178, 5186

WoSt 3103, 3300, 3302, 3304, 3305, 3306, 3307, 5011, 5304

E. Requirements in the Major

See individual major in Programs section.

F. Electives to complete the 185-230 credits required for graduation.

Agricultural Science and Industries Curriculum Requirements

(These requirements include, but also go beyond, the All-College Requirements above; see individual major in Programs section for additional requirements.)

The curriculum in agricultural science and industries is for students interested in a career in sales management, communications, finance, production, and research and development of agricultural commodities. The curriculum also provides an excellent background for graduate study in a wide variety of disciplines in the agricultural sciences and in agricultural and applied economics. For specific career opportunities and additional requirements, see the appropriate major in the Programs section. Majors in this curriculum include agricultural economics, agricultural education, agronomy, animal science, horticultural science, integrated pest management, and soil science.

Courses required for this curriculum have been selected to help you obtain the background in the biological and physical sciences and the skills in oral and written communication that are essential as preparation for studies in scientific and professional agriculture. This background prepares you to adapt and apply biological, physical, and economic principles to problems encountered in agricultural science, production, and management. Coursework requirements in The Individual and Society and in Literature, Humanities, and Fine Arts serve to broaden your educational background in the social sciences, humanities, literature, and the arts, and to better equip you to contribute to society and to develop personal interests and understanding.

The breadth of coursework possible in this curriculum (about one-third of the total credits are elective) permits you to develop an individualized program of study. Considerable flexibility accommodates various levels of preparation, aptitudes, and interests.

In addition to the specific requirements for your major, you must complete the following distribution requirements:

A. Communication, Language, Symbolic Systems (A-F)

- Math 1111—College Algebra and Analytical Geometry (5)
- Rhet 1101—Writing to Inform and Persuade (4)
- Rhet 1104—Library Research Methods (1)
- Rhet 1151—Writing in Your Major (4)
- Rhet 1222—Public Speaking (4)
- Rhet 3562—Writing in Your Profession (4)

B. Physical and Biological Sciences (A-F)

- Biol 1009—General Biology (5)
- Biol 1103—General Botany (5)
 - or Biol 1106—General Zoology (5)
- Phys 1001, 1005—The Physical World, Laboratory (4, 1)
 - or Phys 1041, 1045—Introductory Physics, Laboratory (4, 1)

Note: If your curriculum requires *one* quarter of physics, take Phys 1001, 1005. If your curriculum requires *two* quarters of physics, take Phys 1041, 1045 and 1042, 1046.

Select *one* of the five following chemistry sequences:

Sequence One

- Chem 1001—Chemical Principles and Covalent Systems (5)
- BioC 1301—Elementary Biochemistry I (5)
- BioC 1302, 1303—Elementary Biochemistry II and Laboratory (3,2)

Sequence Two

- Chem 1001—Chemical Principles and Covalent Systems (5)
- Chem 1002—Chemical Principles and Covalent Systems (5)
- BioC 1302, 1303—Elementary Biochemistry II and Laboratory (3,2)

Sequence Three

- Chem 1004—General Principles of Chemistry (5)
- Chem 1005—General Principles of Chemistry (5)
- BioC 1301—Elementary Biochemistry I (5)

Sequence Four

- Chem 1004—General Principles of Chemistry (5)
- Chem 1005—General Principles of Chemistry (5)
- Chem 3301, 3305—Elementary Organic Chemistry I and Laboratory (4,2)

Sequence Five

- (Recommended for students who plan to enter graduate school)
- Chem 1004—General Principles of Chemistry (5)
- Chem 1005—General Principles of Chemistry (5)
- Chem 3301, 3305—Elementary Organic Chemistry I and Laboratory (4, 2)
- Chem 3302, 3306—Elementary Organic Chemistry II and Laboratory (4, 2)

Distribution Requirements

In addition, you must complete at least two courses, not including laboratories, in the physical, biological, and analytical sciences. These *must* be selected from the following courses or their equivalent. Courses from this list that are applied to major requirements cannot be used to meet this requirement.

- AgEc 5020—Applied Linear Programming (4)
- AgET 3030—Introduction to Problem Solving with Computers (4)
- BioC 1302, 1303—Elementary Biochemistry II and Laboratory (3, 2)
- Biol 1103—General Botany (5)
or Biol 3012—Plant Biology (5)
- Biol 1106—General Zoology (5)
or Biol 3011—Animal Biology (3)
or Biol 3111—Animal Biology (4)
- Biol 5001—Biochemistry (4)
or BioC 5001—Biochemistry (4)
- Biol 5003—Genetics (4)
- Biol 5041—Ecology (4)
- Bot 3109—Plant Anatomy (5)
- Chem 1006—Principles of Solution Chemistry (4)
- Chem 3100, 3101—Quantitative Analysis and Laboratory (3, 2)
- Chem 3301, 3305—Elementary Organic Chemistry I and Laboratory (4, 2)
- Chem 3302, 3306—Elementary Organic Chemistry II and Laboratory (4, 2)
- Chem 3303—Elementary Organic Chemistry III (4)
- EBB 3001—Introduction to Ecology (4)
- EBB 5014—Ecology of Plant Communities (5)
- GCB 3022—Genetics (4)

- Geo 1001, 1021—Physical Geology and Laboratory (4, 1)
- MicB 3103—General Microbiology (extension registration only, fall) (5)
or VPB 3103—General Microbiology (5)
- Phys 1042, 1046—Introductory Physics and Laboratory (4, 1)
- DSci 3050—Quantitative Methods for Administration (4)
- Any mathematics course that requires Math 1111 or 1201 as a prerequisite
- Any statistics course that requires Math 1111 as a prerequisite

C. The Individual and Society—14 credits minimum (specific requirements must be taken A-F; electives may be taken S-N)

See All-College Requirements above. One course required in the area of Development of Civilization:

- AgEc 1020—Principles of Macroeconomics (5) A-N

D. Literature, Humanities, and Fine Arts—8 credits minimum (may be taken S-N)

See All-College Requirements above.

E. Requirements in the Major

See individual major in Programs section.

F. Electives to complete the 192 credits required for graduation with the bachelor of science degree.

Programs



Programs

The requirements for the College of Agriculture undergraduate programs presented in alphabetical order below are for high school graduates directly entering the college. Students planning to transfer to the college should check with their counselors to be sure they complete courses equivalent to those required. Also included below is a description of the graduate-level Master of Agriculture program, which is administered by the College of Agriculture (not the Graduate School).

The preceding Distribution Requirements section contains information on *All-College Requirements* and on *Agricultural Science and Industries Curriculum Requirements*.

Agricultural Business Administration

Department of Agricultural and Applied Economics
231 Classroom-Office Building
612/625-1222

The agricultural business administration curriculum places an emphasis on economic analysis and management principles relating to agricultural businesses and industries that manufacture and supply materials for farm production (feed, seed, fertilizers, machinery, equipment, pharmaceuticals) and assemble, process, market, transport, and distribute food and fiber products. The program provides a balance between agricultural and applied economics and business administration studies, with a limited amount of agricultural science. You may elect a variety of courses in your junior and senior years to accommodate your interests and career goals.

As a graduate of the curriculum you will be prepared for employment in managerial-related positions in agribusiness. Examples of employment areas include commodity trading and analysis, finance, management, marketing, sales management, administration, public and industrial relations, production management, economic and statistical analysis, operations research and reporting, managerial accounting, and transportation analysis.

After graduation you may seek employment in one of these areas, or you may enter graduate study in preparation for research, teaching, or continuing education positions in academic institutions or research agencies and industry.

Major Requirements

Agricultural business administration students must complete the requirements listed below. Consult with your adviser to determine a suitable sequence for completing the required courses. Course substitutions in categories A, B, C, and D may be made only with the approval of the College Office, and in categories E and F only with the approval of your adviser and the Department of Agricultural and Applied Economics.

A. Communication, Language, Symbolic Systems

Math 1131—Finite Mathematics
Math 1142—Short Calculus (5)
or Math 1211—Calculus I (5)
Rhet 1101—Writing to Inform and Persuade (4)
Rhet 1104—Library Research Methods (1)
Rhet 1151—Writing in Your Major (4)
Rhet 1222—Public Speaking (4)
Rhet 3562—Writing in Your Profession (4)

One of the following courses:

Rhet 3254—Advanced Public Speaking (4)
Rhet 3266—Discussion Methods (4)
Rhet 5170—Managerial Communications (4)
Rhet 5257—Scientific and Technical Presentations (4)
Rhet 5561—Writing for Publication (4)

B. Physical and Biological Sciences—20 credits from:

Biol 1009—General Biology (5)
Biol 1103—General Botany (5)
Biol 1106—General Zoology (5)
Chem 1001—Chemical Principles and Covalent Systems (5)
or Chem 1004-1005—General Principles of Chemistry (5,5)
Chem 1002—Chemical Principles and Covalent Systems (5)
or BioC 1301—Elementary Biochemistry I (5)
BioC 1302—Elementary Biochemistry II (3)
EBB 3001—Introduction to Ecology (4)
Geo 1001, 1021—Physical Geology and Laboratory (4,1)
Phys 1001, 1005—The Physical World and Laboratory (4,1)
Phys 1041, 1045—Introductory Physics and Laboratory (4,1)
Phys 1042, 1046—Introductory Physics and Laboratory (4,1)
Biol 1009, Chem 1001, BioC 1301 are strongly recommended.

C. The Individual and Society—15 credits minimum

See All-College Requirements in preceding section.
One course required in the area of Development of Civilization.

- Psy 1001—General Psychology (5)
- Soc 1001—Introduction to Sociology (4)
- or Soc 1651—Rural Sociology (4)

Note: No courses in agricultural economics or economics may be used to meet this requirement except AgEc 3040—Economic Development of American Agriculture (4).

D. Literature, Humanities, and Fine Arts—8 credits minimum

See All-College Requirements in preceding section.

E. Professional Courses in the Major

BUSINESS ADMINISTRATION

- Mgmt 3001—Fundamentals of Management (4)
- Mgmt 3004—Business Policy: Strategy Formulation and Implementation (5)
- or AgEc 3290—Agribusiness Management (4)
- MSci 1010—Fundamentals of Computers, Information Technology in Organizations (4)
- MSci 1020—Data Analysis and Statistical Inference for Managers (4)
- Plus 16 credits from:

At least two of these courses

- OM 3000—Introduction to Operations Management (4)
- DSci 3055—Introduction to Management Sciences (4)
- BLaw 3058—Introduction to Law, and the Law of Contracts and Agency (4)
- AgEcon 3300—Agricultural Management Information Systems (4)
- MSci 3030—Information Systems and Information Management (4)

Other courses that may be used to fulfill the 16-credit requirement

- Mktg 3000—Principles of Marketing (4)
- Ins 3100—Risk Management and Insurance (4)
- LM 3000—Introduction to Logistics Management (4)
- IR 3002—Industrial Relations Systems: Labor Markets and the Management of Human Resources (4)
- or IR 3010—Human Relations and Applied Organization Theory (4)

ECONOMICS AND ACCOUNTING

- Acct 1024—Principles of Financial Accounting I (3)
- Acct 1025—Principles of Financial Accounting II (3)
- Acct 3001—Principles of Managerial Accounting (4)
- AgEc 1000—Orientation to Agricultural and Applied Economics (1)
- AgEc 1020—Principles of Macroeconomics (5)
- AgEc 1030—Principles of Microeconomics (4)
- AgEc 1400—Agricultural Markets and Prices (4)
- AgEc 3101—Microeconomic Theory (4)
- AgEc 3102—Macroeconomic Theory (4)
- AgEc 3500—Farm and Agribusiness Finance (5)
- or BFin 3000—Finance Fundamentals (4)
- AgEc 3710—Agricultural and Market Policies (4)
- Plus 11 additional credits in agricultural economics

F. Agricultural Science Courses

A minimum of 20 credits in agricultural science courses including at least 4 credits in animal science and 4 credits in agronomy. Courses in agricultural education, agricultural journalism, fisheries and wildlife, landscape architecture, rhetoric, or the physical and biological sciences may not be used to meet this requirement. In agricultural engineering, only AgET 3250, 3606, and 3610 may be used.

G. Electives to complete the 192 credits required for graduation with the bachelor of agricultural business administration degree.

Agricultural Economics

*Department of Agricultural and Applied Economics
231 Classroom-Office Building
612/625-1222*

Students who plan to work in economic or business management phases of agricultural production, or in industries related to agriculture that require an extensive knowledge of the technical aspects of the work, will find a concentration in agricultural economics useful. (If you expect to be employed in business management and desire less technical training in agriculture, you may find the curriculum in agricultural business administration more suitable. Either program is appropriate if you plan to pursue graduate work in agricultural economics.)

In this curriculum, you may complete studies in one of three areas of emphasis within agricultural economics: agricultural finance, agricultural marketing, or farm management. Other areas of emphasis are possible and may be developed by the individual student.

Major Requirements

All students in the agricultural economics major must complete the requirements listed below. Course substitutions in categories A, B, C, and D may be made only with the approval of the College Office, and in categories E and F only with the approval of your adviser and the Department of Agricultural and Applied Economics.

A. Communication, Language, Symbolic Systems

- Rhet 1101—Writing to Inform and Persuade (4)
- Rhet 1104—Library Research Methods (1)
- Rhet 1151—Writing in Your Major

Programs

- Rhet 1222—Public Speaking (4)
Rhet 3562—Writing in Your Profession (4)
Stat 1001—Introduction to Ideas of Statistics (4)
or DSci 1050—Elementary Managerial Statistics (4)
Math 1131—Finite Mathematics (5)
Math 1142—Short Calculus (5)
or Math 1211—Calculus I (5)

B. Physical and Biological Sciences

- Biol 1009—General Biology (5)
Biol 1103—General Botany (5)
or Biol 1106—General Zoology (5)
Phys 1001, 1005—The Physical World, Laboratory (4, 1)
or Phys 1041, 1045—Introductory Physics, Laboratory (4, 1)
One of these sequences:
Sequence One
Chem 1001—Chemical Principles and Covalent Systems (5)
Chem 1002—Chemical Principles and Covalent Systems (5)
or BioC 1301—Elementary Biochemistry I (5)
BioC 1302—Elementary Biochemistry II (3)
Sequence Two
Chem 1004-1005—General Principles of Chemistry (5, 5)
Chem 1002—Principles of Chemistry and Covalent Systems (5)
or BioC 1301—Elementary Biochemistry I (5)

C. The Individual and Society—15 credits minimum

- See All-College Requirements in preceding section.
One course required in the area of Development of Civilization.
Note: No course in agricultural economics or economics may be used to meet this requirement except AgEc 3040—Economic Development of American Agriculture (4).

D. Literature, Humanities, and Fine Arts—8 credits minimum

See All-College Requirements in preceding section.

E. Professional Courses in the Major

- AgEc 1000—Orientation to Agricultural and Applied Economics (1)
AgEc 1020—Principles of Macroeconomics (5)
AgEc 1030—Principles of Microeconomics (4)
AgEc 1250—Principles of Accounting (5)
AgEc 1400—Agricultural Markets and Prices (4)
AgEc 3101—Microeconomic Theory (4)
AgEc 3102—Macroeconomic Theory (4)
AgEc 3710—Agricultural and Market Policies (4)
AgEc 3820—Farm Management Economics (4)
Plus 11 additional credits in agricultural economics

AGRICULTURAL FINANCE

- AgEc 3500—Farm and Agribusiness Finance (5)
AgEc 5500—Advanced Agricultural Finance (4)

At least one course from:

- AgEc 3290—Agribusiness Management (4)
AgEc 3830—Organizing the Farm Business for Entry, Growth, and Transfer (4)

- AgEc 3850—Farm Business and Enterprise Analysis (4)
AgEc 5440—Cooperatives and Agribusiness Organization (4)
AgEc 5480—Futures, Markets, and Prices (4)
AgEc 5600—Land Economics (4)
AgEc 5840—Management of the Farm Business (4)

AGRICULTURAL MARKETING

At least 11 credits from:

- AgEc 3420—Grain Marketing Economics (3)
AgEc 3430—Dairy Marketing Economics (3)
AgEc 3440—Livestock Marketing Economics (3)
AgEc 5400—Intermediate Market and Price Analysis (4)
AgEc 5440—Cooperatives and Agribusiness Organization (4)
AgEc 5480—Futures, Markets, and Prices (4)

FARM MANAGEMENT

- AgEc 3500—Farm and Agribusiness Finance (5)
AgEc 3830—Organizing the Farm Business for Entry, Growth, and Transfer (4)
At least one course from:
AgEc 3420—Grain Marketing Economics (3)
AgEc 3430—Dairy Marketing Economics (3)
AgEc 3440—Livestock Marketing Economics (3)
AgEc 3850—Farm Business and Enterprise Analysis (4)
AgEc 5020—Applied Linear Programming (4)
AgEc 5480—Futures, Markets, and Prices (4)
AgEc 5840—Management of the Farm Business (4)

FOR STUDENTS PLANNING TO ENTER GRADUATE SCHOOL

At least 11 credits from (in lieu of 11 AgEc credits):

- Econ 3103—Welfare Economics (4)
Econ 5151—Elements of Economic Analysis: Firm and Household (3)
Econ 5152—Elements of Economic Analysis: Income and Employment (3)
AgEc 5750—Agricultural Trade (4)
AgEc 5860—Economics of Agricultural Production (4)

Plus four courses from the following:

- Math 1211—Calculus I (5)
Math 1221—Calculus II (5)
Math 1231—Calculus III (5)
Math 3142—Introduction to Linear Algebra (4)
Math 3211—Multivariable Calculus (5)
Stat 5021—Statistical Analysis I (5)
Stat 5121—Theory of Statistics (4)
Stat 5122—Theory of Statistics (4)

F. Agricultural Science Courses

A minimum of 27 credits in agricultural science courses including at least 4 credits in animal science and 4 credits in agronomy. Courses in agricultural education, agricultural journalism, fisheries and wildlife, landscape architecture, rhetoric, or the physical and biological sciences may not be used to meet this requirement. In agricultural engineering, only AgET 3250, 3606, and 3610 may be used.

G. Electives to complete the 192 credits required for graduation with the bachelor of science degree.

Minor Requirements

The department offers two minors. The minor in agricultural economics is highly structured to require minimal advising by department faculty. The minor in applied economics is much more flexible and must be developed with the assistance of an adviser from the department. (These minors are not available to majors in the Department of Agricultural and Applied Economics.)

Agricultural Economics Minor

- AgEc 1020—Principles of Macroeconomics (5)
or Econ 1001—Principles of Macroeconomics (4)
- AgEc 1030—Principles of Microeconomics (4)
or Econ 1002—Principles of Microeconomics (4)
- AgEc 1250—Principles of Accounting (5)
- AgEc 1400—Agricultural Markets and Prices (4)
or AgEc 3820—Farm Management Economics (4)
- AgEc 3101—Microeconomic Theory (4)
or Econ 3101—Microeconomic Theory (4)

Optional courses (at least two):

- AgEc 1400—Agricultural Markets and Prices (4)
- AgEc 3420—Grain Marketing Economics (3)
- AgEc 3430—Dairy Marketing Economics (3)
- AgEc 3440—Livestock Marketing Economics (3)
- AgEc 3500—Farm and Agribusiness Finance (5)
- AgEc 3820—Farm Management Economics (4)
- AgEc 3830—Organizing the Farm Business for Entry, Growth, and Transfer (4)
- AgEc 3850—Farm Business and Enterprise Analysis (4)
- AgEc 5400—Intermediate Market and Price Analysis (4)
- AgEc 5440—Cooperatives and Agribusiness Organization (4)
- AgEc 5480—Futures, Markets, and Prices (4)
- AgEc 5840—Management of the Farm Business (4)

Applied Economics Minor

- AgEc 1020—Principles of Macroeconomics (5)
or Econ 1001—Principles of Macroeconomics (4)
- AgEc 1030—Principles of Microeconomics (4)
or Econ 1002—Principles of Microeconomics (4)
- AgEc 3101—Microeconomic Theory (4)
or Econ 3101—Microeconomic Theory (4)

Plus 16 credits in agricultural economics or economics agreed upon by the student and an adviser from agricultural and applied economics

Agricultural Education

*Department of Vocational and Technical Education
320 Vocational-Technical Education Building
612/624-2221*

(The specializations in this major are subject to change. Please refer to the Agricultural Education Division for the latest approved program.)

The major in agricultural education, offered jointly with the College of Education, is designed for students who plan to teach agriculture or horticulture in public schools, area vocational-technical institutes, or community colleges in Minnesota, or for students who plan to work in educational positions in agriculture-related organizations. The program provides comprehensive education in agriculture and permits emphasis in animal science, agronomy, agricultural economics, horticulture, soils, or mechanized agriculture for those preparing for extension work, other professional careers in the field, or farming. It also offers the special training in education necessary for recommendation for licensure as an instructor of agriculture, horticulture, specialty crops, or animal care.

Students should apply for admission to the College of Education in the final quarter of their sophomore year. This application may be completed in the Division of Agricultural Education, 320 Vocational-Technical Education Building. Students must complete the application requirements as directed by the Agricultural Education staff. To be eligible for admission, you must have a grade point average of at least C (2.00) for all courses taken at the University of Minnesota, Twin Cities campus.

Transfer students who have completed fewer than two years of college work apply for admission to the College of Agriculture. These students will then apply to the College of Education in the quarter in which they complete their sophomore year.

Transfer students who have completed two or more years of college work apply for joint admission to the College of Agriculture and the College of Education at the Office of Admissions and Records, 130 Coffey Hall, University of Minnesota, 1420 Eckles Avenue, St. Paul, MN 55108. The College of Agriculture will review the application. Upon acceptance into the College of Agriculture, these students will also be accepted by the College of Education when the joint admission application has been processed.

Programs

To be eligible for student teaching, you must have a grade point average for coursework taken on the Twin Cities campus of at least 2.00 overall and at least 2.30 in technical agriculture courses in your area of specialization, as follows:

Vocational Agriculture Specialization
2.30 GPA in courses in agricultural economics, agronomy, animal science, entomology, food science, forestry, horticulture, agricultural journalism, agricultural engineering technology, plant pathology, soils, and veterinary medicine.

Vocational Horticulture Specialization
2.30 GPA in entomology, forestry, plant physiology, horticulture, agricultural engineering technology, plant pathology, agricultural economics, and soils.

Agricultural Education (Non-licensure) Specialization
2.30 GPA overall. 80 credits minimum in technical agriculture and 192 credits total for graduation.

Students applying for the vocational agricultural education specialization must have a satisfactory background in agriculture. Those entering the horticultural education specialization must have a satisfactory background in horticulture. The Division of Agricultural Education Occupational Experience Committee evaluates student experience. Each specialization requires a minimum of 80 credits in technical agriculture coursework and a total of 192 credits for graduation.

Major Requirements

Students majoring in agricultural education must complete the requirements listed below. Course substitutions in categories A, B, C, and D may be made only with the approval of the College Office, category E only with the approval of your adviser and the College of Education, and category F with the approval of your adviser and the Division of Agricultural Education.

A. Communication, Language, Symbolic Systems

See Agricultural Science and Industries Curriculum Requirements in preceding section.

B. Physical and Biological Sciences

See Agricultural Science and Industries Curriculum Requirements in preceding section.

Note: Agricultural Education majors may complete the one-quarter physics sequence, Phys 1001 and 1005—The Physical World and Laboratory.

C. The Individual and Society—14 credits minimum

See All-College Requirements in preceding section.
One course required in the area of Development of Civilization.

AgEc 1020—Principles of Macroeconomics (5)

AgEc 1030—Principles of Microeconomics (4)

Psy 1001—General Psychology (5)

D. Literature, Humanities, and Fine Arts—8 credits minimum

See All-College Requirements in preceding section.

E. Professional and Supporting Courses in the Major

VOCATIONAL AGRICULTURE, HORTICULTURE SPECIALIZATIONS—46 credits minimum

AgEd 1001—Introduction to Agricultural Education (1)

AgEd 1010—History and Philosophy of Vocational and Community Education (3)

AgEd 3010—Organization and Direction of FFA Activities (2)

AgEd 3031—Student Teaching in Agriculture (10)

AgEd 5028—Teaching Methods in Agricultural Education (5)

AgEd 5049—Agricultural Education for Adults (4)

AgEd 5061—Program Planning and Evaluation (3)

AgEd 5071—Supervised Occupational Experiences in Agriculture (3)

EPsy 3131—Introduction to Human Relations (3)

PubH 3004—Basic Concepts in Personal and Community Health (5)

VoEd 5800—Working With Special Needs Students (3)

or, with adviser's permission, PsyS 3106—Exceptional Students in Regular Classes (2)

SeEd 3155—Psychological Foundations of Secondary Education (5)

NON-LICENSEURE SPECIALIZATION—23 credits minimum

AgEd 1001—Introduction to Agricultural Education (1)

AgEd 1010—History and Philosophy of Vocational and Community Education (3)

AgEd 5021—Education Through Extension Methods (3)

or AgEd 5128—Methods of Teaching (3)

AgEd 5025—Extension Program Development (3)

or AgEd 5061—Program Planning and Evaluation (3)

AgEd 3010—Organization and Direction of FFA Activities (2)

or AgEd 5200—Seminar: Working With Youth Through Adults (1-3)

3 credits from:

- AgEd 5072—Practicum: Agricultural Business and Industry (1-3)
- or AgEd 5027—Practicum: Extension Experiences (2-6)
- or AgEd 3029—Directed Experience in Agricultural Education (1-3)

Plus additional education credits, chosen with adviser

F. Specializations

In addition to the requirements listed in category E above, you must complete requirements for one of the specializations listed below:

VOCATIONAL AGRICULTURE SPECIALIZATION—80 credits minimum

- AgEc 1020—Principles of Macroeconomics (5)
- AgEc 1030—Principles of Microeconomics (4)
- AgEc 3810—Farm Management Economics (4)
- AgEc 3850—Farm Business and Enterprise Analysis (4)
- AgEd 5072—Practicum: Agricultural Business and Industry (3)
- AgET 1020—Agricultural Shop—Metalwork (4)
- AgET 5020—Program Planning and Instructional Methods in Agricultural Mechanics (3)
- Agro 1010—Principles of Agronomy (5)
- AnSc 1100—Introductory Animal Science (5)
- AnSc 3401—Principles of Animal Nutrition (3)
- AnSc 3402—Applied Animal Nutrition (2)
 - or AnSc 5601—Swine Production (4)
 - or AnSc 5602—Sheep Production (4)
 - or AnSc 5603—Beef Cattle Production (4)
 - or AnSc 5604—Dairy Farm Management (4)
 - or AnSc 5605—Poultry Production (4)

Ent 1005—Economic Entomology (4)

Hort 1010—Home Horticulture (4)

Soil 1122—Introductory Soil Science (4)

Plus 24-26 additional credits in technical agriculture

VOCATIONAL HORTICULTURE SPECIALIZATION—80 credits minimum

- AgEc 1020—Principles of Macroeconomics (5)
 - AgEc 1030—Principles of Microeconomics (4)
 - AgEd 5072—Practicum: Agricultural Business and Industry (3)
 - AgET 3205—Power and Power Use (4)
 - AgET 5020—Program Planning and Instructional Methods in Agricultural Mechanics (4)
 - Ent 1005—Economic Entomology (4)
 - Hort 1100—Biology of Horticultural Production (4)
 - Hort 1016—Greenhouse Management (3)
 - Hort 1036—Plant Propagation (4)
 - PIPa 1001—Introductory Plant Pathology (4)
 - PIPh 3131—Survey of Plant Physiology (4)
 - Soil 1122—Introductory Soil Science (4)
- Plus 19 additional credits in horticulture and 14 additional credits in technical agriculture

AGRICULTURAL EDUCATION (NON-LICENSE) SPECIALIZATION—80 credits minimum

- AgEc 1020—Principles of Macroeconomics (5)
- AgEc 1030—Principles of Microeconomics (4)
- AgEt 1020—Agricultural Shop—Metalwork (4)
- Agro 1010—Principles of Agronomy (5)

Agro 1100—Morphology and Identification of Crops and Weeds (4)

AnSc 1100—Introductory Animal Science (5)

AnSc 3401—Principles of Animal Nutrition (3)

Ent 1005—Economic Entomology (4)

PIPa 1001—Introductory Plant Pathology (4)

Elective courses (39 credits), including five courses from:

- AgEc 1400—Agricultural Markets and Prices (4)
- AgEc 3810—Farm Management Economics (4)
- AgEc 3850—Farm Business and Enterprise Analysis (4)
- AgET 3205—Power and Power Use (4)
- AgET 3215—Machinery and Equipment (4)
- AgET 3610—Electricity in Agriculture (4)
- Agro 1110—Seed Analysis and Grain Grading (3)
- AnSc 1110—Dairy Cattle Evaluation (2)
- AnSc 1120—Livestock and Meat Evaluation (4)
- AnSc 1520—Milk Production (3)
- AnSc 3131—Live Animal Performance and Selection (3)
- AnSc 3402—Applied Animal Nutrition (2)
- Ent 5210—Integrated Pest Management (5)

G. Electives to complete the 192 credits required for graduation with the bachelor of science degree.

Agricultural Engineering

(Institute of Technology)

*Department of Agricultural Engineering
213 Agricultural Engineering
612/625-7733*

A four-year professional curriculum leading to the degree of bachelor of agricultural engineering, B.Ag.E., is offered by the department of Agricultural Engineering through the Institute of Technology. Students register in the Institute of Technology. Emphasis in the curriculum is on the physical sciences and engineering design, but economics, agricultural science, and other subjects are included.

Each student, with the assistance of an adviser, plans a curriculum tailored to his or her individual interests. The principal fields of specialization within agricultural engineering are design of agricultural power and machinery, soil management and water control, building design and environmental control, and food and process engineering. Students select special courses from a number of subject areas to give them a broad background in topics related to their specialization.

Programs

Lower Division (98 credits)

- Comp 1011—Writing Practice I (5)
Math 1211-1221-1231—Calculus I-II-III (15)
Math 3211-3221—Multivariable Calculus, Introduction to Linear Algebra and Linear Differential Equations (10)
Phys 1271-1281-1291—General Physics (12)
Phys 1275-1285-1295—General Physics Laboratory (3)
Chem 1004-1005—General Principles (10)
AgEn 1060—Agricultural Engineering Orientation (1)
AgEn 1031—Computations in Agricultural Engineering (2)
ME 1025—Engineering Graphics (4)
AEM 1015—Statics (4)
AEM 3016, 3036—Deformable Body Mechanics, Dynamics (8)
CE 3400—Fluid Mechanics (4)
CSci 3101, CSci 3102 or AgET 3030—Computer Programming (4)
Liberal Education Electives (16)

Upper Division (92 credits)

- Comp 3031—Technical Writing for Engineers (4)
EE 3003-3004—Circuits and Electronics (5)
ME 3301-5342—Thermodynamics, Heat Transfer (8)
AgEn 3052—Physio-Engineering in Agriculture (4)
AgEn 3060—Analysis in Agricultural Engineering (4)
AgEn 5081, 5082, 5083 or 5084—Design (4)
Agricultural Engineering Electives (five courses from at least three of groups a-e) (20)
(a) AgEn 5060—Processing
AgEn 5130—Food Engineering
AgEn 5140—Thermal Processes for Food
(b) AgEn 5330—Agricultural Machinery
AgEn 5340—Agricultural Tractors
(c) AgEn 5440—Erosion Control, Watershed Engineering
AgEn 5550—Drainage and Irrigation Engineering
(d) AgEn 5730—Agricultural Structures Design
AgEn 5740—Environmental Control for Agricultural Production
AgEn 5910—Agricultural Waste Management
(e) AgEn 5070—Automatic Control and Instrumentation
AgEn 5072—Finite Element Methods: Fundamentals and Applications
AgEn 5074—Microcomputer Interfacing
Engineering Electives (4)
Agricultural and Biological Science Electives (8)
Liberal Education Electives (11)
Electives as needed to meet graduation requirements of 190 credits (20)

Electives are usually chosen to develop professional competence in a given area of specialization, but they can be used for broad professional preparation. Sample programs and lists of suggested electives are available at the department office or from individual advisers.

Agricultural Engineering Technology Minor

*Department of Agricultural Engineering
213 Agricultural Engineering
612/625-7733*

A minor in agricultural engineering technology is offered by the Department of Agricultural Engineering. This minor enables the student to develop a background for applying principles of engineering technology to problems in production agriculture, related industries, and soil and water conservation.

The minor requires completion of 21 credits:

- AgET 3250—Farm Machinery (4)
AgET 3606—Farm Building Design, Layout, Systems (4)
AgET 3610—Electricity and Electronics in Agriculture (4)
AgET 5400—Irrigation and Drainage (4)
AgET 5410—Hydrology and Water Quality (5)

Agronomy

*Department of Agronomy and Plant Genetics
411 Borlaug Hall
612/625-7773*

Agronomists deal with the principles underlying the growth, management, and improvement of field crops. Field crops are the large acreage crops of the world such as corn, barley, soybeans, sorghum, wheat, and forages. Increases in their productivity add significantly to the world's supply of food and fiber. You should consider a major in agronomy if you are interested in the process of growth and development in plants, the influence of our environment on crop adaptation and productivity, the role of herbicides in controlling plant competition and increasing crop productivity, and the development of crop varieties with increased resistance to disease and insects, greater yield potential, and high nutritional quality.

As a graduate in agronomy you will be qualified for many positions involved with the production and improvement of field crops. Career opportunities include positions as technical representatives for agricultural chemical and seed companies; field agronomists for specialty crops such

as sugar beets, dry beans, and peas; state and federal crop regulatory agents; grain buyers and merchandisers, agricultural extension workers; storage elevator operators; field agronomists for crop production consulting firms; and numerous others. Students interested in farming can acquire a solid background in crop production principles.

If your interests are research, and you plan to continue your studies in graduate school, you should develop a suitable course program with your adviser to obtain the background necessary to undertake graduate studies in the specialization of your choice.

Major Requirements

All students in the agronomy major must complete the requirements listed below. See your adviser to determine a suitable sequence for completion of the required courses. Course substitutions in categories A, B, C, and D may be made only with the approval of the College Office, and in categories E and F only with the approval of your adviser and the Department of Agronomy and Plant Genetics.

Option 1: Agronomic Science

This option is intended for students who plan to continue their education in graduate school or are seeking a specialization in crop science with a minimum background in soil science.

A. Communication, Language, Symbolic Systems

See Agricultural Science and Industries Curriculum Requirements in preceding section
Math 1142—Short Calculus (5)

B. Physical and Biological Sciences

BioC 1301—Elementary Biochemistry I (5)
BioC 1302, 1303—Elementary Biochemistry II and Laboratory (3, 2)
Biol 1009—General Biology (5)
Biol 1103—General Botany (5)
Chem 1001—Chemical Principles and Covalent Systems (5)
or Chem 1004-1005—General Principles of Chemistry (5, 5)
Phys 1001, 1005—The Physical World and Laboratory (4, 1)
or Phys 1041, 1045—Introductory Physics and Laboratory (4, 1)

Two additional courses selected from category B, part II, of the Agricultural Science and Industries Curriculum Requirements in preceding section

C. The Individual and Society—14 credits minimum

See All-College Requirements in preceding section.
One course required in the area of Development of Civilization.

AgEc 1020—Principles of Macroeconomics (5)

D. Literature, Humanities, and Fine Arts—8 credits minimum

See All-College Requirements in preceding section.

E. Professional Courses in the Major

Agro 1100—Morphology and Identification of Crops and Weeds (4)
Agro 3001—Professional Skills Enrichment (1)
Agro 3010—Adaptation, Distribution, and Ecology of Field Crops (4)
Agro 3020—Growth, Development, and Culture of Field Crops (5)
Agro 3030—Maturation, Harvest, and Storage of Field Crops (4)
Agro 3060—Field Plot Design in Agronomy (3)
Agro 3200—Seminar (1)
Agro 5000—Professional Experience Program (4)
Agro 5020—Introduction to Plant Breeding (4)
Agro 5030—Weed Control (5)

One of the following:

Agro 5010—Forage Production and Utilization (4)
Agro 5040—Corn and Soybean Management (3)
Agro 5060—Small Grains, Sunflower, and Sugar Beet Management (3)

Two of the following (must include one soil course):

Agro 1010—Principles of Agronomy (4)
Agro 1020—Special Problems (3)
Agro 1110—Seed Analysis and Grain Grading (3)
Agro 3150—Advanced Seed and Grain Evaluation (4)

Agro 5001—Problems in Agronomy for Advanced Students (3-5)

Agro 5010—Forage Production and Utilization (4)

Agro 5040—Corn and Soybean Management (3)

Agro 5060—Small Grains, Sunflower, and Sugar Beet Management (3)

Agro 5200—World Food Supply Problems (4)

AgET 1215—Farm Machinery Practical (2)

note: recommended for students without farm machinery experience

AgET 3615—Crop Processing and Storage (4)

AgET 5400—Irrigation and Drainage (4)

AnSc 3401—Principles of Animal Nutrition (3)

Soil 3210—Physical Soil Management and Tillage (4)

Soil 3220—Soil, Water Management, and Conservation (3)

Soil 3416—Soil Fertility (5)

Soil 3520—Soil Morphology, Classification, and Genesis (4)

Soil 5610—Soil Biology (3)

Soil 5230—Soil-Plant-Water Relations (3)

F. Supporting Courses

Ent 1005—Economic Entomology (4)

GCB 3022—Genetics (4)

PIPa 3001—Introductory Plant Pathology (6)

PIPh 3131—Survey: Plant Physiology (4)

Soil 1122—Introductory Soil Science (4)

Programs

G. Electives to complete the 192 credits required for graduation with the bachelor of science degree.

Option 2: Agronomy-Soil Science Option for Agronomy and Plant Genetics Department/Soil Science-Agronomy Option for Soil Science Department

This option is intended for students who are seeking agribusiness careers related to crop and soil science—including consulting, field agronomy, working for agricultural chemical and seed companies or related areas—or who are entering farming.

A. Communication, Language, Symbolic Systems

- Math 1111—College Algebra and Analytical Geometry (5)
or Math 1142—Short Calculus (5)
Rhet 1101—Writing to Inform and Persuade (4)
Rhet 1104—Library Research Methods (1)
Rhet 1151—Writing in Your Major (4)
Rhet 1222—Public Speaking (4)
Rhet 3562—Writing in Your Profession (4)

B. Physical and Biological Sciences

- Chem 1004—General Principles of Chemistry (5)
Chem 1005—General Principles of Chemistry (5)
BioC 1301—Elementary Biochemistry (5)
or Chem 3301—Elementary Organic Chemistry (4)
and Chem 3305—Elementary Organic Chemistry Laboratory (2)
BioC 1302, 1303—Elementary Biochemistry and Laboratory (3,2)
or Chem 3302—Elementary Organic Chemistry (4)
Biol 1009—General Biology (5)
Biol 1103—General Botany (5)
Phys 1041, 1045—Introductory Physics and Laboratory (4, 1)
Geo 1001—Introduction to Geology (4) and 1021—Physical Geology Lab; Geology of Minnesota (1)
or 1111—Introductory Physical Geology (5)
Select one (1) additional course from:
Chem 3100, 3101—Quantitative Analysis Lecture and Laboratory (3, 2)
Phys 1042—Introductory Physics (4) and 1046—Introductory Physics Laboratory (1)
Any mathematics course requiring Math 1111 or 1201 as a prerequisite (5)
EBB 3001—Introduction to Ecology (4)
Biol 1106—General Zoology (5)
Bot 3109—Plant Anatomy (5)

C. The Individual and Society—14 credits minimum

- AgEc 1020—Principles of Macroeconomics (5)
AgEc 1030—Principles of Microeconomics (4)
One course in Development of Civilization, Historical and Philosophical Studies (see *All-College Requirements*)

D. Literature, Humanities and Fine Arts—8 credits minimum

E. Professional Courses

AGRONOMY

- Agro 1100—Morphology and Identification of Crops and Weeds (4)
Agro 3010—Adaptation, Distribution, and Ecology of Field Crops (4)
Agro 3020—Growth, Development, and Culture of Field Crops (5)
Agro 3030—Maturation, Harvest, and Storage of Field Crops (4)
Agro 3060—Field Plot Design in Agronomy (3)
Agro 5030—Weed Control (5)
Agro 5040—Corn and Soybean Management (3)
or Agro 5060—Small Grains, Sunflower, and Sugar Beet Management (3)

SOILS

- Soil 1122—Introductory Soil Science (4)
Soil 1262—Introduction to Meteorology (4)
Soil 3220—Soil, Water Management, and Conservation (3)
Soil 3520—Soil Morphology, Classification, and Genesis (4)
Soil 3416—Soil Fertility (5)
Select 2 courses from:
Soil 3210—Physical Soil Management and Tillage (4)
Soil 5340—Organic and Pesticidal Residues (5)
Soil 5610—Soil Biology (4)

JOINT OFFERINGS

- Agro 1001—Orientation to Agronomy (1)
or Soil 1001—Orientation to Soil Science (1)

F. Supporting Courses

- Ent 1005—Economic Entomology (4)
PIPa 3001—Introductory Plant Pathology: Lecture, Laboratory, and Introduction to Diagnosis (6)
AgEc 3810—Principles of Farm Management (4)
PIPh 3131—Survey of Plant Physiology (4)
Select 4 courses from the following:
GCB 3022—Genetics (4)
AgET 1215—Field Machinery Practical (2)—*required for students without farm machine experience*
AgET 5410—Hydrology (4)
AgET 5400—Drainage and Irrigation (4)
AnSc 1100—Introductory Animal Science (5)
AnSc 3401—Principles of Animal Nutrition (3)
Agro 5010—Forage Production and Utilization (4)
Agro 5020—Introduction to Plant Breeding (4)

G. Electives to complete the 192 credits required for graduation with a bachelor of science degree.

Minor Requirements

The department offers two minors, one in agronomy and one in integrated crop-pest management. The minor in agronomy is designed for students seeking a thorough understanding of the principles of crop science and their application to the production and improvement of field crops. These

principles are used to solve problems facing farmers, seed suppliers, fertilizer dealers, industrial representatives, crop production consultants, and others seeking to improve the production and quality of food, feed, and fiber.

The minor in integrated crop-pest management (ICPM), an interdisciplinary program combining coursework and field experience, is for students who wish to develop competence in this area in addition to their majors.

In addition to 32 credits, the program requires at least one quarter of field experience. The intent of a training session and the field experience is to show the relationships among the disciplines of agronomy, entomology, horticulture, plant pathology, and soil science as they relate to the control of pests during the production of crops. You should plan the fieldwork as early as possible, preferably before you complete much coursework for the program. Experience as a scout in an ICPM program is highly recommended as a means of meeting this requirement.

Students seeking a minor in agronomy or ICPM should develop their course of study in cooperation with an adviser in the Department of Agronomy and Plant Genetics.

Course substitutions may be made only with the consent of your adviser and the Department of Agronomy and Plant Genetics.

A. Agronomy Minor

Agro 3010—Adaptation, Distribution, and Ecology of Field Crops (4)

Agro 3020—Growth, Development, and Culture of Field Crops (5)

Agro 3030—Maturation, Harvest, and Storage of Field Crops (4)

Agro 3200—Undergraduate Seminar (1)
One course from:

Agro 5010—Forage Production and Utilization (4)

Agro 5040—Corn and Soybean Management (3)

Agro 5060—Small Grains, Sunflower, and Sugar Beet Management (3)

At least one course from:

Agro 1010—Principles of Agronomy (4)

Agro 1100—Morphology and Identification of Crops and Weeds (4)

Agro 1110—Seed Analysis and Grain Grading (3)

Agro 5010—Forage Production and Utilization (4)

Agro 5020—Introduction to Crop Breeding (4)



Programs

- Agro 5030—Weed Control (5)
Agro 5040—Corn and Soybean Management (3)
Agro 5060—Small Grains, Sunflower, and Sugar Beet Management (3)

B. Integrated Crop-Pest Management Minor

Required Background Courses (not considered part of the minor)

- Ent 1005—Economic Entomology (4)
PIPa 3001—Introductory Plant Pathology (6)
Soil 1122—Introductory Soil Science (4)
Agro 1100—Morphology and Identification of Crops and Weeds (4)
AgEc 3810—Farm Management Economics (4)

Required Courses

- Agro 5030—Weed Control (5)
Ent 5210—Integrated Pest Management (5)
PIPa 5006—Fungi, Algae, and Parasitic Seed Plants in Plant Disease (4)

Additional Courses: Select at least 16 credits from this list, including only courses from three departments outside student's major

- AgEc 3610—Community Resource Development (4)
or AgEc 5650—Economics of Natural Resource Policy (4)
AgEc 3850—Farm Business and Enterprise Analysis (4)
AgET 1215—Field Machinery Practical (2)
Agro 3020—Growth, Development, and Culture of Field Crops (5)
Agro 5010—Forage Production and Utilization (4)
Agro 5040—Corn and Soybean Management (3)
Agro 5060—Small Grains, Sunflower, and Sugar Beet Management (3)
Ent 5215—Insects in Relation to Plant Diseases (4)
Hort 3031—Fruit Science (4)
Hort 3072—Turf Management (4)
Hort 5034—Commercial Vegetable Production I (3)
Hort 5035—Commercial Vegetable Production II (3)
PIPa 5005—Viruses and Bacteria in Plant Disease (4)
PIPa 5007—Nematodes and Abiotic Agents in Plant Disease (4)
PIPa 5700—Contemporary Chemical Control of Plant Diseases (4)
Soil 3210—Physical Soil Management and Tillage (4)
Soil 3416—Soil Fertility (5)
Soil 3520—Soil Morphology, Classification, and Genesis (4)
Soil 3610—Soil Biology (3)
Soil 5230—Soil-Plant-Water Relations (3)

Animal Science

*Department of Animal Science
122 Peters Hall
612/624-2722*

Animal science specialists study the physical, biological, social, and economic factors involved in the production of farm animals and poultry. Animal science graduates are employed as farmers, farm managers, county extension agents and livestock buyers, and in a variety of other positions in the meat packing industry, dairy industry, feed industry, farm supply industry, banks and other finance agencies, consulting organizations, breed associations, government agencies, and artificial insemination organizations.

Students in animal science must choose one of three submajors that best fits their career goals:

- animal industry marketing
- animal life sciences
- animal production systems

Those seeking business-oriented careers in agricultural industries associated with farm animals should select the *animal industry marketing* submajor.

Courses in this submajor cover both the biology of farm animals and the business aspects of animal industry, as well as prepare students for careers in public relations, international relations, promotion, communications, business, administration, marketing of animals and animal products, and providing advice and services to animal producers.

The *animal life sciences* submajor is designed for students oriented toward graduate studies in animal science or related scientific areas, including veterinary medicine. This submajor develops the strong foundation in physical and biological sciences necessary for graduate studies in biological sciences or veterinary medicine, as well as a strong foundation in animal science.

The *animal production systems* submajor prepares students for careers in the production of farm animals and poultry. Upon completing this program students

should know the physical, biological, social, and economic factors involved in careers as farmers, farm managers, and county extension agents and in positions in dairy, meat packing, farm supply, consulting, breed, government, and artificial insemination organizations.

Major Requirements

All students in animal science must complete the requirements listed below. Course substitutions in categories A, B, C, and D may be made only with the approval of the College Office, and in E and F only with the approval of your adviser and the Department of Animal Science.

A. Communication, Language, Symbolic Systems

See Agricultural Science and Industries Curriculum Requirements in preceding section. In addition, students in Animal-Life Sciences must complete a calculus sequence.

B. Physical and Biological Sciences

ANIMAL INDUSTRY MARKETING

See Agricultural Science and Industries Curriculum Requirements in preceding section.

ANIMAL LIFE SCIENCES

- Biol 1009—General Biology (5)
- Biol 1103—General Botany (5)
 - or Biol 1106—General Zoology (5)
- Chem 1004—General Principles of Chemistry (5)
- Chem 1005—General Principles of Chemistry (5)
- Chem 1006—Principles of Solution Chemistry (5)
- Chem 3301, 3305—Elementary Organic Chemistry I and Laboratory (4,2)
- Chem 3302, 3306—Elementary Organic Chemistry II and Laboratory (4,2)
- Biol 5001—Biochemistry (5)
- Physics 1041, 1045—Introductory Physics and Laboratory (4,1)
- VPB 3103—General Microbiology (5)
 - or MicB 3103—General Microbiology (5) (Extension registration only, fall)
 - or Biol 5013—Microbiology (5)

ANIMAL PRODUCTION SYSTEMS

See Agricultural Science and Industries Curriculum Requirements in preceding section.

C. The Individual and Society—14 credits minimum

See All-College Requirements in preceding section. One course required in the area of Development of Civilization.

AgEc 1020—Principles of Macroeconomics (5)

D. Literature, Humanities, and Fine Arts—8 credits minimum

See All-College Requirements in preceding section.

E. Professional Courses in the Major

- AnSc 1100—Introductory Animal Science (5)
- AnSc 3220—Principles of Animal Breeding (5)
- AnSc 3301—Systemic Physiology (6)
- AnSc 3401—Principles of Animal Nutrition (3)

One of the following courses:

- AnSc 5601—Swine Production (4)
- AnSc 5602—Sheep Production (4)
- AnSc 5603—Beef Cattle Production (4)
- AnSc 5604—Dairy Farm Management (4)
- AnSc 5605—Poultry Production (4)

One of the following courses:

- AnSc 5401—Swine Nutrition and Feeding (4)
- AnSc 5403—Ruminant Nutrition (4)
- AnSc 5405—Poultry Nutrition (3)

Complete one of the following animal science submajors:

ANIMAL INDUSTRY MARKETING

- AgEc 1400—Agricultural Markets and Prices (4)
- AgEc 3440—Livestock Marketing Economics (3)
- Rhet 3254—Advanced Public Speaking (4)
- Rhet 5257—Scientific and Technical Presentations (4)
- Rhet 5565—Writing for Publication (4)

ANIMAL LIFE SCIENCES

- AnSc 1510—Consumer Meat Science (2)
- AnSc 5703—Literature and Seminar (2-3)
- GCB 3022—Genetics (4; cannot also be counted toward category B)
- Stat 3011—Statistical Analysis (4)
 - or Stat 5021—Statistical Analysis I (5)

ANIMAL PRODUCTION SYSTEMS

- AnSc 1510—Consumer Meat Science (2)
- AnSc 5703—Literature and Seminar (2-3)
- AgEc 1400—Agricultural Markets and Prices (4)
- AgEc 3810—Principles of Farm Management (4)
 - or AgEc 3820—Farm Management Economics (4)
- AgET 3030—Introduction to Problem Solving with Computers (4)
- Stat 3011—Statistical Analysis (4)

F. Electives to complete 192 credits required for graduation with the bachelor of science degree. Recommended electives for submajors are:

ANIMAL INDUSTRY MARKETING

- AgEc 1250—Principles of Accounting (5)
- AgEc 3040—Economic Development of American Agriculture (4)
- AgEc 3070—Agriculture and Economic Growth in Developing Countries (4)
- AgEc 3430—Dairy Marketing Economics (3)
- AgEc 5790—World Food Supply Problems (3)
 - or Agro 5200, LACS 5280, FScN 5643, Soc 5675
- AgET 3030—Introduction to Problem Solving with Computers (4)
- Agro 1010—Principles of Agronomy (5)
- AnSc 1120—Livestock and Meat Evaluation (4)
- AnSc 1510—Consumer Meat Science (2)
- AnSc 1520—Milk Production (3)
- AnSc 5703—Literature and Seminar (2-3)
- BLaw 3058—Introduction to Law, and the Law of Contracts and Agency (4) (extension registration only)

Programs

Jour 1001—Introduction to Mass Communications (2)
Jour 1002—Visual Communication (2)
Mktg 3000—Principles of Marketing (4) (extension registration only)
Rhet 1220—Principles of Human Communication (4)
Rhet 3101—Functional Photography (4)
Rhet 3130—Publicity (4)
Rhet 3266—Communication, Discussion in Small Group Decision Making (4)
Rhet 5170—Managerial Communications (4)
Soil 1122—Introductory Soil Science (4)

ANIMAL LIFE SCIENCES

AgEc 1250—Principles of Accounting (5)
AgEc 1400—Agricultural Markets and Prices (4)
AgEc 3040—Economic Development of American Agriculture (4)
AgEc 3810—Principles of Farm Management (4)
AgET 3030—Introduction to Problem Solving with Computers (4)
Agro 1010—Principles of Agronomy (5)
AnSc 3305—Reproduction Physiology, Artificial Insemination, and Lactation (5)
AnSc 3510—Growth and Development of Animal Tissues (3)
AnSc 5104—Agricultural Systems Analysis and Modeling (4)
AnSc 5327—General Endocrine Physiology (3)
AnSc 5609—Principles of Farm Animal Environment (3)
AnSc 5710—Special Problems (arr)
Chem 3100, 3101—Quantitative Analysis Lecture and Laboratory (3, 2)
Phys 1042, 1046—Introductory Physics and Laboratory (4, 1)
Soil 1122—Introductory Soil Science (4)

ANIMAL PRODUCTION SYSTEMS

AgEc 1250—Principles of Accounting (5)
AgEc 3430—Dairy Marketing Economics (3)
AgEc 3440—Livestock Marketing Economics (3)
AgEc 3500—Farm and Agribusiness Finance (5)
AgEc 3830—Organizing the Farm Business for Entry, Growth, and Transfer (4)
AgEc 5020—Applied Linear Programming (4)
AgEc 5440—Cooperatives and Agribusiness Organization (4)
AgEc 5840—Management of the Farm Business (4)
Agro 1010—Principles of Agronomy (5)
Agro 3020—Growth, Development, and Culture of Field Crops (5)
Agro 3030—Maturation, Harvest, and Storage of Field Crops (4)
Agro 5010—Forage Production and Utilization (4)
AgET 3606—Farm Building Design, Layout, Systems (4)
AnSc 1120—Livestock and Meat Evaluation (4)
AnSc 1520—Milk Production (3)
AnSc 3113—Animal Welfare (4)
AnSc 3305—Reproductive Physiology, Artificial Insemination, and Lactation (5)
AnSc 3510—Growth and Development of Animal Tissues (3)
AnSc 5231—Dairy Cattle Breeding (4)
AnSc 5280—Livestock Entomology (3)
AnSc 5609—Principles of Farm Animal Environment (3)

FR 5231—Range Management (3)
LACS 3502—Animal Health and Disease (5)
Mgmt 3001—Fundamentals of Management (4) (extension registration only)
Mgmt 3002—Psychology in Management (4) (extension registration only)
Soil 1122—Introductory Soil Science (4)

Minor Requirements

Students interested in animal science as a minor should consult an adviser in animal science to help develop a coherent program. Required courses include:

AnSc 3401—Principles of Animal Nutrition (3)
AnSc 3220—Principles of Animal Breeding (5)
AnSc 3301—Systemic Physiology (6)

Electives:

AnSc electives to total 26 credits.

Biological Sciences

Freshman and sophomore students interested in earning a degree in the biological sciences may complete their prerequisite work in the College of Agriculture, since the College of Biological Sciences (CBS) accepts junior and senior students only. They will be assisted in program planning by an adviser in CBS and can transfer to CBS when they have met the requirements for entry. Pre-CBS students may apply directly to the College of Agriculture for admission.

For further information about biological sciences programs, see the *College of Biological Sciences Bulletin*, or contact the College of Biological Sciences, 223 Snyder Hall, University of Minnesota, 1475 Gortner Avenue, St. Paul, MN 55108 (612/624-9717).

Consumer Food Science

Department of Food Science and Nutrition
225 Food Science and Nutrition
612/624-1290

This program is designed to prepare students for employment in the areas of promotion, product development, marketing, and consumption of food. Upon completing the program you should have a sound knowledge of basic scientific principles of food science, consumer aspects of food product development, testing, marketing,

advertising, and communication. Required coursework includes studies in marketing, agricultural and applied economics, and statistics. In addition, you will select a concentration in one of five collateral areas of emphasis—economics and business administration, sociopsychology, communication, food product development, or nutrition. Through choice of the collateral area, you can help prepare for a particular job emphasis after earning the bachelor's degree, or for graduate study in a specific area such as business administration, agricultural and applied economics, or food science.

This program is open to students registered in either the College of Agriculture or the College of Home Economics. Faculty advisers are normally from the Department of Food Science and Nutrition, which is jointly administered by the two colleges.

Major Requirements

Listed below are the requirements for the major in consumer food science. Course substitutions in categories A, B, C, and D may be made only with the approval of the College Office, and in categories E and F only with the approval of your adviser and the Department of Food Science and Nutrition. Work closely with your adviser to select appropriate courses in biochemistry and chemistry if you are considering a food and product development or a nutrition collateral area or graduate work in food science.

A. Communication, Language, Symbolic Systems

- Math 1142—Short Calculus (5)
or Math 1131—Finite Math (5)
or Math 1211—Calculus I (5)
- Rhet 1101—Writing to Inform and Persuade (or equivalent course) (4)
- Rhet 1104—Library Research Methods (1)
- Rhet 1151—Writing in Your Major (4)
- Rhet 1222—Public Speaking (4)
- Rhet 3562—Writing in Your Profession (4)

B. Physical and Biological Sciences

- Biol 1009—General Biology (5)
- Biol 5001—Biochemistry (4)
- Chem 1004—General Principles of Chemistry (5)
- Chem 1005—General Principles of Chemistry (5)

- Chem 3301—Elementary Organic Chemistry I (4)
- Chem 3302—Elementary Organic Chemistry II (4)
- Chem 3305—Elementary Organic Chemistry Laboratory I (2)
- Chem 3306—Elementary Organic Chemistry Laboratory II (2)

C. The Individual and Society

- See All-College Requirements in preceding section.
- One course required in the area of Development of Civilization.
- AgEc 1020—Principles of Macroeconomics (5)
or Econ 1001—Principles of Macroeconomics (4)
- AgEc 1030—Principles of Microeconomics (4)
or Econ 1002—Principles of Microeconomics (4)
- Psy 1001—General Psychology (5)
- Soc 1001—Introduction to Sociology (4)

D. Literature, Humanities, and Fine Arts—9 credits minimum

See All-College Requirements in preceding section.

E. Professional Courses in the Major

- AgEc 3101—Microeconomic Theory (4)
- AgEc 3102—Macroeconomic Theory (4)
- FScN 1102—Technology of Food Processing (4)
- FScN 3110—Food Chemistry (4)
- FScN 3112—Food Chemistry Laboratory (2)
- FScN 3123—Microbiology of Foods (5)
- FScN 3272—Introduction to Food Decision Making (2)
- FScN 3403—Experimental Foods (4)
- FScN 3472—Principles of Food Purchasing (4)
- FScN 3600—Principles of Nutrition (4)
- FScN 3622—Life Cycle and Community Nutrition (4)
or FScN 5622—Macro-Nutrient Metabolism (5)
- FScN 5100—General Seminar (1)
- FScN 5360—Sensory Evaluation of Food Quality (4)
- FScN 5403—Experimental Study of Foods (5)
- FScN 5412—Physicochemistry of Foods (3)
- FScN 5413—Structural-Functional Relations in Food Systems (3)
- Mktg 3000—Principles of Marketing (4)
- Stat 3011-3012—Statistical Analysis (8)
or Stat 5021—Statistical Analysis (5)

F. Collateral Area

In addition to the above requirements, you must complete a minimum of 20 credits in one of the areas below. Courses are usually selected from those listed below, but you may select others in consultation with your adviser. You may select more than one area.

ECONOMICS AND BUSINESS ADMINISTRATION

- Acct 1024—Principles of Financial Accounting I (3)
- Acct 1025—Principles of Financial Accounting II (3)
- Acct 3001—Managerial Accounting (4)
- AgEc 1250—Principles of Accounting (5)
- AgEc 5560—Economics of Consumer Policies (4)
- AgEc 5580—Economic Organization of the Household (4)
- BGS 3001—Managerial Economics (4)
- BFin 3000—Finance Fundamentals (4)
- FScN 5390—Introduction to Food Law (4)
- FScN 5474—Food Consumption Economics (4)

Programs

- Mgmt 3001—Fundamentals of Management (4)
Mktg 3010—Buyer Behavior, Marketing Analysis (4)
Mktg 3020—Marketing Operations Management (4)
Mktg 3050—Marketing Communications (4)
Psy 5751—Psychology of Advertising (4)
or Jour 5251—Psychology of Advertising (4)
DSci 3055—Introduction to Management Sciences (4)
Soc 5201—Introduction to Social Psychology (4)
Stat 5301—Design of Experiments (5)
Soc 5411—Formal Organizations (4)

SOCIOPSYCHOLOGY

- Mktg 3010—Buyer Behavior, Marketing Analysis (4)
Psy 3031—Sensation and Perception (4)
Psy 3201—Introduction to Social Psychology (4)
Psy 3401—Social Organization (4)
Soc 5201—Introduction to Social Psychology (4)
Soc 5355—Opinion and Communication: Social Factors (4)
Soc 5401—Social Organizations (4)
Soc 5411—Formal Organizations (4)

COMMUNICATION

Required:

- FScN 3400—Food Communication Techniques (3)
Other courses may include:

Writing, Editing, Production

- Comp 1027—Intermediate Expository Writing (4)
Comp 3011—Writing About Literature (4)
Comp 3012—Writing in the Humanities: Writing About Non-Fiction Texts (4)
Comp 3013—Writing for Arts Other Than Literature (4)
Comp 3014—Writing for the Quantitative Social Sciences (4)
Comp 3015—Writing About Science (4)
Rhet 5565—Writing for Publication (4)
Rhet 5571—Writing for Special Purposes (2)

Oral Communications

- Rhet 5257—Scientific and Technical Presentations (4)
Rhet 3254—Advanced Public Speaking (4)
Rhet 3266—Communication, Discussion in Small Group Decision Making (4)
Rhet 5258—Interviewing: Dynamics of Face-to-Face Communication (4)

Visual Communications

- Rhet 3176—The Use of Scientific and Technical Film (4)
Rhet 3101—Functional Photography (4)

General

- Jour 3201—Principles of Advertising (4)
Jour 5251/Psy 5751—Psychology of Advertising (4)
Rhet 3700—Rhetorical Theory: Persuasion and the Literature of Science (4)
Rhet 5165—Studies in Organizational Communication, Conflict and Change (4)
Rhet 5170—Managerial Communications (4)
Other journalism courses that are open to non-journalism majors

FOOD AND PRODUCT DEVELOPMENT

- FScN 5000—Professional Experience Program (4 cr max)
FScN 5111—Independent Study in Food Science and Nutrition (1-5)

- FScN 5120—Food Microbiology (5)
FScN 5122—Control of Microorganisms in Food Processing (2)
FScN 5135—Food Engineering Unit Operations (5)
FScN 5136—Unit Operations Laboratory (2)
FScN 5310—Advanced Food Chemistry (3)
FScN 5312—Chemical and Instrumental Analysis of Foods (5)
FScN 5404—Current Issues in Food and Nutrition (2-4)
FScN 5406—Current Literature in Foods (2-4)
FScN 5512—Meat Technology (5)
FScN 5530—Industrial Processing of Fruits and Vegetables (4)
FScN 5540—Fats and Oils Chemistry and Technology (4)
FScN 5555—Freezing and Dehydration of Foods (5)
FScN 5562—Flavor Technology (3)
FScN 5643—Seminar: World Food Supply Problems (3)
BioC 5025—Laboratory in Biochemistry (2)
TexC 5625—Color Metrology (3)

NUTRITION

- Phsl 1002—Human Physiology (4)
or Phsl 3051—Human Physiology (primarily for nursing and physical therapy students) (5)
BioC 5025—Laboratory in Biochemistry (2)
FScN 5622—Macro-Nutrient Metabolism (5)
FScN 5623—Vitamin and Mineral Biochemistry (4)
The remaining courses should be selected from nutrition, public health, biochemistry, and medicine in consultation with your adviser.

G. Electives to complete the 185 credits required for graduation with the bachelor of science degree.

Economics of Public Resource Management

*Department of Agricultural and Applied Economics
231 Classroom-Office Building
612/625-1222*

Courses of study in this program may be oriented toward resource economics, regional economics, or economics of public services. As a graduate of this program, you will be prepared for employment in extension services, planning commissions, regional development commissions, and many public and private agencies involved with resource and community development activities. You may also enter graduate programs in agricultural economics, resource economics, resource development, regional economics, planning, or other related fields.

Major Requirements

Students selecting the economics of public resource management major must complete the requirements listed below.

A. Communication, Language, Symbolic Systems—31 credits minimum (A/F)

One of the math sequences:

Sequence One

Math 1131—Finite Mathematics (5)

Math 1142—Short Calculus (5)

or Math 1211—Calculus I (5)

Sequence Two

Math 1201—Pre-Calculus (5)

Math 1211—Calculus I (5)

Math 1221—Calculus (5)

Rhet 1101—Writing to Inform and Persuade (4)

Rhet 1104—Library Research Methods (1)

Rhet 1151—Writing in Your Major (4)

Rhet 1222—Public Speaking (4)

Rhet 3254—Advanced Public Speaking (4)

or Rhet 3266—Discussion Methods (4)

Rhet 3562—Writing in Your Profession (4)

B. Physical and Biological Sciences—24 credits minimum (A/F)

Biol 1009—General Biology (5)

Chem 1001—Chemical Principles and Covalent Systems (5)

or Chem 1004—General Principles of Chemistry (5)

Chem 1002—Chemical Principles and Covalent Systems (5)

or Chem 1005—General Principles of Chemistry (5)

EBB 3001—Introduction to Ecology (4)

Geo 1001, 1021—Physical Geology and Laboratory (4,1)

or Phys 1041, 1045—Introductory Physics and Laboratory (4,1)

or Phys 1001, 1005—The Physical World and Laboratory (4, 1)

C. The Individual and Society—26 credits minimum

See All-College Requirements in preceding section.

One course required in the area of Development of Civilization.

AgEc 1020—Principles of Macroeconomics (5)

or Econ 1001—Principles of Macroeconomics (4-5)

AgEc 1030—Principles of Microeconomics (4)

or Econ 1002—Principles of Microeconomics (4)

Pol 1001—Government Politics (5)

or Pol 1041—Contemporary Political Ideologies (4)

Psych 1001—General Psychology (5)

Soc 1001—Introduction to Sociology (4)

or Soc 1002—American Community (4)

or Soc 1651—Rural Sociology (4)

D. Literature, Humanities, and Fine Arts—8 credits minimum

See All-College Requirements in preceding section.

E. Professional Courses in the Major—50 credits minimum

AgEc 1000—Orientation to Agricultural and Applied Economics (1)

AgEc 1250—Principles of Accounting (5)

or Acct 1024—Principles of Financial Accounting I (3)

and Acct 1025—Principles of Financial Accounting II (3)

AgEc 3101—Microeconomic Theory (4)

or Econ 3101—Microeconomic Theory (4)

AgEc 3102—Macroeconomic Theory (4)

or Econ 3102—Macroeconomic Theory (4)

AgEc 3640—Public Finance: Concepts and Practices (4)

or AgEc 5640—Financing State and Local Governments (4)

AgEc 3610—Community Resource Development (4)

AgEc 3900—Special Topics in the Economics of Public Services (3)

AgEc 5099—RCD Interdisciplinary Seminar I (4)

AgEc 5100—RCD Interdisciplinary Seminar II (4)

Select remaining credits from the following:

AgEc 3290—Agribusiness Management (4)

or Mgmt 3001—Fundamentals of Management (4)

AgEc 5560—Economics of Consumer Policies (4)

AgEc 5600—Land Economics (4)

AgEc 5620—Regional Economic Analysis (4)

AgEc 5630—Regional Development Systems (4)

AgEc 5650—Economics of Natural Resource Policy (4)

AgEc 5660—Economics of Public Services (4)

AgEc 5670—Economics of Agricultural Transportation (4)

Econ 3103—Welfare Economics (4)

RCD 5200—Community Development Simulation (4)

F. Supporting Courses

Three areas of concentration are available; students should choose one.

RESOURCE ECONOMICS—29 credits minimum

Arch 5137—Planning: Urban Function and Structure (4)

Biol 1103—General Botany

or Biol 1106—General Zoology (5)

Phys 1042-1046—Introductory Physics and Laboratory (4, 1)

or Soil 1122—Introductory Soil Science (4)

Soc 5401—Social Organization (4)

or Soc 5651—Rural Social Institutions (4)

or RCD 3010—The Minnesota Community: Analysis of its Organization, Change, and Development (4)

Stat 5021—Statistical Analysis I (5)

Recommended Electives:

Courses from ag econ, ag engineering, computer science, rural community development, geography, soil science, and others are recommended to enhance the concentration in resource economics. Contact your faculty adviser or the Peer Advising Office for a complete listing.

PUBLIC SERVICES—28 credits minimum

Arch 5137—Planning: Urban Function and Structure (4)

or Geog 5001, 5002—Geographical Analysis I, II (4, 4)

or Geog 5372, 5373—Metropolitan Analysis I, II (4, 4)

DSci 1050—Elementary Managerial Statistics (4)

or Stat 1051—Introduction to Ideas of Statistics (4)

Programs

Recommended Electives:

During the junior and senior years, students take four or five courses in a specialized area of emphasis such as transportation, health policy and health care delivery, regional and community development, housing, or the economics of education. Contact your faculty adviser or the Peer Advising Office for a complete listing.

REGIONAL ECONOMICS—20 credits minimum

DSci 1050—Elementary Managerial Statistics (4)
or Stat 1051—Introduction to Ideas of Statistics (4)

PA 5545—Planning Methods (4)

PA 5521—Strategy and Tactics in Project Planning (4)

or Geog 5001, 5002—Geographical Analysis I, II (4, 4)

or Geog 5372, 5373—Metropolitan Analysis I, II (4, 4)

or Soc 5661—Rural Community Analysis (4)

Recommended Electives:

Courses from agricultural economics, geography, management information systems, rural community development, sociology, and others are suggested to enhance the concentration in regional economics. Contact your faculty adviser or the Peer Advising Office for a complete listing.

G. Electives to complete the 192 credits required for graduation with the bachelor of science degree.

Food Science and Technology

*Department of Food Science and Nutrition
225 Food Science and Nutrition
612/624-1290*

Food science and technology applies modern science and engineering to the manufacture and distribution of food. To accomplish this objective, an understanding of the basic principles and techniques of many disciplines—including chemistry, physics, economics, engineering, microbiology, nutrition, management, public health, and agricultural production—must be applied to food processing and preservation as well as to marketing situations. Food scientists and technologists are concerned with the theoretical and practical aspects of the food industry that involve the food chain from the production of raw materials to the ultimate utilization of products by consumers. This curriculum balances fundamental principles and useful applications of theory within a flexible program that permits you to tailor your studies to fit personal career goals.

The program emphasizes the attitudes,

knowledge, and skills essential to understanding the principles of food science. In it you learn to recognize and analyze problems of the food industry and to arrive at solutions through the application of principles of the biological and physical sciences, engineering, and business. You develop competence in a professional discipline related to the food industry through supplementary studies in an area of emphasis in business administration, chemistry, engineering, microbiology, or public health. Food scientists and technologists should be prepared to work with cereals, dairy products, fruits and vegetables, meat and poultry products, or fabricated foods of the future.

This program is open to students registered in either the College of Agriculture or the College of Home Economics. Faculty advisers are normally from the Department of Food Science and Nutrition, which is jointly administered by the two colleges.

Many graduates of the program seek employment after earning the bachelor of science degree, while others continue on to graduate study. Career areas include production management, product and process research and development, public health and regulatory agency service, teaching, merchandising, advertising, technical service and sales, quality control supervision, and international nutrition and food agency work.

Major Requirements

The requirements for the major in food science and technology are listed below. Course substitutions in categories A, B, C, and D may be made only with the approval of the College Office, and in categories E and F only with the approval of your adviser and the Department of Food Science and Nutrition.

A. Communication, Language, Symbolic Systems

Math 1211, 1221—Calculus I and II (5, 5)

or Math 1142—Short Calculus (5)

Rhet 1101—Writing to Inform and Persuade (or equivalent) (4)

Rhet 1104—Library Research Methods (1)

Rhet 1151—Writing in your Major (4)

Rhet 1222—Public Speaking (4)

Rhet 3562—Writing in your Profession (4)
 Stat 3011, 3012—Statistical Analysis (4, 4)
 or Stat 5021—Statistical Analysis (5)

B. Physical and Biological Sciences

Biol 1009—General Biology (5)
 Biol 5001—Biochemistry (4)
 BioC 5025—Biochemistry Laboratory (2)
 Chem 1004—General Principles of Chemistry (5)
 Chem 1005—General Principles of Chemistry (5)
 Chem 3301, 3305—Elementary Organic Chemistry I
 and Laboratory (4, 2)
 Chem 3302, 3306—Elementary Organic Chemistry II
 and Laboratory (4, 2)
 MicB 5105—Biology of Microorganisms (5)
 or VPB 3103—General Microbiology (5)
 Phys 1041, 1045—Introductory Physics and Labora-
 tory (4, 1)
 Phys 1042, 1046—Introductory Physics and Labora-
 tory (4, 1)

C. The Individual and Society—14 credits mini- mum

See All-College Requirements in preceding section.
 One course required in the area of Development of
 Civilization.

AgEc 1020—Principles of Macroeconomics (5)
 or Econ 1001—Principles of Macroeconomics (4)
 AgEc 1030—Principles of Microeconomics (4)
 or Econ 1002—Principles of Microeconomics (4)

D. Literature, Humanities, and Fine Arts—9 cred- its minimum

See All-College Requirements in preceding section.

E. Professional Courses in the Major

FScN 1102—Technology of Food Processing (4)
 FScN 3110—Food Chemistry (4)
 FScN 3112—Food Chemistry Laboratory (2)
 FScN 3600—Principles of Nutrition (4)
 FScN 5100—General Seminar (1)
 FScN 5120—Food Microbiology (5)
 FScN 5122—Control of Microorganisms in Food Pro-
 cessing (2)
 FScN 5123—Microbiology of Food Fermentations (2)
 FScN 5135—Food Engineering Unit Operations (5)
 FScN 5136—Unit Operations Laboratory (2)
 FScN 5312—Chemical and Instrumental Analysis of
 Foods (5)

Plus at least 20 credits from the following (with at
 least 8 from FScN 5512, 5522, 5523, 5530, 5540,
 5555):

FScN 5000—Professional Experience Program (4)
 (A-N only)
 FScN 5111—Independent Study in Food Science
 and Nutrition (1-5)
 FScN 5310—Advanced Food Chemistry (3)
 FScN 5320—Food Biotechnology (3)
 FScN 5350—Application of Experimental Design
 in the Food Industry (4)
 FScN 5360—Sensory Evaluation of Food Quality
 (4)
 FScN 5380—Food Packaging (3)
 FScN 5390—Introduction to Food Law (4)
 FScN 5412—Physicochemistry of Foods (3)
 FScN 5413—Structural-Functional Relations in
 Food Systems (3)

FScN 5512—Meat Technology (5)
 FScN 5522—Technology of Fluid and Concen-
 trated Milk Products (4)
 FScN 5523—Technology of Fermented Dairy
 Products (4)
 FScN 5524—Sensory Evaluation of Dairy Prod-
 ucts (1)
 FScN 5530—Industrial Processing of Fruits and
 Vegetables (4)
 FScN 5540—Fats and Oils Chemistry and Tech-
 nology (4)
 FScN 5555—Freezing and Dehydration of Foods
 (5)
 FScN 5562—Flavor Technology (3)

F. Areas of Emphasis

In addition to the above requirements, you must com-
 plete one of the following areas of emphasis, designed
 to support and complement your major field. Courses
 used to complete the area of emphasis cannot be used
 to meet other major course requirements. It is as-
 sumed that a well-conceived area of emphasis will in-
 clude some 3000- and 5000-level courses.

CEREALS

For the student interested in cereals, including the
 handling, storage, and marketing of grains as well as
 the utilization of cereal-based products in food sys-
 tems. At least 20 credits should be selected. Courses
 must include:

FScN 5413—Structural Functional Relations in Food
 Systems (3)

AgEc 3420—Grain Marketing Economics (3)

Other courses may include:

Agro 1100—Morphology and Identification of
 Crops and Weeds (4)
 Agro 1110—Seed Analysis and Grain Handling (3)
 AgEc 1400—Agricultural Markets and Prices (4)
 Biol 3012—Plant Biology (5)
 Bot 3109—Plant Anatomy (5)
 Ent 1005—Economic Entomology (4)
 Ent 3175—Introductory Entomology (5)
 Ent 5252—Stored Product Pest Management (4)
 FScN 3403—Experimental Foods (4)
 GCB 3022—Genetics (4)
 GCB 5606—Electron Microscopy (3)
 PLPa 3001—Introductory Plant Pathology (6)
 PIPa 5106 or 5107—Mycology (4)
 PIPh 3131—Survey of Plant Physiology (4)

CHEMISTRY

For the student seeking a fundamental approach to
 the chemistry of foods and food processes. FScN 5310
 is required of all students selecting this area of em-
 phasis. You must select at least 20 credits of chem-
 istry, which may include FScN 5310 if not counted in
 category E.

Other credits may include:

BioC 5002—Biochemistry Topics (3)
 Chem 1006—Solution Chemistry (4)
 Chem 3100, 3101—Quantitative Analysis and
 Laboratory (3, 2)
 Chem 5520—Elementary Physical Chemistry (3)
 Chem 5521—Elementary Physical Chemistry (3)

DAIRY TECHNOLOGY

For the student primarily interested in the technology
 and processing of dairy products. At least 20 credits
 must be selected to represent dairy processing, dairy
 marketing and economics, and other related areas.

Programs

Courses must include:

- FScN 5522—Technology of Fluid and Concentrated Milk Products (4)
FScN 5523—Technology of Fermented Dairy Products (4)
AgEc 3430—Dairy Marketing Economics (3)
Other courses may include:
AnSc 1520—Milk Production (3)
AgEc 1400—Agricultural Markets and Prices (4)
FScN 5524—Sensory Evaluation of Dairy Products (1)
FScN 5360—Sensory Evaluation of Food Quality (4)

ENGINEERING TECHNOLOGY

For the student interested primarily in the engineering technology aspects of food process development and production. At least 25 credits in a cohesive program are to be selected in consultation with your adviser.

Students interested in a four-year food engineering degree should consult the listing of the Department of Agricultural Engineering in the *Institute of Technology Bulletin*.

FLAVOR

For the student interested in a career in flavor manufacture, analysis, or sensory evaluation. At least 20 credits must be selected from flavor-related courses.

- Courses must include:
FScN 5360—Sensory Evaluation of Food Quality (4)
FScN 5562—Flavor Technology (3)
Other courses may include:
BioC 5002—Biochemistry Topics (3)
Chem 3303—Elementary Organic Chemistry III (4)
Chem 5301—Spectral Methods for Organic Qualitative Analysis (4)
Chem 5344—Heterocyclic Compounds (3)
Chem 5365—Organic Qualitative Analysis (4)
FScN 5111—Independent Study in Food Science and Nutrition (Special Problems in Flavor Chemistry) (2)
FScN 5524—Sensory Evaluation of Dairy Products (1)
FScN 5462—Advanced Topics in Sensory Evaluation of Food (2-4)

INDUSTRIAL ENGINEERING

For the student with competence and interest in the industrial engineering aspects of the food industry. The requirements include either:

- ME 3900—Introduction to Engineering Statistics (4) or Stat 3091—Introduction to Probability and Statistics (4), plus at least 20 credits from the industrial engineering courses described in the *Institute of Technology Bulletin*.

MANAGEMENT

For the student interested in the problems of the business and economic phases of food industries. You must select at least 30 credits from course offerings in the departments of Agricultural and Applied Economics, Economics, Rhetoric, and from the School of Management.

- BioC 1301—Elementary Biochemistry I (5), BioC 1302—Elementary Biochemistry II (3), and BioC 1303—Elementary Biochemistry Laboratory (2) may be substituted for Chem 3301 (4), 3302 (4), 3305 (2), 3306 (2), Biol 5001 (4) and BioC 5025 (2) in category B.

MEAT SCIENCE AND TECHNOLOGY

For the student primarily interested in the technology of meat products. At least 20 credits must be selected to represent meat science, technology, marketing, and economics. Courses must include:

- FScN 5512—Meat Technology (5)
AgEc 3440—Livestock Marketing Economics (3)
Other courses may include:
AgEc 1400—Agricultural Markets and Prices (4)
AgEc 5480—Futures, Markets, and Prices (4)
AnSc 1120—Livestock and Meat Evaluation (4)
AnSc 3143—Meat: Judging and Grading (2)
LACS 5651—Veterinary Community Medicine (3)

MICROBIOLOGY

For the student interested in courses related to the microbiological aspects of the food processing industry. You must select about 20 credits of microbiology-oriented courses in biochemistry, microbiology, plant pathology, public health, and related departments. These usually include:

- MicB 5321—Physiology of Bacteria (3)

NUTRITION

For the student interested in courses related to the nutritional aspects of the food processing industry. At least 20 credits of nutrition-oriented courses must be completed in food science and nutrition, biochemistry, animal science, and related departments, and must include:

- Phsl 1002—Human Physiology (4)
or Phsl 3051—Human Physiology (5)

PUBLIC HEALTH

For the student interested in activities performed by the sanitarian in either government or industrial work related to the regulation and quality control of raw materials and finished products in the food field. At least 20 credits are to be selected from course offerings of the School of Public Health. See the *School of Public Health Bulletin* for course listings.

OTHER AREAS

The above areas of emphasis may not satisfy the needs and interests of every student. With the aid of your adviser, you may plan a course of study in another area of emphasis or in a combination of suggested areas.

Examples include advertising, journalism, sales, mechanical engineering, statistics, and experimental design. Some 3000- and 5000-level courses must be included. Each area must total at least 20 credits, have a logical focus, and serve to support and strengthen the Food Science and Technology major.

G. Electives to complete the 186 credits required for graduation with the bachelor of science degree.

Horticultural Science

Department of Horticultural Science and Landscape Architecture
305 Alderman Hall
612/624-5300

The horticultural science major offers the following areas of emphasis:

floriculture—production, improvement, and use of floral plants

food production—fruit and vegetable science

nursery and landscape management—economic, managerial, and scientific aspects of nursery stock production and landscape management

turf and landscape management—the science and practice of landscape management, commercial turf production, and maintenance

horticulture individualized specialization—for students with a strongly developed professional goal not served by the above areas of emphasis

Persons holding bachelor's degrees in horticulture work in fruit and vegetable production, floriculture, urban horticulture, turf management, landscape horticulture, and nursery management in state, city, and county agencies as well as in private industry.

Holders of the master's or doctor's degree qualify for challenging research, extension, and teaching positions in industry, government, and education. If you plan to pursue graduate study in horticultural science, you should complete additional work in mathematics and the basic sciences. Consult your adviser about selection of such coursework.

Major Requirements

All students in the horticultural science major must complete the requirements listed below. Consult with your adviser to determine a suitable sequence for completing the required courses. Course substitutions in categories A, B, C, and D may be made only with the approval of the College Office, and in categories E and F only with the approval of your adviser and the Department of Horticultural Science and Landscape Architecture.

A. Communication, Language, Symbolic Systems

See Agricultural Science and Industries Curriculum Requirements in preceding section.

B. Physical and Biological Sciences

BioC 1301—Elementary Biochemistry I (5)
 BioC 1302, 1303—Elementary Biochemistry II and Laboratory (3, 2)

Biol 1009—General Biology (5)

Biol 1103—General Botany (5)

Chem 1004, 1005—General Principles of Chemistry (10)

or Chem 1001—Chemical Principles and Covalent Systems (5)

Phys 1001, 1005—The Physical World and Laboratory (4, 1)

C. The Individual and Society—14 credits minimum

See All-College Requirements in preceding section.

One course required in the area of Development of Civilization.

AgEc 1020—Principles of Macroeconomics (5)

D. Literature, Humanities, and Fine Arts—8 credits minimum

See All-College Requirements in preceding section.

E. Supporting Courses

Ent 1005—Economic Entomology (4)

or Ent 5050—Forest Entomology (4)

PIPa 3001—Introductory Plant Pathology (6)

or PIPa 5050—Forest Pathology (4)

PIPH 3131—Survey of Plant Physiology (4)

Soil 1122—Introductory Soil Science (4)

F. Professional Courses in the Major—45 credits (including 25 at the 3000 level or above)

In addition to the horticulture courses listed below that are required of all students, you must complete one of the five areas of emphasis that follow:

REQUIRED OF ALL STUDENTS

Hort 1016—Greenhouse Management (4)

Hort 1036—Plant Propagation (4)

Hort 1099—Orientation to Horticulture (1)

or Hort 1100—Biology of Horticultural Production (4)

Hort 3099—Seminar (1)

Note: You must complete Hort 1016, 1036, 1099, and 1100 plus 50 credits in categories A, B, C, D, and E above before you begin taking horticulture courses at the 3000 level or above.

FLORICULTURE

AgEc 1250—Principles of Accounting (4)

Bot 3109—Plant Anatomy (5)

GCB 3022—Genetics (4)

Hort 1022—Herbaceous Plant Material (5)

Hort 3053—Ornamentals for Interior Design (4)

Hort 3081—Floral Design and Business (4)

Hort 3097—Horticulture Practicum (2-4)

or Hort 5000—Professional Experience Program (4)

Hort 5040—Plant Growth Regulation (4)

Hort 5052—Commercial Floriculture: Fall Crops (4)

Hort 5053—Commercial Floriculture: Winter Crops (4)

Hort 5054—Commercial Floriculture: Spring Crops (4)

Stat 1001—Introduction to Ideas of Statistics (4)

or Stat 3011—Statistical Analysis (4)

GC 1513—Principles of Small Business Operation (5)

Programs

FOOD PRODUCTION

- Agro 5020—Introduction to Plant Breeding (3)
- Agro 5030—Weed Control (5)
- GCB 3022—Genetics (4)
- Hort 3033—Postharvest Handling and Physiology of Horticultural Crops (3)
- Hort 3097—Horticulture Practicum (2-4)
- Hort 5040—Plant Growth Regulators (3)
- Hort 5091—Directed Studies (2-6)
- Stat 3011—Statistical Analysis (4)

At least four courses from:

- Hort 5032—Tree Fruit Production (4)
- Hort 5033—Small Fruit Production (3)
- Hort 5034—Commercial Vegetable Production I: Tuber, Root, and Bulb Crops (3)
- Hort 5035—Commercial Vegetable Production II: Fruit, Seed, and Leafy Crops (3)
- Hort 5037—Systematics and Utilization of Vegetable Crops Germ Plasm (3)

Plus an additional 10-14 credits of horticulture electives to include 3 credits at the 3000 level.

NURSERY AND LANDSCAPE MANAGEMENT

- Hort 1021—Woody Plant Materials (5)
- Hort 1022—Herbaceous Plant Materials (5)
- Hort 3030—Landscape Design of Residential and Small Commercial Sites (4)
- Hort 3072—Turf Management (4)
- Hort 5000—Professional Experience Program (4)
- Hort 5026—Landscape Management (5)
- Hort 5046—Nursery Management I (4)
- Hort 5047—Nursery Scheduling and Enterprise Development (2)
- Hort 5048—Nursery Management II (4)

- Soil 3416—Soil Fertility (5)
or Soil 3210—Physical Soil Management and Tillage (4)
- LA 1025—Basic Visualization (4)
or Ind 1600—Drafting (3)
or LA 3094—Landscape Architecture Graphics (4) (extension only)

- GC 1513—Principles: Small Business Operations (5)

- AgEcon 1030—Principles of Macroeconomics (5)

12 business enrichment¹ credits from:

- Acct 1024, 1025—Principle of Finance Accounting I (6)
or AgEc 1250—Principles of Accounting (5)
- Acct 3001—Managerial Accounting (5)
- Mktg 3000—Principles of Marketing (4)
- AgEc 3102—Microeconomic Theory (4)
- AgEc 3820—Farm Management Economics (4)
- AgEc 5400—Intermediate Market and Price Analysis (4)
- BFIn 3000—Financial Fundamentals (4)
or AgEc 3500—Farm and Agribusiness Finance
- BLaw 3058—Introduction to Law and Law of Contracts and Agency (4)
- GC 1571—Introduction to Basic Programming and Microcomputers (5)
or MIS 3300—Introduction to Computers (4)
- Ins 3100—Risk Management and Insurance (4)
- IR 3002—Industrial Relations Systems; Labor Market, the Management of Human Resources (4)
or GC 3560—Personnel Administration (4)

- Jour 3201—Principles of Advertising (4)
- Mgmt 3001—Fundamentals of Management (4)
or AgEc 3101—Microeconomic Theory (4)
- Mgmt 3004—Business Policy: Strategy Formulation and Implementation (5)
or AgEc 3290—Agribusiness Management (4)
- Mktg 3000—Principles of Marketing (4)
or Mktg 3010—Buyer Behavior, Marketing Analysis (4)

- OM 3000—Introduction to Operations Management (4)

- DSci 1050—Elementary Managerial Statistics (4)
or Stat 1051—Introduction to Ideas of Statistics (4)

- DSci 3055—Introduction to Management Science (4)

One course from:

- AgEc 5020—Applied Linear Programming (4)
- AgET 3030—Introduction to Problem Solving with Computers (4)
- Biol 1106—General Zoology (5)
- Biol 3041—Ecology (4)
- Biol 5041—Ecology (4)
- Bot 3109—Plant Anatomy (5)
- Chem 1006—Principles of Solution Chemistry (4)
- DSci 3050—Statistical Methods for Managerial Decision Making (4)
- EBB 3001—Introduction to Ecology (4)
- GCB 3022—Genetics (4)
- Geo 1001, 1021—Physical Geology and Laboratory (4, 1)
- MicB 3103—General Microbiology (5)

TURF AND LANDSCAPE MANAGEMENT

- AgEc 1250—Principles of Accounting (5)
- Agro 5030—Weed Control (5)
- Hort 1021—Woody Plant Materials (5)
- Hort 1022—Herbaceous Plant Materials (5)
- Hort 3072—Turf Management (4)
- Hort 5026—Landscape Management (5)
- Hort 5042—Turf Grass Science (5)
- Hort 3097—Hort Practicum (2-4)
or Hort 5091—Directed Studies (2-4)
or Hort 5000—PEP (4)

- Soil 3416—Soil Fertility (5)

8 credits from:

- Hort 5042x—Turf Grass Science (continued) (2)
- Hort 5032—Tree Fruit Production (4)
or Hort 5034—Vegetable Production I (3)
or Hort 5035—Vegetable Production II (3)
- Hort 5046, 5047, 5048—Nursery Management (10)
- Hort 3030—Landscape Design and a graphics course (8)
- L.A. 3071x—Landscape Technology (2)
- Soil 3210—Soil Physical Properties (4)

One of the following:

- AgEc 5020—Applied Linear Programming (4)
- Bot 3109—Plant Anatomy (5)
- GCB 3022—Genetics (4)
- Geo 1001, 1021—Physical Geology and Laboratory (4, 1)

¹Must have 72 credits to register for most of these courses; AgEc minor may substitute for business enrichment

MicB 3103—General Microbiology (5) (extension registration only, fall)
or VPB 3103—General Microbiology (5)

HORTICULTURE INDIVIDUALIZED SPECIALIZATION

Bot 3201—Taxonomy
80 Focus credits with document explaining it and justifying course content
35 Group B credits

G. Electives to complete the 192 credits required for graduation with the bachelor of science degree.

Minor Requirements

This minor enables you to develop your horticultural knowledge, skills, and attitudes to a preprofessional level. The program has the rigor but not the length of a major in horticultural science. It prepares you for a richer personal life, nonprofessional job entry, and subsequent formal or informal studies in horticulture. The program includes a minimum of 25 credits in horticulture plus required supporting courses.

Required Supporting Courses

Chem 1001—Chemical Principles and Covalent Systems (5)
or Chem 1004—General Principles of Chemistry (5)

Soil 1122—Introductory Soil Science (4)

Biol 1009—General Biology (5)

Biol 1103—General Botany (5)

Required Courses

Hort 1016—Greenhouse Management (4)

Hort 1036—Plant Propagation (4)

Hort 1100—Biology of Horticultural Production (4)

Optional Courses

Hort electives to bring total to 25 credits (one related area course may be used to meet this requirement). You may apply a maximum of 4 credits in special problems or independent study.

Integrated Pest Management

Department of Plant Pathology
495 Borlaug Hall
612/625-8200

The Integrated Pest Management (IPM) curriculum prepares students for employment in occupations dealing with plant damage problems caused by diseases, insects, and weeds on all economically important plants. Students learn how to identify plant pests and to understand how the environment affects pest populations in order to select and apply the most

comprehensive, cost-effective, and environmentally safe pest management strategies. Solid grounding in basic biological and physical sciences is necessary background for studying pest biology and the culture of agronomic or horticultural plants. As an IPM major, you will learn to effectively integrate cultural, chemical, genetic and biological plant pest control strategies into plant production management systems.

IPM graduates have employment opportunities with private crop consulting companies, the agrichemical industry, seed companies, state and federal plant pest regulatory agencies, and a variety of other public and private firms. Students with an interest in graduate studies should work closely with their adviser to ensure that appropriate background courses in science and mathematics are taken.

Major Requirements

Students majoring in Integrated Pest Management must complete the requirements listed below. Course substitutions in categories A, B, C, and D may be made only with the approval of the College Office, and in categories E, F, and G only with the approval of your adviser and Department of Plant Pathology.

A. Communication, Language, Symbolic Systems

See Agricultural Science and Industries Curriculum Requirements in preceding section.

B. Physical and Biological Sciences

See Agricultural Science and Industries Curriculum Requirements in preceding section.

AgET 3030—Introduction to Problem Solving with Computers (4)

C. The Individual and Society—14 credits minimum

See All-College Requirements in preceding section.

One course required in the area of Development of Civilization.

AgEc 1030—Principles of Microeconomics (5)

D. Literature, Humanities, and Fine Arts—8 credits minimum

See All-College Requirements in preceding section.

E. Professional Courses in the Major

Agro 1100—Morphology and Identification of Crops & Weeds (4)

Programs

Agro 5030—Weed Control (5)
BLaw 3058—Introduction to Law & the Law of Contracts & Agency (4)
Ent 1005—Economic Entomology (4)
Ent 5210—Integrated Insect Management (5)
PIPa 3001—Introductory Plant Pathology (6)
PIPa 5500—Disease Epidemiology and Management (4)

PIPa 5700—Plant Disease Control (4)
PIPh 3131—Survey of Plant Physiology (4)
Soil 1122—Introductory Soil Science (4)
Soil 5340—Organic and Pesticide Residue (5)
Stat 3081—Experimental Techniques and Statistical Inference (5)

Summer Internship (4)—consult adviser

F. Crop Specialization—choose either specialization in agronomy or horticulture.

AGRONOMY

Two courses from:

- Agro 3010—Adaptation, Distribution, and Production of Field Crops (4)
- Agro 3020—Growth, Development, and Culture of Field Crops (5)
- Agro 3030—Maturation, Harvest, and Storage of Field Crops (4)

One course from:

- Agro 5040—Corn and Soybean Management (3)
- Agro 5060—Small Grains, Sunflower, and Sugar-beet Management (3)

HORTICULTURE

Hort 1036—Plant Propagation
Hort 1100—Biology of Horticultural Production

One course from:

- Hort 1016—Greenhouse Management (4)
- Hort 5032—Tree Fruit Production (4)
- Hort 5033—Small Fruit Production (3)
- Hort 5034—Commercial Vegetable Production: Tuber, Root, and Bulb Crops (3)
- Hort 5035—Commercial Vegetable Production: Fruit, Seed, and Leafy Crops (3)
- Hort 5042—Turf Grass Science (5)

G. Pest Specialization—Select one area of specialization and complete the elective and required courses:

ENTOMOLOGY

One course from:

- Ent 5020—Insect Taxonomy (5)
- Ent 5040—Insect Ecology (3)

One course from:

- Ent 5220—Stored Product Pest Management (4)
- Ent 5250—Forest Entomology (4)
- Ent 5280—Livestock Entomology (3)

PLANT PATHOLOGY

PIPa 5105—Introduction to the Study of Fungi (4)

Two courses from:

- PIPa 5005—Viruses and Bacteria in Plant Disease (4)
- PIPa 5006—Fungi, Algae, and Parasitic Seed Plants in Plant Disease (4)
- PIPa 5007—Air Pollution and Other Abiotic Causes of Plant Disease (3)
- PIPa 5008—Introduction to Plant Nematology (2)

SOIL SCIENCE, WEED SCIENCE

Soil 3416—Soil Fertility (5)
Soil 3610—Soil Biology (4)

H. Electives to complete the 192 credits required for graduation with the bachelor of science degree

Landscape Architecture

Landscape Architecture Program
205 North Hall, 2005 Buford Avenue
612/625-8285

Landscape architecture is concerned with the impact, disposition, and management of natural resources as well as the quality of experience that results from the development of land for specific human use.

The landscape architect is concerned with a wide range of projects: large-scale regional landscape planning; design of exterior environments for working, living, and recreation; commercial, institutional, and industrial development; transportation systems; and multiple-use areas. Projects may vary in scale from single-family residences to regional open space systems. Professional services include land use feasibility studies, site selection studies, site layout proposals, detail grading, construction drawings, and planting plans.

Regional resource planning and design, recreation planning and design, urban landscape design, and detail site planning projects involve landscape architects, architects, planners, engineers, geographers, physical scientists, social scientists, and others. The relationship between regional or single site qualities of terrain, soil, climate, vegetation, orientation, visual quality, and the program for development are studied carefully to assure sound recommendation.

Bachelor of Landscape Architecture (BLA) Program—This five-year program, offered jointly by the College of Agriculture and the Institute of Technology, emphasizes the design process. It is designed to provide the basic professional training for the practice of landscape architecture and to allow for exploration of one or more areas of professional interest. It leads to the professional bachelor of landscape architecture degree.

A total of 230 credits are required for graduation, 130 of them in 3000- and 5000-level courses. This more advanced work includes a design sequence that takes a minimum of three years. Students, through consultation with their advisers, select specialized areas of interest in which to concentrate their studies. These areas include site planning, focusing on developing small-scale land areas for intensive human use; regional design, focusing on organizing large-scale land areas and analyzing their development potential in terms of land use; urban design, focusing on the organization of urban environments and systems; and recreational design, focusing on either broad or site aspects of recreational land use. Other areas of interest may be developed.

It is recommended that you complete a minimum of 800 hours of work experience outside of classwork. At least 400 of these hours should be spent in landscape construction or in a landscape nursery and 400 hours in the office of a professional landscape architect.

Bachelor of Landscape Architecture B.L.A./M.L.A. Combined Degree Program—This alternative program is available for students with previous baccalaureate degrees who wish to undertake professional degree studies in landscape architecture. The program is jointly offered by the College of Agriculture and the Graduate School. It is designed to provide the basic professional training for the practice of landscape architecture and an opportunity for research into a specialized area of the field.

Specific requirements for this degree are defined in the *Graduate School Bulletin*.

Bachelor of Environmental Design (B.E.D.) Program—This nonprofessional program is offered only through the Institute of Technology. It is designed to allow you to explore a broad range of environmental courses as well as complete two years of professional courses in landscape architecture. Upon completion of the

B.E.D. degree requirements, you may continue on for the professional B.L.A. degree, enter a professional master's degree program, or transfer to another discipline such as city design, city and regional planning, or an area of the social or natural sciences.

A total of 192 credits are required for the B.E.D. degree. It is recommended that you also complete 400 hours of summer work in landscape architecture. Individualized study programs may be arranged with approval of the faculty.

In the B.L.A. and B.E.D. degree programs, you must pass required core courses in the curriculum with a minimum grade of C. These courses are LA 1025, 1026, 3071, 3072, 3101, 5117, 5119, 5226, 5261, 5265; Hort 1021, 1022; and all design courses.

Admission procedures and major requirements for the bachelor of landscape architecture program are detailed below. For information about the bachelor of environmental design program, see the *Institute of Technology Bulletin*.

Admission Procedures—To enter the landscape architecture program you must submit an application by April 1 of the year in which you wish to begin. Admission to the program is permitted only in the fall quarter unless advanced standing is granted. For further information regarding procedures and requirements, contact the departmental office, 205 North Hall, or call 625-8285.

Applicants will be notified by letter of the admission decision by May 15. Those admitted must notify the landscape architecture program chair of their intention to attend by July 1, or their places will be forfeited. Those not accepting the opportunity must reapply if they wish to enter the program at a later date.

Major Requirements

You must complete a minimum of 75 out of 100 credits of the pre-landscape architecture requirements in categories A through E before applying for admission to the landscape architecture program.

Programs

A. Communication, Language, Symbolic Systems

- Rhet 1101—Writing to Inform and Persuade (4)
 - Rhet 1104—Library Research Methods (1 cr)
 - Rhet 1151—Writing in Your Major (4)
 - Rhet 1222—Public Speaking (4)
 - Rhet 3562—Writing in Your Profession (4)
 - Math 1111—College Algebra and Analytical Geometry (5)
- One additional college-level course in mathematics, statistics, or computer science (3)

B. Physical and Biological Sciences—18 credits minimum

These credits are to be selected from courses in such areas as botany, biology, chemistry, geology, natural sciences, and physics. See your adviser if you have questions about selecting coursework.

C. The Individual and Society—16 credits minimum

See All-College Requirements in preceding section.
One course required in the area of Development of Civilization.

D. Literature, Humanities, and Fine Arts—8 credits minimum

See All-College Requirements in preceding section.

E. Professional and Supporting Courses in the Major

- 4 credits in land measurement from:
- Geog 3551—Introduction to Remote Sensing (5)
or Geog 3551—Introduction to Cartography (5)
or FR 5200—Aerial Photo Interpretation (3)
or FR 5262—Remote Sensing of Natural Resources (4)
or CE 3100—Introduction to Surveying and Mapping (4)

LA 1022—History of Environmental Development: Landscape Architecture (4)

Soil 1122—Introductory Soil Science (4)
12 credits in studio arts

- One course from:
- LA 1021—History of Environmental Development: Architecture (4)
 - LA 1023—History of Environmental Development: Planning (4)
 - Arch 5056—Modern Architecture (4)

- Two courses from:
- LA 1001—Design Your Environment (2)
 - LA 1024—Landscape Theory (4)
 - LA 1031—Introduction to Landscape Architecture (4)
 - LA 3001—Environmental Design: Man and Environment (4)
 - LA 3002—Environmental Design: Tools and Processes (4)

F. Professional Courses in the Major

- Hort 1021—Woody Plant Materials (5)
- Hort 1022—Herbaceous Plant Materials (5)
- LA 1025—Basic Visualization I (4)
- LA 1026—Basic Visualization II (4)

- LA 3071—Landscape Technology: Ground Form Design (4)
 - LA 3072—Landscape Technology: Circulation and Utilities Design (4)
 - LA 3081—Basic Design (6)
 - LA 3082—Basic Design (6)
 - LA 3083—Basic Design (6)
 - LA 3091—Intermediate Design (6)
 - LA 3092—Intermediate Design (6)
 - LA 3093—Detail Site Design (6)
 - LA 3101—Communicating Landscape Quality (4)
 - LA 5110—Advanced Landscape Planning and Design (6)
 - LA 5117—Planting Design: Aesthetic and Functional Criteria (4)
 - LA 5119—Planting Design: Ecological Principles/Land Use Concepts (4)
 - LA 5224—Contemporary Issues in Landscape Architecture (4)
 - LA 5226—Professional Practice (4)
 - LA 5265—History of Landscape Architecture: Individual Influences (4)
- One course from:
- LA 3075—Landscape Technology: Materials and Construction Design (4)
 - LA 5073—Landscape Technology: Land Analysis Techniques (4)
 - LA 5225—Landscape Technology: Working Drawings and Specifications (4)
- Two courses from:
- LA 5101—Site Planning and Design (6)
 - LA 5103—Urban Landscape Design (6)
 - LA 5105—Recreational Planning and Design (6)
 - LA 5107—Regional Landscape Design (6)

G. Electives supporting the professional degree to complete the 230 credits required for graduation with the bachelor of landscape architecture degree.

Master of Agriculture

*College of Agriculture
277 Coffey Hall
612/624-3009*

The master of agriculture (M.Ag.) is an advanced professional degree, administered by the College of Agriculture, emphasizing competence in the application of knowledge and management of science and technology or technical communications. This application and management thrust contrasts with the research orientation of the master of science degree, administered by the Graduate School. The master of agriculture instructional program is at the graduate level but is not part of the Graduate School. Advanced professional competence in principles and applications of scientific technology and management are developed through an

individual program of study in a field or combination of fields in agricultural and related sciences. The professional M. Ag. degree is usually considered terminal; students planning eventual Ph.D. study should pursue master of science (M.S.) training.

Degree Requirements—Majors are offered in most departments in the College of Agriculture. Consult the College Office (277 Coffey Hall) or the brochure "The Master of Agriculture" for current offerings.

As part of the 45-credit minimum requirement, at least 18 credits (A/F) in the major and 9 credits (A/F) in a related field are required. All courses must be taken at the graduate level. The related field must consist of credits earned in a single discipline or in closely allied disciplines outside the major. Students must also complete a communications skills course, an "integrating paper," and a final oral exam that includes a seminar presentation.

Up to 18 quarter transfer credits of B or better taken before admission may be used in partial fulfillment of the program requirement. Transferred courses must be at the graduate level and must have been completed within three years of admission.

For an application and more information, contact the College of Agriculture, 277 Coffey Hall, 1420 Eckles Avenue, St. Paul, MN 55108 (612/624-3009).

Nutrition and Dietetics

*Department of Food Science and Nutrition
225 Food Science and Nutrition
612/624-1290*

This program is intended for those interested in the field of nutrition and its various applications in dietetics, public health, and nutrition science. The options offered in dietetics and community nutrition meet the requirements of the American Dietetic Association for membership and for internship. Students completing either option and a 6- to 12-month hospital or public health internship may seek

employment in hospitals or community agencies.

The nutrition science option is planned for those interested in graduate study in this area. Students in this option should maintain a minimum grade point average of 2.80. Employment possibilities for persons holding graduate degrees in nutrition science include college and university teaching and university and industrial research.

You must complete the organic chemistry sequence by the end of your sophomore year in order to have the prerequisites to enter courses normally scheduled in the junior year, or you may be delayed in completing the program. Transfer students who have completed organic chemistry or biochemistry courses that are not as extensive as those listed below are required to take additional courses in both fields.

The American Dietetic Association has accredited a coordinated program in dietetics at the University. With the cooperation of Twin Cities area hospitals, this program enables qualified students to integrate an internship experience with the final two years of undergraduate study. Upon completing the program students are assured membership in the American Dietetic Association. Enrollment is limited, and interested students should apply to the program director early in their sophomore year.

This program is open to students registered in either the College of Agriculture or the College of Home Economics. Faculty advisers are normally from the Department of Food Science and Nutrition, which is jointly administered by the two colleges.

Major Requirements

Students selecting the nutrition and dietetics major must complete the requirements listed below. Course substitutions in categories A, B, C, and D may be made only with the approval of the College Office, and in categories E and F with the recommendation of your adviser and the

Programs

approval of the Department of Food Science and Nutrition.

A. Communication, Language, Symbolic Systems

- Math 1111—College Algebra and Analytical Geometry (5)
Rhet 1101—Writing to Inform and Persuade (or equivalent course) (4)
Rhet 1104—Library Research Methods (1)
Rhet 1151—Writing in Your Major (4)
Rhet 1222—Public Speaking (4)
Rhet 3562—Writing in Your Profession (4)

B. Physical and Biological Sciences

- Anat 3001—Elementary Anatomy (4)
BioC 5025—Laboratory in Biochemistry (2)
Biol 1009—General Biology (5)
Biol 5001—Biochemistry (4)
Chem 1004—General Principles of Chemistry (5)
Chem 1005—General Principles of Chemistry (5)
Chem 3301, 3305—Elementary Organic Chemistry and Laboratory (4, 2)
Chem 3302, 3306—Elementary Organic Chemistry and Laboratory (4, 2)
VPB 3103—General Microbiology (5)
or MicB 5105—Biology of Microorganisms (5)
Phsl 3051—Human Physiology (5)
or Phsl 1002—Human Physiology (4)

C. The Individual and Society

- See All-College Requirements in preceding section.
One course required in the area of Development of Civilization.
AgEc 1020—Principles of Macroeconomics (5)
or Econ 1001—Principles of Macroeconomics (4)
AgEc 1030—Principles of Microeconomics (4)
or Econ 1002—Principles of Microeconomics (4)
Psy 1001—General Psychology (5)
Soc 1001—Introduction to Sociology (4)

D. Literature, Humanities, and Fine Arts—9 credits minimum

See All-College Requirements in preceding section.

E. Professional Courses in the Major

- FScN 3110—Food Chemistry (4)
FScN 3112—Food Chemistry Laboratory (2)
FScN 3272—Introduction to Food Decision Making (2)
FScN 3403—Experimental Foods (4)
FScN 3472—Principles of Food Purchasing (4)
FScN 3600—Principles of Nutrition (4)
FScN 3622—Life Cycle and Community Nutrition (4)
FScN 3730—Quantity Food Production Management (5)
FScN 5100—General Seminar (1)
FScN 5622—Macro Nutrient Metabolism (5)
FScN 5623—Vitamin and Mineral Biochemistry (4)
FScN 5665, 5675—Applied Clinical Nutrition and Laboratory I (2, 1)
FScN 5666, 5676—Applied Clinical Nutrition and Laboratory II (2, 1)
FScN 5667—Applied Clinical Nutrition III (2)

FScN 5750—Principles of Foodservice Management (4)

LaMP 5177—Pathology for Allied Health Students (4)
Mgmt 3001—Fundamentals of Management (4)

4 or 5 additional credits in sociology or anthropology
3 credits in psychology of learning from:

- HSU 5011—Instructional Skills for Health Professionals: The Teaching-Learning Process (3)
EPsy 5114—Psychology of Student Learning (3)
EPsy 5115—Adult Learning, Educational Practice (3)

3-5 credits in statistics or computer usage from:

- EPsy 5260—Introductory Statistical Methods (4)
PubH 5404—Introduction to Biostatistics and Statistical Decision (4)
Soc 3801—Sociological Methods I: Descriptive Statistics (5)
Stat 1001—Introduction to Ideas of Statistics (4)
Stat 3091—Introduction to Probability and Statistics (4)
Stat 5021—Statistical Analysis (5)

F. Area of Emphasis

In addition to the above requirements, you must complete one of the five following areas of emphasis.

CLINICAL DIETETICS AND GENERAL DIETETICS

The requirements for these options are met by the general program listed in categories A through E above and meet The American Dietetic Association requirements for these specializations.

COMMUNITY NUTRITION

If you want to add the community specialization of The American Dietetic Association, you should add 6 credits of approved coursework chosen in consultation with your adviser.

COORDINATED PROGRAM IN DIETETICS

The basic curriculum is similar to that specified in categories A through E above. However, it also includes field experience courses in which didactic and clinical phases of instruction are coordinated. A detailed plan of the coordinated program may be obtained from the Department of Food Science and Nutrition.

NUTRITION SCIENCE

If you want a nutrition science emphasis or are considering graduate study, you may, with the approval of your adviser, substitute up to 28 credits from the courses listed below for an equivalent number of credits from the major requirements. Courses cannot be substituted for FScN 5622 or 5623. This option is intended primarily to provide preparation for graduate studies and does *not* meet The American Dietetic Association requirements for internship.

- BioC 5744—Biochemical Laboratory (4)
BioC 5751—General Biochemistry (4)
BioC 5752—General Biochemistry (4)
Chem 1006—Principles of Solution Chemistry (4)
Chem 3100—Quantitative Analysis Lecture (3)
Chem 3303—Elementary Organic Chemistry III (4)
Chem 5520—Elementary Physical Chemistry (3)
Chem 5521—Elementary Physical Chemistry (3)

Math 1142—Short Calculus (5)
 or Math 1201—Pre-Calculus (5)
 Math 1211—Calculus I (5)
 Math 1221—Calculus II (5)
 10-15 credits of college physics

G. Electives to complete the 185 credits required for graduation with the bachelor of science degree.

Resource and Community Development Curriculum

The resource and community development curriculum prepares students for careers in resource development, community development, public land use, rural and urban zoning, conservation, recreation, resource economics and sociology, environmental design, landscape architecture, and related areas.

Students completing majors in the program can seek positions with federal, state, county, and local planning, administrative, and management agencies as well as with private landscape architecture, planning, banking, recreation, and research organizations. The training offered by the different majors also prepares students for continued study at the graduate level.

Resource and community development is an interdisciplinary curriculum designed to focus the complementary disciplines of agriculture and forestry on planning and administrative training. It relates the traditional specialties of applied resource development and management as well as the social and economic specialties to expanding contemporary needs. In addition to studies in a selected specialty, students acquire a broad background in supporting areas.

The individual majors associated with the resource and community development curriculum include the following (see the appropriate heading earlier in this section, or consult the administering unit listed in parentheses for more information):

Economics of Public Resource Management (Department of Agricultural and Applied Economics)

Landscape Architecture (Department of Horticultural Science and Landscape Architecture)

Recreation Resource Management (College of Forestry)

Soil and Water Resource Management (Department of Agricultural Engineering and Department of Soil Science)

Soil Science

Department of Soil Science
 439 Borlaug
 612/625-1244

Soil science is concerned with the management of the soil resource so that it will continue to provide the necessary environment for the production of food, fiber, and forest. This involves water resource management, climatology, soil conservation, soil fertility, soil biology, soil classification, and many other aspects of soil science.

As a graduate from the department, you may be employed as a soil and water specialist, soil surveyor, fertilizer and farm chemical company representative, farm manager, land appraiser, conservationist, environmental quality specialist, or specialist in rural, urban, and recreational planning.

If you plan to continue your studies for a master's or doctor's degree in preparation for teaching, research, or extension at the college level, you should select the science option.

Major Requirements

Students in the Soil Science Department have three options for specialization: *soil science—agronomy option*; *soil science—science option*; and the *soil and water resource management* major in the resource and community development program.

Students selecting options in soil science must complete the requirements listed below. Course substitutions in categories A, B, C, and D may be made only with the approval of the College Office, and in categories E and F only with the approval of your adviser and the Department of Soil Science.

Programs

Soil Science—Agronomy Option

A. Communication, Language, Symbolic Systems

See Agricultural Science and Industries Curriculum Requirements in preceding section.

Math 1111—College Algebra and Analytical Geometry (5)

or Math 1142—Short Calculus (5)

B. Physical and Biological Sciences

Chem 1004—General Principles of Chemistry (5)

Chem 1005—General Principles of Chemistry (5)

BioC 1301—Elementary Biochemistry (5)

or Chem 3301, 3305—Elementary Organic Chemistry and Laboratory (4, 2)

BioC 1302, 1303—Elementary Biochemistry and Laboratory (3, 2)

or Chem 3302—Elementary Organic Chemistry (4)

Biol 1009—General Biology (5)

Biol 1103—General Botany (5)

Phys 1041, 1045—Introductory Physics and Laboratory (4, 1)

Geo 1001—Introduction to Geology (4)

and Geo 1021—Physical Geology Lab: Geology of Minnesota (1)

or Geo 1111—Introductory Physical Geology (5)

Select one (1) additional course from:

Chem 3100, 3101—Quantitative Analysis Lecture and Laboratory (3, 2)

Phys 1042, 1046—Introductory Physics and Laboratory (4, 1)

Any Mathematics course that requires Math 1111 as a prerequisite.

EBB 3001—Introduction to Ecology (4)

Biol 1106—General Zoology (5)

Bot 3109—Plant Anatomy (5)

C. The Individual and Society—14 credits minimum

See All-College Requirements in preceding section.
One course required in the area of Development of Civilization.

AgEc 1020—Principles of Macroeconomics (5)

AgEc 1030—Principles of Microeconomics (4)

D. Literature, Humanities, and Fine Arts—8 credits minimum

See All-College Requirements in preceding section.

E. Supporting Courses

Ent 1005—Economic Entomology (4)

PIPa 3001—Introductory Plant Pathology: Lecture, Laboratory, and Introduction to Diagnosis (6)

AgEc 3810—Principles of Farm Management (4)

PIPh 3131—Survey of Plant Physiology (4)

Select 4 courses from the following:

GCB 3022—Genetics (4)

AgET 1215—Farm Machinery (2) (required for students without farm machinery experience)

or AgET 3520—Farm Machinery Management (3)

AgET 5410—Hydrology and Water Control (5)

AgET 5400—Drainage and Irrigation (4)

AnSc 1100—Introductory Animal Science (5)

AnSc 3401—Principles of Animal Nutrition (3)

Agro 5020—Introduction to Plant Breeding (4)

Agro 5010—Forage Production and Utilization (4)

F. Professional Courses

AGRONOMY

Agro 1100—Morphology and Identification of Crops and Weeds (4)

Agro 3010—Adaptation, Distribution, and Ecology of Field Crops (4)

Agro 3020—Growth, Development, and Culture of Field Crops (5)

Agro 3030—Maturation, Harvest, and Storage of Field Crops (4)

Agro 3060—Field Plot Design in Agronomy (3)

Agro 5030—Weed Control (5)

Agro 5040—Corn and Soybean Management (3)

or Agro 5060—Small Grains, Sunflower, and Sugar Beet Management (3)

SOILS

Soil 1122—Introductory Soil Science (4)

Soil 1262—Introduction to Meteorology (4)

Soil 3220—Soil Conservation and Land Use Management (4)

Soil 3520—Soil Morphology, Classification, and Genesis (4)

Soil 3416—Soil Fertility (5)

2 courses from:

Soil 3210—Physical Soil Management and Tillage (4)

Soil 5340—Organic and Pesticidal Residues (5)

Soil 5610—Soil Biology (4)

JOINT OFFERINGS

Soil 1001—Orientation to Soil Science (1)

or Agro 1001—Orientation to Agronomy (1)

Soil 3918—Senior Seminar (1)

or Agro 3918—Senior Seminar (1)

G. Electives to complete the 192 credits required for graduation with the Bachelor of Science degree.

Soil Science—Science Option

A. Communication, Language, Symbolic Systems

See Agricultural Science and Industries Curriculum Requirements in preceding section.

Math 1142—Short Calculus (5)

B. Physical and Biological Sciences

Chem 1004—General Principles of Chemistry (5)

Chem 1005—General Principles of Chemistry (5)

Chem 1006—Principles of Solution Chemistry (4)

BioC 1301—Elementary Biochemistry (5)

or Chem 3301, 3305—Elementary Organic Chemistry and Laboratory (4, 2)

Biol 1009—General Biology (5)

Biol 1103—General Botany (5)

Phys 1041, 1045—Introductory Physics and Laboratory (4, 1)

Phys 1042, 1046—Introductory Physics and Laboratory (4, 1)

Geo 1001—Introduction to Geology (4)

and Geo 1021—Physical Geology Lab: Geology of Minnesota (1)

or Geo 1111—Introductory Physical Geology (5)

Chem 3100, 3101—Quantitative Analysis Lecture and Laboratory (3, 2)
 MicB 3103—General Microbiology (5) (extension registration only, fall)
 or VPB 3103—General Microbiology (5)

C. Individual and Society—14 credits minimum

See All-College Requirements in preceding section.
 One course required in the area of Development of Civilization.

AgEc 1020—Principles of Macroeconomics (5)

D. Literature and Humanities—8 credits minimum

See All-College Requirements in preceding section.

E. Supporting Courses

WATER RESOURCE—minimum of 2 courses with adviser's approval

- AgET 5400—Drainage, Irrigation (4)
- AgET 5410—Hydrology, Water Control (4)
- CE 5401—Water Resources Engineering (4)
- CE 5420—Introduction to Water Resource Management (4)
- FR 5114—Forest Hydrology (3)
- Geo 5611—Groundwater Geology (4)

PLANT SCIENCES—minimum of 3 courses with 2 from agronomy or horticulture with adviser's approval

ANIMAL SCIENCE—minimum of 2 courses with adviser's approval

- AnSc 1100—Introductory Animal Science (5)
- AnSc 3401—Principles of Animal Nutrition (3)
- Biol 1106—General Zoology (5)
- Ent 1005—Economic Entomology (4)
- FW 3052—Introduction to Fisheries and Wildlife Biology and Management (4)

COMPUTER SCIENCE—4 credits minimum

- CSci 3101—A FORTRAN Introduction to Computer Programming (4)
- AgET 3030—Introduction to Problem Solving with Computers (4)

F. Professional Courses in the Major—24 credits minimum

- Soil 1001—Orientation to Soil Science (1)
- Soil 1122—Introductory Soil Science (4)
- Soil 1262—Introduction to Meteorology (4)
 or Soil 5240—Microclimatology (3 or 4)
- Soil 3210—Physical Soil Management and Tillage (4)
- Soil 3220—Soil Conservation and Land Use Management (4)
- Soil 3416—Soil Fertility (5)
- Soil 3520—Soil Morphology, Classification, and Genesis (4)
- Soil 3918—Senior Seminar (1)
- Soil 5610—Soil Biology (4)

G. Electives to complete the 192 credits required for graduation with the bachelor of science degree.

Minor Requirements

Two options are available to students who

wish to complete a minor in soil science. Both require a minimum of 26 credits.

Option A

- Geo 1001, 1021—Physical Geology and Laboratory (4,1)
- Soil 1122—Introductory Soil Science (4)
- Soil 3210—Physical Soil Management and Tillage (4)
- Soil 3220—Soil Conservation and Land Use Management (3)
- Soil 3416—Soil Fertility (5)
- Soil 3520—Soil Morphology, Classification, and Genesis (4)
- Soil 5610—Soil Biology (4)

Option B

- Geo 1001, 1021—Physical Geology and Laboratory (4,1)
 - Soil 1122—Introductory Soil Science (4)
- Five courses from:
- Soil 3210—Physical Soil Management and Tillage (4)
 - Soil 3220—Soil Conservation and Land Use (4)
 - Soil 3416—Soil Fertility (5)
 - Soil 3520—Soil Morphology, Classification, and Genesis (4)
 - Soil 5610—Soil Biology (4)
 - Soil 3xxx or 5xxx (excluding seminars)

Soil and Water Resource Management

Department of Soil Science
 439 Borlaug
 612/625-1244

Department of Agricultural Engineering
 213 Agricultural Engineering
 612/625-7733

The objective of the soil and water resource management curriculum is to provide an interdisciplinary program of basic physical, biological, and social science studies combined with studies in resource and community development, agricultural engineering, and soil and water science. As a student in the program, you may have an adviser in either the Department of Soil Science or the Department of Agricultural Engineering.

As a graduate of this program you will be prepared for careers in the management and use of soil and water resources. Employment opportunities exist for soil and water specialists in rural, urban, and recreational planning, conservation, land appraisal, pollution control and other fields involving the interpretation and use of soil and water information.

Programs

Major Requirements

Students majoring in soil and water resource management must complete all requirements listed in categories A, B, C, D, and E. Course substitutions in categories A, B, C, and D may be made only with the approval of the College Office. Course selection and substitutions in categories E and F can be made only with the approval of your adviser.

A. Communication, Language, Symbolic Systems

- Math 1111—College Algebra and Analytical Geometry (5)
- Math 1142—Short Calculus (5)
- Rhet 1101—Writing to Inform and Persuade (4)
- Rhet 1104—Library Research Methods (1)
- Rhet 1151—Writing in Your Major (4)
- Rhet 1222—Public Speaking (4)
- Rhet 3562—Writing in Your Profession (4)

B. Physical and Biological Sciences

- Biol 1009—General Biology (5)
- Biol 1103—General Botany (5)
- Chem 1004—General Principles of Chemistry (5)
- Chem 1005—General Principles of Chemistry (5)
- EBB 3001—Introduction to Ecology (4)
or EBB 3101—Ecology for Engineers and Physical Scientists (4)
- Geo 1111—Introductory Physical Geology (5)
- Phys 1041, 1045—Introductory Physics and Laboratory (4, 1)
- Phys 1042, 1046—Introductory Physics and Laboratory (4, 1)
- Soil 1122—Introductory Soil Science (4)

C. The Individual and Society

- See All-College Requirements in preceding section.
One course required in the area of Development of Civilization.
- AgEc 1020—Principles of Macroeconomics (5)
 - AgEc 1030—Principles of Microeconomics (4)
 - Geog 1301—Human Geography (5)
 - Soc 1001—Introduction to Sociology (4)
or Soc 1002—American Community (4)

D. Literature, Humanities, and Fine Arts—8 credits minimum

- See All-College Requirements in preceding section.
- Rhet 1310—Humanities: The Land in American Experience (4)

E. Professional Courses in the Major

- AgEc 3610—Community Resource Development (4)
- AgET 3030—Introduction to Problem Solving with Computers (4)
- Anth 5117—Energy, Resource Use, and System Change (4)
- FR 3232—Management of Recreational Lands (3)
or FR 5200—Aerial Photo Interpretation (3)

- RCD 1010—Issues in Environment (3)
- Soc 3401—Principles of Social Organization (5)
or Soc 5651—Rural Social Institutions (4)
or Soc 5661—Rural Community Analysis (4)
- Soil 1262—Introduction to Meteorology (4)

F. Soil and Water Resources

- AgET 5099, 5100—Interdisciplinary Seminar (4, 4)
or Soil 5099, 5100—RCD Interdisciplinary Seminar (4, 4)
 - AgET 5400—Drainage and Irrigation (4)
 - AgET 5410—Hydrology and Water Quality (5)
 - FR 5153—Advanced Forest Hydrology (4)
 - Soil 1001—Orientation to Soil Science (1)
 - Soil 3118—Seminar: Soil Pollution and Public Policy (1)
 - Soil 3210—Physical Soil Management and Tillage (4)
 - Soil 3220—Soil Conservation and Land Use Management (4)
 - Soil 3416—Soil Fertility (5)
 - Soil 3520—Soil Morphology, Classification, and Genesis (4)
 - Soil 3918—Senior Seminar (1)
- 12 credits minimum for:
- Agro 3010—Adaptation, Distribution, and Ecology of Field Crops (4)
 - CE 5401—Water Resource Engineering (4)
 - CE 5420—Introduction to Water Resource Management (4)
 - Geol 5601—Limnology (4)
 - Geol 5611—Groundwater Geology (4)
 - PubH 5241—Environmental Health Aspects of Water Supply (3)
or PubH 5244—Environmental Health Aspects of Wastewater Systems (3)
 - PubH 5242—Environmental Health Aspects of Groundwater Systems (2)
 - Soil 5340—Organic and Pesticidal Residues (5)
 - Soil 5610—Soil Biology (4)

G. Electives to complete the 192 credits required for graduation with the bachelor of science degree.

Technical Communication

Department of Rhetoric
202 Haecker Hall
612/624-3445

Technical communicators apply modern techniques to the dissemination of knowledge in industry, business, education, and government. Technical communicators write for audiences that range from scientists to management to the consumer of products and services provided by technology. To accomplish their objectives, technical communicators must first be generalists, well acquainted with the basic principles of science, engineering, the social sciences, and management practices. In addition, they must be familiar

with and able to apply the basic principles of writing and editing, graphics, communication research and theory, and oral communication. The interdisciplinary technical communication curriculum is designed to provide the necessary fundamental theory for application in these areas within a program flexible enough to allow you to plan a course of study appropriate to your career goals.

As a graduate of the program, you may be employed in government, education, and organizations in such fields as agriculture, communication, computer science, electronics, research and development, and transportation. You may pursue a career as a writer-editor, an extension specialist, or a training or communication specialist.

If you plan to pursue a graduate communication program, you should consult with your adviser about selection of appropriate coursework early in your program.

Admission to the College of Agriculture does not automatically admit you to the technical communication program. To be admitted to the program, you must make application to the Department of Rhetoric. Applications are due May 1st, and you will be notified of your acceptance or rejection by June 1st. You will retain pre-major status until you are accepted into the program. For more information, contact the Department of Rhetoric.

Major Requirements

Students majoring in the undergraduate program in technical communication must complete the requirements listed below. Course substitutions in categories A, B, C, and D may be made only with the approval of the College Office, and in categories E and F only with the approval of the Department of Rhetoric.

A. Communication, Language, Symbolic Systems—27 credits minimum

- Math 1111—College Algebra and Analytical Geometry (5)
- Rhet 1101—Writing to Inform and Persuade (4)
- Rhet 1104—Library Research Methods (1)
- Rhet 1151—Writing in Your Major (4)

Rhet 1222—Public Speaking (4)

Rhet 1500—Introduction to Word Processing (2) S/N

Rhet 3562—Writing in Your Profession (4)

One course from:

AgEt 3030—Introduction to Problem Solving with Computers (4)

CSci 3101—Introduction to FORTRAN Programming (4)

CSci 3102—Introduction to Pascal Programming (4)

CSci 3104—Introduction to Programming and Problem Solving (4)

MIS 3300—Introduction to Computers and Management Information Systems (4)

B. Physical and Biological Sciences—18 credits minimum from:

BioC 1301—Elementary Biochemistry I (5)

BioC 1302, 1303—Elementary Biochemistry II and Laboratory (3, 2)

Biol 1009—General Biology (5)

Biol 1103—General Botany (5)

Biol 1106—General Zoology (5)

Bot 1009—Minnesota Plant Life (4)

Bot 1012—Plants Useful to Man (4)

Chem 1004—General Principles of Chemistry (5)

Chem 1005—General Principles of Chemistry (5)

EBB 3001—Introduction to Ecology (4)

GCB 3022—Genetics (4)

Geo 1001, 1021—Physical Geology and Laboratory (4,1)

Geo 1002—Historical Geology (4)

Geo 1111—Introductory Physical Geology (5)

MicB 3103—General Microbiology (5) (extension registration only, fall)

Phsl 1002—Human Physiology (4)

Phys 1001, 1005—The Physical World and Laboratory (4, 1)

Phys 1041, 1045—Introductory Physics and Laboratory (4, 1)

Phys 1042, 1046—Introductory Physics and Laboratory (4, 1)

C. The Individual and Society—14 credits minimum

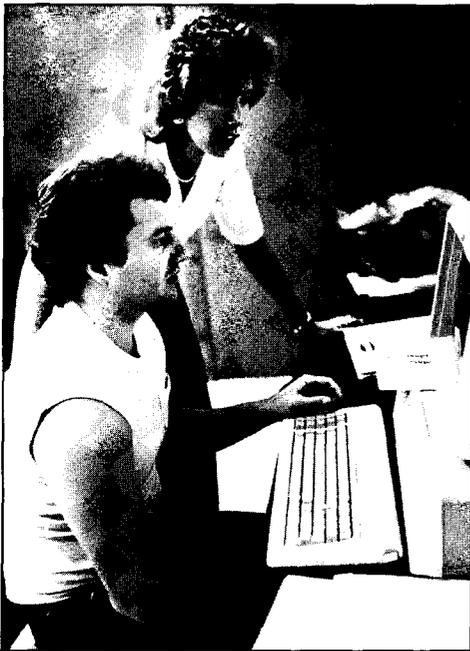
See All-College Requirements, category C, in preceding section.

D. Literature, Humanities, and Fine Arts—16 credits minimum

See All-College Requirements, category D in preceding section.

E. Professional Courses in the Major—70 credits minimum

Students majoring in technical communication must complete a total of 70 credits in category E with a minimum number in each competency area listed below. Note that the minimums do not add up to 70 credits, since you are expected to surpass the minimums in areas of particular interest. Required courses in certain competency areas are identified. Courses identified as recommended may be taken with the approval of your adviser. Courses not listed may be taken only with



the approval of the director of the Technical Communication Program or, in his or her absence, the head of the Department of Rhetoric.

REQUIRED FOR ALL STUDENTS—6 credits minimum

Rhet 3582—Senior Seminar (2)
Rhet 5180—Internship in Technical Communication (4-6)

WRITING AND EDITING—14 credits minimum

Recommended
Comp 1027—Intermediate Expository Writing (4)
Rhet 3572—Grammatical Editing for Technical Writers (2)
Rhet 5561—Advanced Editing Seminar: Electronic Publishing (2)
Rhet 5565—Writing for Publication (4)
Rhet 5571—Writing for Special Purposes (2)
Rhet 5581—Document Design (4)

ORAL COMMUNICATION—8 credits minimum

Required
Rhet 5257—Scientific and Technical Presentations (4)
Rhet 5258—Interviewing: Dynamics of Face-to-Face Communication (4)

Recommended
Rhet 3254—Advanced Public Speaking (4)
Rhet 3266—Communication, Discussion in Small Group Decision Making (4)
Rhet 3270—Speech: Special Problems (1-5)
Spch 3201—Introduction to Broadcasting Production (4)
Spch 3203—Radio Production (4)
Spch 5411—Small Group Communication (4)
Spch 5431—The Process of Persuasion (4)

VISUAL COMMUNICATION—7 credits minimum

Required
Ind 1600—Drafting (3)
Recommended
Dsgn 1521—Color and Design (4)
Dsgn 1523—Visual Presentation I (4)
Dsgn 1525—Two-Dimensional Design I (4)
GC 1536—Introduction to Commercial Art (3)
Ind 1602—Drawing and Design (3)
Ind 1620—Graphic Communication I (3)
Ind 1622—Graphic Communication II (3)
Ind 3120—Graphic Communication: Intermediate (Applied Photography) (3-9)
Ind 3121—Graphic Communication: Advanced (3)
Rhet 3101—Functional Photography (4)
In addition to these recommended courses, there are many University courses in art, cinematography, television production, and photography that would satisfy this requirement. If you have a special interest in any of these areas, consult with your adviser.

COMMUNICATION SYSTEMS—7 credits minimum

Recommended
Rhet 5150—Direction of Training in Business and Service Organizations (4)
Rhet 5165—Studies in Organizational Communication, Conflict, and Change (4)
Rhet 5170—Managerial Communications (4)
Rhet 5400—Dissemination and Utilization of Information (4)
Rhet 5531—Technical Writing Course Development (2)
Rhet 5600—Transfer of Technology (4)
Spch 3111—Leadership Communication (3)
Spch 5412—Group and Organizational Communication (4)
Spch 5414—Authority and Power in Task-Oriented Communication (4)

COMMUNICATION THEORY AND RESEARCH—7 credits minimum

Required
Rhet 1220—Principles of Human Communication (4)
Rhet 3700—Rhetorical Theory (4)
Recommended
Clas 3045—Basic Program in Technical Terminology and Word Study (2)
Engl 3851—The English Language (4)
Engl 5815—History of English Language (4)
Engl 5831—American English (4)
Engl 5851—Structure of Modern English (4)
Ling 3001—Introduction to Linguistics (5)
Ling 3601—Introduction to Historical Linguistics (4)
Rhet 5147—Efficient Reading (4)
Rhet 5500—Research in Communication Strategies (4)
Rhet 5541—Readings in Scientific and Technical Prose (2)
Spch 5403—Theory Construction and Analysis in Communication (4)
Spch 5421—Quantitative Research in Communication (4)
Spch 5611—Classical Rhetoric (4)
Stat 5021—Statistical Analysis I (5)

PHILOSOPHY AND HISTORY OF SCIENCE AND TECHNOLOGY—7 credits minimum

Recommended

- HMed 3002—Medicine and Disease in History: 17-19th Centuries (4)
- HMed 3003—Medicine and Disease in History: Modern (4)
- HSci 1712—Technology and Western Civilization: Medieval (4)
- HSci 1713—Technology and Western Civilization: Modern (4)
- HSci 1811—Introduction to History of Science: Ancient Science (4)
- HSci 1812—Introduction to History of Science: Medieval Science (4)
- HSci 1813—Introduction to History of Science: Modern Science (4)
- Phil 5601—Philosophy of Science (4)
- Phil 5615—Minds, Bodies, and Machines (4)

F. Technical Electives—20 credits minimum

Through the selection of your technical electives, you are expected to develop enough competency in a science, social science, or engineering discipline to acquire an understanding of the goals and methods of science and technology. You may also use this portion of the program to prepare for employment in some specific area such as computers or medical writing. Technical electives will be chosen with the aid of your adviser and can be interdisciplinary as well as intradisciplinary. You may choose from such areas as agriculture, computer science, forestry, the health sciences, home economics, and the natural and physical sciences. At least 8 credits must be at the 3000 level or higher.

G. Electives to complete the 190 credits required for graduation with the bachelor of science degree.

Minor Requirements

Technical Communication—The technical communication minor is intended to augment your major by increasing your capability to communicate in your chosen field. It requires 30-32 credits in addition to the basic communication requirements of the College of Agriculture (Rhetoric 1101, 1104, 1151, 1222, and 3562). Contact the Director of the Undergraduate Technical Communication Program in the Department of Rhetoric for assistance in planning a minor in technical communication.

The following courses are required. Note that courses used to fulfill All-College Requirements cannot be applied to this minor.

- Rhet 1220—Principles of Human Communication (4)
- Rhet 3572—Grammatical Editing for Technical Writers (2)

- Rhet 5257—Scientific and Technical Presentations (4)
- Rhet 5258—Interviewing: Dynamics of Face-to-Face Communication (4)

- Rhet 5571—Writing for Special Purposes (2) (Students must register for two quarters and complete 4 credits.)

Two courses from:

- Rhet 1147—Efficient Reading (4)
- Rhet 3254—Advanced Public Speaking (4)
- Rhet 3266—Communication, Discussion in Small Group Decision Making (4)
- Rhet 5170—Managerial Communications (4)
- Rhet 5561—Advanced Editing Seminar: Electronic Publishing (2)
- Rhet 5565—Writing for Publication (4)
- Rhet 5581—Document Design (4)

One course from:

- Rhet 1301—Humanities: Modern Thought and the Enlightenment (4)
- Rhet 1302—Humanities: Modern Thought and the Industrial Revolution (4)
- Rhet 1303—Humanities: Modern Thought and the Impact of Evolution (4)
- Rhet 5541—Readings in Scientific and Technical Prose (2)

Agrarian Studies—The agrarian studies minor is a multidisciplinary program based in the humanities. It is designed to complement professional and scientific major degree programs with a broad background stressing the relation of people to agriculture. The program is based on the ideas that (1) an awareness of the social, historical, and cultural heritage of American agriculture is a valuable and satisfying part of the education of all majors in the College of Agriculture, and (2) such a background is essential to many leadership positions in modern agriculture. Students are introduced to the historical development and imaginative expression of agricultural experience and values. A special feature of the program is that students write a senior, integrative paper relating some aspect of their major field to social, cultural, or historical trends in the larger society. For assistance in planning an agrarian studies minor, contact a faculty adviser in the Department of Rhetoric.

The following courses are required:

- Rhet 1310—Humanities: The Land in American Experience (4)
- Rhet 3375—Humanities: Agricultural Heritage (4)
- Rhet 3374—Humanities: Special Problems (senior paper) (2)

Programs

Three courses from:

- AgEc 3040—Economic Development of American Agriculture (4)
- AgEd 1010—History and Philosophy of Vocational and Community Education (3)
- AnSc 3113—Animal Welfare (4)
- FScN 1012—Nutrition: Concepts and Issues (3)
or FScN 5643—Seminar: World Food Supply Problems (3)
- RCD 1010—Issues in the Environment (3)
- Rhet 1302—Humanities: Modern Thought and the Industrial Revolution (4)
- SOC 1651—Rural Sociology (4)

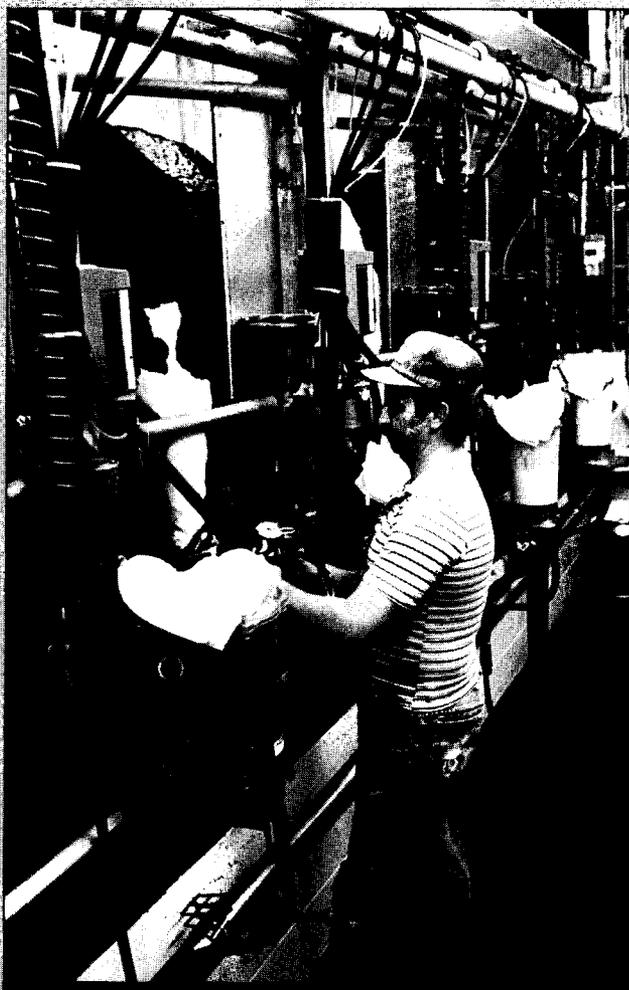
Veterinary Medicine

Students may complete the minimum requirements for admission to the College of Veterinary Medicine within any of the majors in the College of Agriculture. They must meet the requirements for admission to the College of Agriculture and

must be accepted into the major of their choice. Pre-veterinary medicine students are guided by faculty advisers in their major departments and are expected to make satisfactory progress toward completion of the degree in those majors.

For information on procedures and requirements for admission to the College of Veterinary Medicine, criteria for selection, degree programs and courses offered by the college, and related subjects, consult the annual College of Veterinary Medicine mini-bulletin, or the Office of Academic Affairs and Research, College of Veterinary Medicine, 460 Veterinary Teaching Hospitals, University of Minnesota, 1365 Gortner Avenue, St. Paul, MN 55108 (612/624-4747).

Course Descriptions



Course Descriptions

Symbols—The following symbols are used throughout the course descriptions in lieu of page footnotes:

- * Courses in which graduate students may prepare Plan B projects.
- † All courses preceding this symbol must be completed before credit will be granted for any quarter of the sequence.
- § Credit will not be granted if the equivalent course listed after this symbol has been taken for credit.
- ¶ Concurrent registration is allowed (or required) in the course listed after this symbol.
- # Registration Override Permit, completed and signed by the instructor, is required for registration.
- △ Registration Override Permit, completed and signed by the unit offering the course, is required for registration.
- H Honors course.

f,w,s,su Following a course number, indicates fall, winter, spring, or summer terms.

x Course is offered more than one quarter.

Courses primarily for freshmen and sophomores are numbered 1000 through 1998; for juniors and seniors, 3000 through 3998; for juniors, seniors, and graduate students, 5000 through 5998. Courses numbered 8000 and above are restricted to students registered in the Graduate School.

A hyphen between course numbers (e.g., 3142-3143-3144) indicates a sequence of courses that must be taken in the order listed.

A comma between course numbers (e.g., 1234, 1235, 1236) indicates a series of courses that may be entered any quarter.

When no abbreviated department prefix precedes a course number listed as a prerequisite, that prerequisite is in the same department as the course being described.

Agriculture (Agri)

1100. ACTIVE LEARNING AND PROBLEM SOLVING. (3 cr; A-F only; prereq ag Merit Scholar, #)

Orientation to active learning and creative problem-solving strategies. Students will work in groups, under the counseling of faculty members, to solve actual problems in the agricultural disciplines. Orientation to library and computer facilities.

3000. SEMINAR IN INTERNATIONAL AGRICULTURE. (1 cr; prereq intl agri minor)

Oral presentation and discussion of students' research papers, literature review of selected topics, discussions with students and staff of their experiences in international agriculture.

3001. LEADERSHIP DEVELOPMENT: PROJECT LEAD. (2 cr [may be repeated for max 4 cr]; A-F only; prereq agriculture major, #)

Leadership development seminar for undergraduates. Theories of leadership, leadership styles, leadership skills. Students work with mentors from business, education, and government.

5100. INTRODUCTION TO FARMING SYSTEMS RESEARCH AND EXTENSION. (3 cr)

Introduction to Farming Systems Research and Extension, an interdisciplinary and holistic approach to understanding limited resource family farms and integrating family farm research and extension.

5101. FIELDWORK IN FARMING SYSTEMS RESEARCH AND EXTENSION. (3 cr; prereq 5100)

Advanced theory of and practice in Farming Systems Research and Extension with opportunities for student fieldwork.

Agricultural and Applied Economics (AgEc)

1000f. ORIENTATION TO AGRICULTURAL AND APPLIED ECONOMICS. (1 cr; S-N only)

Introduction to the curricula, areas of specialization, coursework, employment opportunities, faculty, and functions of the Department of Agricultural and Applied Economics.

1020f,w. PRINCIPLES OF MACROECONOMICS. (5 cr, \$Econ 1001)

Determinants of national income and employment levels; prices and money; the banking system; monetary and fiscal policy; economic growth and development; role of government in the economy.

1030w,s. PRINCIPLES OF MICROECONOMICS. (4 cr, \$Econ 1002; prereq 1020)

Economics of the firm and household; factor and product price determination; theory of production, consumption, and distribution; supply and demand analysis; equilibrium analysis.

1250f. PRINCIPLES OF ACCOUNTING. (5 cr)
Fundamentals of business accounting; basic finance concepts; use of accounting data for income tax and managerial decision making.

1400f,s. AGRICULTURAL MARKETS AND PRICES. (4 cr; prereq 1030)

Economics of agricultural marketing; factors determining prices and price trends of agricultural commodities, demand for and supply of agricultural products, and food and fiber market organization.

3000w. SEMINAR IN INTERNATIONAL AGRICULTURE. (1 cr, §Agri 3000; S-N grading, free elective for Ag Ec undergrads)

Oral presentation and discussion of students' research papers, literature review of selected topics, discussions with students and staff of their experiences in international agriculture.

3040f. ECONOMIC DEVELOPMENT OF AMERICAN AGRICULTURE. (4 cr; prereq 1030)

Economic, political, social, and technical forces that have shaped the development of American agriculture; the role of agricultural development in national economic development in the United States; implications for presently developing countries.

3070w. AGRICULTURE AND ECONOMIC GROWTH IN DEVELOPING COUNTRIES. (4 cr; prereq 1020, 1030)

Agricultural development problems; the contribution of economics to analyzing these problems; the use of economics in agricultural development policy and planning.

3101w. MICROECONOMIC THEORY. (4 cr, §Econ 3101; prereq 1030 or Econ 1002, Math 1111 or equiv)

Behavior of households, firms, and industries under competitive and monopolistic conditions; factors influencing production, price, and advertising decisions.

3102s. MACROECONOMIC THEORY. (4 cr, §Econ 3102; prereq 1020, 1030 or Econ 1001 and 1002)

Determinants of national income, employment, and price level; aggregate consumption, investment, and government demand; the money market; the labor market.

3290w. AGRIBUSINESS MANAGEMENT. (4 cr; prereq 1020 and 1030 and Mgmt 3001 for agricultural business majors, 3101 or # for others)

Application of economic, other social science, and technical concepts to the decision-making process of firms supplying inputs to agriculture and/or processing and distributing agricultural products.

3300w. AGRICULTURAL MANAGEMENT INFORMATION SYSTEMS. (4 cr, §MIS 3300; prereq 1030)

Introduction to information systems technology, conceptual foundations of MIS, and MIS design implementation and management for farm and non-farm firms in agriculture.

3410s. ECONOMIC ORGANIZATION OF THE HOSPITALITY INDUSTRY. (4 cr; prereq 1020, 1030, Mktg 3000 or #)

Principles of economics applied to markets and firms serving people away from home, including food, lodging, travel, recreation, health care, and related activities.

3420f. GRAIN MARKETING ECONOMICS. (3 cr; prereq 1400)

Economic relationships in the marketing of grain and grain products; analysis of supply and demand; grain grades, storage, and transportation; market structure, channels, pricing and competition; government programs and policies.

3430w. DAIRY MARKETING ECONOMICS. (3 cr; prereq 1400)

Economic relationships in the marketing of milk and milk products; analysis of supply and demand; market structure, channels, pricing and competition; federal milk market price regulations; dairy programs and policies.

3440s. LIVESTOCK MARKETING ECONOMICS. (3 cr; prereq 1400)

Economic relationships in the marketing of livestock and livestock products; analysis of supply and demand; livestock grades, inspection, and transportation; market structure, channels, pricing and competition; government regulations and policies.

3500f. FARM AND AGRIBUSINESS FINANCE. (5 cr; prereq 1030, 1250 or Acct 1024 and 1025 or equiv)

Analysis of financing and investment policies for farm and agribusiness firms with reference to effects on liquidity, solvency, and profitability. Introduction to financial intermediaries in agriculture.

3610f. COMMUNITY RESOURCE DEVELOPMENT. (4 cr; prereq 1020-1030 or Econ 1001-1002 or #)

Basic concepts of resource use including physical and economic classifications; physical and economic feasibility; benefits and costs; external effects; cost sharing; selected resource use problems. Economic areas and units for planning and development; generation of alternative program elements and development of consequences; problems in choosing elements for an optimum resource development program.

3640w. PUBLIC FINANCE: CONCEPTS AND PRACTICES. (4 cr; prereq 1020, 1030 or Econ 1001, 1002)

Survey of government revenue systems, expenditures, taxation, and debt in the United States. Federal, state, and local fiscal institutions; intergovernmental fiscal relations; budget analysis; and policy issues.

Course Descriptions

3710s. AGRICULTURAL AND MARKET POLICIES. (4 cr; prereq 1400 or 3101, 3102 or Econ 3101, 3102 or #)

Analysis of public problems and issues concerning US agriculture and the welfare of rural residents; economic problems of the food and fiber industry and of rural residents and communities; critical appraisal of past and present public programs; economic and social implications of alternative policies and programs; political decision making in policy formulation.

3810f. PRINCIPLES OF FARM MANAGEMENT. (4 cr, §3820; prereq AgEc 1030; not open to majors in AgEc dept)

Introduction to the use of farm accounts in planning; application of economic principles and budgeting procedures to the development of enterprise budgets and whole farm plans; development of projected cash flows and evaluation of investment alternatives.

3820f.w. FARM MANAGEMENT ECONOMICS. (4 cr; prereq 1030)

Introduction to the use of farm accounts in planning; application of economic principles and budgeting procedures to the development of enterprise budgets and whole farm plans; development of projected cash flows; and evaluation of investment alternatives.

3830s. ORGANIZING THE FARM BUSINESS FOR ENTRY, GROWTH, AND TRANSFER. (4 cr; prereq 3810 or 3820; 3850 recommended)

Business and personal considerations and analytical procedures for evaluating opportunities and arrangements for gaining entry into farming; analyzing business expansion alternatives; and deciding how best to transfer the farm business between generations. Acquisition of land and machinery and management of labor.

3850w. FARM BUSINESS AND ENTERPRISE ANALYSIS. (4 cr, prereq 1030, 3810 or 3820, or #)

Principles of selecting, organizing, maintaining, and using a farm accounting system. Financial statements and farm financial management. Tax preparation and planning; analysis and forward planning of crop and livestock enterprises and the overall farm business.

3900f. SPECIAL TOPICS IN THE ECONOMICS OF PUBLIC SERVICES. (3 cr; prereq 1020 or #)

Upper division seminar on public service issues; discussion of principles of analysis followed by case studies on topics of current interest such as economics of income maintenance, education, transportation, health services, housing, municipal services.

3980s. CURRENT ISSUES IN AGRICULTURAL ECONOMICS. (Cr ar; prereq #)

Discussion and analysis of important and timely problems in agricultural economics. Topics vary from quarter to quarter and are listed in the *Class Schedule*. For full details, inquire at the department office prior to registration.

3990. INDEPENDENT STUDY IN AGRICULTURAL AND APPLIED ECONOMICS. (cr ar; prereq #)

Independent study and supervised reading and research on subjects and problems not covered in regularly offered courses.

5000. PROFESSIONAL EXPERIENCE PROGRAM. (4 cr; prereq #; S-N only; free elective for AgEc undergrads; not for grad cr; extension regis only)

Professional experience in agribusiness firms or government agencies obtained through supervised practical experience; evaluative reports and consultations with faculty advisers and employers.

5020s. APPLIED LINEAR PROGRAMMING. (4 cr for undergrad, 3 cr for grad; prereq 1030 and Math 1111 or 1131)

Application of linear programming to farm and agribusiness firms. Emphasizes economic concepts using minimal mathematics. Develops skills in computer use for decision making. Profit maximization, cost minimization, and transportation analysis.

5099f. RCD INTERDISCIPLINARY SEMINAR I. (4 cr, 5099-5100, §RCD 5099, §AgET 5099, §LA 5099, §Soil 5099; prereq resource and community development sr or #)

Selected speakers, readings, and discussion topics dealing with resource and community development analysis and implications for resource allocation. Students participate as a team, combining disciplinary skills to analyze complex resource problems.

5100w. RCD INTERDISCIPLINARY SEMINAR II. (4 cr, 5099-5100, §RCD 5100, §AgET 5100, §LA 5100, §Soil 5100; prereq 5099 or #)

(Continuation of 5099) Papers, presentations, and critiques on selected complex resource problems in Seminar I.

5104w. AGRICULTURAL SYSTEMS ANALYSIS AND MODELING. (4 cr, §PIPa 5104, §AnSc 5104, §Soil 5104; prereq Math 1142 or #)

Introduction to bioeconomic modeling as preparation for interdisciplinary agricultural systems analysis. Basic concepts; deterministic and stochastic models; delays, feedback, and clockwork; data acquisition; model verification and validation; role of models for agroecosystem management.

5271w. BAYESIAN DECISION MAKING. (4 cr, §Econ 5271; prereq Stat 5122 or equiv and Econ 1002 or equiv)

Rationale for expected utility representation of decision problems. Amount of a venture problem. Production decisions by firms. Combinations of ventures, portfolio problems.

5272s. BAYESIAN DECISION MAKING. (4 cr, §Econ 5272; prereq 5271)

Sequential economic decisions; dynamic programming; multivariate utility.

5400w. INTERMEDIATE MARKET AND PRICE ANALYSIS. (4 cr for undergrad, 3 cr for grad; prereq 1400 or 3101 or Econ 3101 or Econ 5151)

Development of analytical models and their application in various market situations. Unique market institutions that have developed in response to marketing problems and policies.

5440s. COOPERATIVES AND AGRIBUSINESS ORGANIZATION. (4 cr for undergrad, 3 cr for grad; prereq 1400)

Analysis of economic problems and issues facing agricultural cooperatives, including changing market organization, financing, taxation, and antitrust regulations.

5480w. FUTURES, MARKETS, AND PRICES. (4 cr for undergrad, 3 cr for grad; prereq 1400 or #)

Economics of cash and futures trading on organized markets; futures trading theory; hedging and speculation.

5500w. ADVANCED AGRICULTURAL FINANCE. (4 cr for undergrad, 3 cr for grad; prereq 3500)

Analysis of financial institutions and financial markets. Managerial policy issues confronting managers of financial intermediaries with reference to those operating in an agricultural setting. Current problem issues confronting financial intermediaries.

5550w. FOOD CONSUMPTION ECONOMICS. (4 cr for undergrad, 3 cr for grad, §FScN 5474; prereq 3101 or equiv)

Analytical and empirical treatment of consumer food behavior. Concentrates on data and methods used to study economic and nutritional aspects of food consumption. Students pursue individual projects.

5560w. ECONOMICS OF CONSUMER POLICIES. (4 cr for undergrad, 3 cr for grad; prereq 3101 or Econ 3101 or #)

Examination of impact on consumers of legislative, regulatory, and judicial policies for tendency to promote efficiency, equity, consumer sovereignty, and freedom of choice. Evaluation of policies for dealing with information, prices, consumer protection, consumer redress, public goods, and regulatory institutions.

5580f. ECONOMIC ORGANIZATION OF THE HOUSEHOLD. (4 cr for undergrad, 3 cr for grad; prereq 1030 or Econ 1002; not open to agricultural economics grads)

Economic concepts applied to the analysis of household production, market and nonmarket work, family formation and size, and household consumption activity.

5600. LAND ECONOMICS. (4 cr for undergrad, 3 cr for grad; prereq 3101, 3102 or Econ 3101, 3102 or #)
Land as a factor of production; land use, classification, and value; sale and rental markets for land; domestic and foreign land policies.

5610s. LAND USE INSTITUTIONS OF LOCAL GOVERNMENT. (4 cr for undergrad, 3 cr for grad; prereq 1020, 1030)

Introduction to law as an institution of government as applied to land use. Emphasis on regulatory powers, especially zoning, including types of permits, methods of exercising discretion, constitutional and statutory constraints, administrative procedures, growth control techniques, planned developments, exclusionary zoning, separation of powers, and judicial review. Other regulatory powers include subdivision controls, building, housing and sanitary codes, and official maps.

5620f. REGIONAL ECONOMIC ANALYSIS. (4 cr for undergrad, 3 cr for grad; prereq 1030 or Econ 1002)

Analysis of regional industry and community structure; role of resource, transportation, and institutional constraints; trade, migration, and investment in regional growth and change. Use of regional economic information in business investment and location planning.

5630w. REGIONAL DEVELOPMENT SYSTEMS. (4 cr for undergrad, 3 cr for grad; prereq 1030 or Econ 1002)

Population, income, and employment disparities in regional growth and development in selected countries. Regional development strategies and institutions for public intervention in regional development process. Regional systems analyses and forecasts for economic policy and development planning.

5640. FINANCING STATE AND LOCAL GOVERNMENTS. (4 cr for undergrad, 3 cr for grad; prereq 3101 or Econ 3101)

Problems and issues in financing state and local public services in the United States. State and local revenue systems, debt, and expenditures. Intergovernmental fiscal relations. Budget analysis.

5650s. ECONOMICS OF NATURAL RESOURCE POLICY. (4 cr for undergrad, 3 cr for grad; prereq 3101 or Econ 3101 or Econ 5151 or #)

Application of economic analysis, including project evaluation, to current natural resource issues. Emphasis on conservation and resource scarcity, environmental quality, population growth, and resource use issues and their implications for public policy.

5660. ECONOMICS OF PUBLIC SERVICES. (4 cr for undergrad, 3 cr for grad; prereq 3101 or Econ 3101 or Econ 5151 or #)

Introduction to the issues of finance and supply and demand for public services; pricing, producing, and financing public goods; bureaucratic decision making; implementation of policies.

5670f. ECONOMICS OF AGRICULTURAL TRANSPORTATION. (4 cr for undergrad, 3 cr for grad; prereq 3101 or #)

Application of economic analysis to current issues in agricultural and rural transportation policy. Relationship between transportation infrastructure and economic development and regional and national trade.

Course Descriptions

5720s. ECONOMICS OF WORLD AGRICULTURE. (4 cr for undergrad, 3 cr for grad; prereq 1020, 1030 or #)

Distribution, quality, and utilization of agricultural resources; agricultural organization and structure; location of agricultural activity; national and international agricultural policies.

5730w. EUROPEAN AGRICULTURE AND EUROPEAN FOOD AND AGRICULTURAL POLICIES. (4 cr for undergrad, 3 cr for grad)

Characteristics of agriculture in Europe; determinants of development of European agriculture; goals and instruments of EC agricultural policy.

5740s. AGRICULTURAL POLICY IN PLANNED ECONOMIES. (4 cr for undergrad, 3 cr for grad; prereq 3101 or Econ 3101 or #)

Principle of economics used to analyze agricultural policy and performance in centrally planned economies. Emphasis on Soviet agriculture; some attention to China and Eastern Europe.

5750f. AGRICULTURAL TRADE AND COMMERCIAL POLICIES. (4 cr for undergrad, 3 cr for grad; prereq 3101, 3102 or Econ 3101, 3102)

Patterns of trade in agricultural products; trade policies and practices of export and import nations; commodity agreements; agricultural trade policies of common market areas; negotiations and potential trade developments.

5790f. WORLD FOOD SUPPLY PROBLEMS. (3 cr, \$Agro 5200, \$Soc 5675, \$LACS 5280, \$FScN 5643; prereq ag, pre-veterinary medicine, home economics, or social science majors, or #, or agricultural economics grads with #)

A multidisciplinary approach to the social, economic, and technical problems of feeding the world's growing population. Principles sought from the social and economic sciences, plant sciences, and animal sciences for their application to food problems.

5840s. MANAGEMENT OF THE FARM BUSINESS. (4 cr for undergrad, 3 cr for grad; prereq 3820; 3830, 3850 recommended)

Decision-making procedures under conditions of uncertainty; development of an information system to monitor and control the ongoing operation; control of crop and livestock enterprises; labor management; and cash flow management.

5860f. ECONOMICS OF AGRICULTURAL PRODUCTION. (4 cr for undergrad, 3 cr for grad; primarily for grads; prereq 21 cr in economics or agricultural economics)

Production economics applied to agriculture; profitable combination of production factors; comparative advantage and location of production.

5890f, w, s. INDEPENDENT STUDY: ADVANCED TOPICS IN FARM MANAGEMENT. (1-6 cr; prereq #)

Special topics or individual work suited to the needs of particular groups of students.

5990f, w, s. SPECIAL TOPICS AND INDEPENDENT STUDY IN AGRICULTURAL AND APPLIED ECONOMICS. (Cr ar; prereq #)

Special classes, independent study, and supervised reading and research on subjects and problems not covered in regularly offered courses.

For Graduate Students Only

(For descriptions, see *Graduate School Bulletin*)

8200. ADVANCED TOPICS IN AGRICULTURE AND APPLIED ECONOMICS

8205. RESEARCH METHODOLOGY IN AGRICULTURAL ECONOMICS

8220. APPLIED MATHEMATICAL PROGRAMMING

8231. AGRICULTURAL PRICES

8245. AGRICULTURAL MARKETING ECONOMICS

8264. RESOURCE ECONOMICS

8266. APPLIED REGIONAL ECONOMICS

8270. APPLIED WELFARE ECONOMICS AND PUBLIC POLICY

8278. AGRICULTURAL AND ECONOMIC DEVELOPMENT

8287. PRODUCTION FUNCTIONS: THEORY AND ESTIMATIONS

8288. DYNAMIC PRODUCTION ECONOMICS

8335. SEMINAR: PRICE ANALYSIS

8344. SEMINAR: COOPERATIVE MARKETING

8345. SEMINAR: AGRICULTURAL MARKETING

8346. SEMINAR: LAW AND AGRICULTURAL ECONOMICS

8356. SEMINAR: CONSUMPTION ECONOMICS

8360. SEMINAR: LAND ECONOMICS AND TENURE

8364. SEMINAR: RESOURCE ECONOMICS AND POLICY

8366. SEMINAR: APPLIED REGIONAL ECONOMICS

8373. SEMINAR: FOOD AND AGRICULTURAL POLICY IN THE UNITED STATES

8375. ECONOMICS OF EC FOOD AND AGRICULTURAL POLICIES

8378. SEMINAR: AGRICULTURAL DEVELOPMENT

8382. SEMINAR: FARM MANAGEMENT AND PRODUCTION ECONOMICS

8591. CONSUMPTION ECONOMICS

Agricultural Education (AgEd)

1001. INTRODUCTION TO AGRICULTURAL EDUCATION. (1 cr; prereq #)

Orientation to employment and service in agricultural education; qualifications of teachers, survey of preparatory offerings, the program in Minnesota.

1010. HISTORY AND PHILOSOPHY OF VOCATIONAL AND COMMUNITY EDUCATION. (3 cr)

Analysis and interpretation; alternative value positions involving social, economic, and related community variables.

3010. ORGANIZATION AND DIRECTION OF FFA ACTIVITIES. (2 cr)

Development of FFA leadership: vocational agriculture/agribusiness and natural resources education, youth leadership organization; integration of classroom and supervised occupational experience.

3021. EDUCATION THROUGH EXTENSION METHODS. (3 cr; prereq soph)

Role of nonschool agencies in rural and agricultural education; methods and techniques of formal and informal instruction in school and nonschool educational programs.

3029. DIRECTED EXPERIENCE IN AGRICULTURAL EDUCATION. (1-3 cr)

Observation of activities of teachers of agriculture; familiarization with the staff, curriculum, and physical facilities and equipment in a department of vocational agriculture, with opportunity to participate in the functions of a teacher.

3031. STUDENT TEACHING IN AGRICULTURE. (10 cr; prereq jr, 5028, SeEd 3155, #)

Instruction in developing individual farming programs, contacting parents, program analysis of community needs, conducting classes, community activities, Future Farmers of America, and case studies.

3041. PRACTICUM: AGRICULTURAL EDUCATION TECHNOLOGY. (1-3 cr [may be repeated for max 5 cr])

Individualized study packages of 1 credit each of technology in agriculture, horticulture, off-farm agriculture, agricultural mechanics, adult and beginning farmer programs, youth organizations, program evaluation, and visual aids.

5000. PROFESSIONAL EXPERIENCE PROGRAM. (4 cr; prereq #; not for grad cr; extension regis only)

Supervised practical professional experience in agricultural business and industries; evaluative reports and consultations with faculty advisers and employers.

5010. HISTORY AND PHILOSOPHY OF VOCATIONAL AND COMMUNITY EDUCATION. (3 cr)

Analysis and interpretation; alternative value positions involving social, economic, and related community variables.

5021. EDUCATION THROUGH EXTENSION METHODS. (3 cr, §HEEd 5021; prereq grad student or #)

Methods and techniques of formal and nonformal education used by Extension Service and other organizations.

5023. EXTENSION METHODS FOR DEVELOPING COUNTRIES. (3 cr, §HEEd 5023)

Extension methods to promote rapid adoption of improved practices.

5024. HISTORY AND PHILOSOPHY OF EXTENSION SERVICES. (3 cr, §HEEd 5024)

Origin, philosophy, historical development, objectives, and organizational structure of the Extension Service.

5025. EXTENSION PROGRAM DEVELOPMENT. (3 cr, §HEEd 5025)

Planning, implementing, and evaluating the program development process.

5026. EXTENSION ADMINISTRATION. (3 cr, §HEEd 5026; prereq #)

Administration of the Cooperative Extension Service organization at the county, area, and state levels.

5027. PRACTICUM: EXTENSION EXPERIENCES. (2-9 cr [max 9 cr], §HEEd 5027; S-N optional)

Observation of and participation in activities of Extension Service staff at county and state level; familiarization with staffing, program planning and development, and educational and administrative functions.

5028. TEACHING METHODS IN AGRICULTURAL EDUCATION. (5 cr; prereq SeEd 3155 or †SeEd 3155)

Methods utilized in teaching agriculture in public schools; use of media, principles of learning, problem solving, test construction, classroom management, and specific practice in problem-solving teaching techniques; use of competency-based individualized instruction as a medium for course presentation and a model for teaching methods.

5032. HIGH SCHOOL CURRICULUM IN AGRICULTURE. (3 cr; prereq 10 cr education)

Philosophy, organization, and administration of instruction in agriculture departments in secondary schools.

5034. PROCEDURES IN TEACHING AGRICULTURE. (3 cr; prereq #)

New developments in methodology; assessment of innovations and procedures; consideration of various levels of instruction.

Course Descriptions

5035. METHODS AND PRACTICES IN TEACHING POST-HIGH SCHOOL AGRICULTURE. (3 cr)

Problems unique to area vocational-technical school and junior college teaching; improving ability to organize and present subject matter.

5041. WORKSHOP: AGRICULTURAL EDUCATION TECHNOLOGY. (1-6 cr [max 6 cr])

New understandings, techniques, and materials in animal science, plant science, horticulture, soil science, agricultural mechanics, forestry, natural resources, youth organization, visual aids, and occupational exploration.

5042. AGRICULTURAL MECHANICS. (1-3 cr [max 12 cr])

Technical and managerial information, techniques, and materials. Designed to facilitate participant's instructional planning, resource development, and instruction. Topic to be identified with each offering.

5043. FARM MANAGEMENT. (1-3 cr [max 12 cr])

Application of agricultural economics theory, principles, techniques, and materials. Designed to facilitate participant's instructional planning, resource development, and instruction. Topic to be identified with each offering.

5049. AGRICULTURAL EDUCATION FOR ADULTS. (4 cr)

Methods, organization, and implementation of systematic education programs for beginning and established farmers; organization of local programs to meet needs of production agriculture in areas of enterprises, agricultural mechanics and management; development of continuing program, observations.

5051. ENTERPRISE ANALYSIS. (3 cr; prereq #)

Analyzing farm business as basis for identifying problems; planning learning experiences to improve farm management at high school, young farmer, and adult levels.

5052. FARM BUSINESS MANAGEMENT EDUCATION. (3 cr; prereq 5049 or #)

Administration, organization, and operation of farm business management education programs for adults; development and utilization of curriculum materials based on farm business record data.

5055. INTRODUCTION TO FARMING SYSTEMS RESEARCH AND EXTENSION. (3 cr, §HEEd 5055)

Introduction to theory and practice; interdisciplinary approach to holistic view of farm family agricultural enterprise.

5056. APPLICATION OF FARMING SYSTEMS RESEARCH AND EXTENSION. (3 cr; prereq AgEd 5055 or HEEd 5055)

Seminar and fieldwork projects; sondeos and on-farm trials conducted.

5061. PROGRAM PLANNING AND EVALUATION. (3 cr; prereq sr)

Development of program of agricultural education in community school, integration with total school program, administrative relationships, techniques and use of program evaluation in planning.

5071. SUPERVISED OCCUPATIONAL EXPERIENCES IN AGRICULTURE. (3 cr)

Organization and administration of an occupational experience program in agriculture for high schools and area schools.

5072. PRACTICUM: AGRICULTURAL BUSINESS AND INDUSTRY. (1-3 cr per qtr [max 9 cr]; prereq 5071 or #)

Observation, study, and experience in agricultural business and industry; application to educational problems in agriculture.

5080. ORGANIZATION AND MANAGEMENT. (3 cr; prereq #)

Administrative structure and function of subcollegiate programs.

5081. CURRENT ISSUES FOR THE BEGINNING AGRICULTURE TEACHER. (1-3 cr [max 3 cr]; prereq #)

Teaching methods, organization of learning resource materials, management of classroom and laboratory learning activities, curriculum planning and organization, management of discipline situations, school and community relationships for the beginning teacher.

5082. CURRENT ISSUES IN AGRICULTURAL EDUCATION. (1-3 cr [max 9 cr]; prereq #)

Emphasizes study and clarification of current issues, strategies of response, implications of response actions, and related leadership roles.

5084. CURRICULA FOR CAREER EXPLORATION IN AGRICULTURAL OCCUPATIONS. (3 cr)

Analysis and evaluation of material; criteria for selection of material; content, organization, resource activities, and teaching techniques.

5085. CAREER DEVELOPMENT IN AGRICULTURAL EMPLOYMENT. (3 cr)

Methods and materials in teaching career development for agricultural industries.

5090. INDEPENDENT STUDY. (1-3 cr; prereq sr or #)

Topics chosen to permit study of areas within education or to supplement areas of inquiry not provided in the regular course structure.

5095. INDEPENDENT STUDY. (3 cr; prereq MED candidate in agricultural education)

Preparation of a paper dealing with studies in agricultural education applied to professional responsibilities.

5128. METHODS OF TEACHING. (3 cr; prereq non-agricultural education major and/or #)
Methods of teaching agriculture or related subjects; development of competencies in planning, organizing, implementing, and evaluating instruction, with practice in instructional techniques.

5129. CURRICULUM PLANNING. (3 cr; prereq 5128 or #5128, non-agricultural education major and/or #)
Methods and procedures in planning a curriculum to teach within a specific subject matter area; curriculum construction in the subject matter field for use in native country setting.

5130. EFFECTIVE TEACHING IN A COLLEGE OF AGRICULTURE. (3 cr; prereq 1 yr grad study in agriculture or #)
Various approaches to effective teaching in a college of agriculture. Development of a personal philosophy of teaching; practice in employing several types of instructional improvement activities. Intended primarily for the graduate student who plans to teach in a college of agriculture.

5200. SEMINAR: WORKING WITH YOUTH THROUGH ADULTS. (1-3 cr per qtr [max 9 cr incl HEEd 5200 and YoSt 5200]; prereq Δ; S-N optional)
Interdisciplinary seminar focusing on definition of the youth work profession; essential skills for youth workers; youth needs, roles, relationships with adults; development and management of a system of support for youth work.

5244. TOPICS IN PROGRAM PLANNING FOR EXTENSION EDUCATION. (1-6 cr [max 9 cr])
Effective extension education programming in relation to situation and needs analysis; coordination of content, people, methodology; development of program models; managing available resources.

5245. TOPICS IN ADMINISTERING EXTENSION EDUCATION. (1-6 cr [max 9 cr], §HEEd 5245)
Issues and current literature; focus on personnel hiring and supervision, financial management, leadership styles, long-range planning; application of theory to administrative practice.

5246. TOPICS IN TEACHING AND DELIVERING EXTENSION EDUCATION. (1-6 cr [max 9 cr], §HEEd 5246)
Teaching techniques involving media, telecommunications, computers, group process methods, experiential learning in extension education settings.

5247. TOPICS IN EVALUATING EXTENSION EDUCATION. (1-6 cr [max 9 cr], §HEEd 5247)
Overall evaluation design; issues in choosing quantitative versus qualitative evaluation methods; developing skills and conceptual frameworks to apply theory to extension settings.

For Graduate Students Only

(For descriptions, see *Graduate School Bulletin*)

8001.* RESEARCH IN AGRICULTURAL EDUCATION

8020. SEMINAR: AGRICULTURAL EDUCATION

8091. FIELD PROBLEMS

8303. SEMINAR: GRADUATE STUDIES REVIEW

Agricultural Engineering

Courses in Agricultural Engineering Technology (AgET)

1020. AGRICULTURAL SHOP—METALWORK. (4 cr; prereq Chem 1004 or #; 2 lect and 6 lab hrs per wk)

Arc and oxyacetylene welding, soldering, use and conditioning of metalworking tools, and identification and characteristics of metals used in farm machinery.

1090. DIRECTED STUDIES IN AGRICULTURAL ENGINEERING. (Cr ar; prereq #)
Independent study of topic(s) involving physical principles as applied to agricultural production and land resources.

1215. FIELD MACHINERY PRACTICAL. (2 cr; 4 lect hrs per wk)

Field machinery principles from the standpoint of machinery used; how it works; principles of operation; overall functions of tilling, seeding, applying chemicals and harvesting; methods of performance evaluation; adjustments that affect performance; and selection for profitable production.

3030. INTRODUCTION TO PROBLEM SOLVING WITH COMPUTERS. (4 cr; prereq Math 1111 or equiv; 3 lect hrs, 1 rec hr per wk)
Elementary problem solving using computers. Writing programs in BASIC language. Use of timesharing terminals. Elements of computer hardware and software.

3091. SPECIAL PROBLEMS IN AGRICULTURAL ENGINEERING. (2-5 cr; prereq #)
Individual study of topics in agricultural engineering. Application of physical principles to agricultural production.

3250. FARM MACHINERY MANAGEMENT. (4 cr; prereq 1215 or experience in field machinery operation; 3 lect and 3 lab hrs per wk)
Mechanical principles of tractors and field machinery. Measuring and predicting the output of a tractor. Implement size and power requirements as related to soil type. Basic management principles applied to determine the size of machinery required for an enterprise.

3606. FARM BUILDING DESIGN, LAYOUT, SYSTEMS. (4 cr; prereq Math 1111, Phys 1041; 2 lect and 4 lab hrs per wk)
Farmstead layout, land measurements, and surveying. Design and usage of concrete, wood, and metal in agricultural buildings with applications and fabrication of building components. Environmental considerations, including animal heat loss, insulation, ventilation, solar energy, sensing devices, and controllers. Waste management.

Course Descriptions

3610. ELECTRICITY AND ELECTRONICS IN AGRICULTURE. (4 cr; prereq Math 1111, Phys 1041; 3 lect and 2 lab hrs per wk)
Basic theory and practical application of electricity in agriculture. Electric motors, heating, lighting, and controls. Selection and maintenance of electrical equipment. Electronic devices and computer control.

5000. PROFESSIONAL EXPERIENCE PROGRAM. (4 cr; prereq #; S-N only; free elective for AgET undergrads; not for grad cr; extension regis only)
Professional experience in agricultural engineering firms or government agencies through supervised practical experience; evaluative reports and consultations with faculty advisers and employers.

5020. PROGRAM PLANNING AND INSTRUCTIONAL METHODS IN AGRICULTURAL MECHANICS. (4 cr; prereq 10 cr agricultural engineering technology, AgEd 3031 or †AgEd 3031)
Planning and designing high school vocational agriculture facilities, organizing equipment, tools, supplies, and storage required by the instructional program. Administering the agricultural mechanics program. Developing teaching techniques and program planning as related to student-supervised study programs in agricultural mechanics.

5027. APPROPRIATE TECHNOLOGY FOR INTERNATIONAL DEVELOPMENT. (4 cr; prereq Math 1111, Chem 1001 or 1004, Phys 1041; 3 lect and 3 lab hrs per wk)
Definitions, history, successes and failures of appropriate technology. Social and technical appropriateness. Water supply, treatment, storage, and conveyance. Water pumps, sanitation. Power; pedal, wind, water, solar, rice-hull furnace, methane, Stirling-cycle engine. Building materials. Agricultural machinery and storage. Transfer and adoption of technology.

5030, 5031, 5032, 5033, 5034, 5035. PROBLEMS AND FIELD STUDIES IN ADVANCED AGRICULTURE. (1-3 cr; prereq 5020 or #)
Principles and practices pertaining to implementation of instructional programs in agricultural mechanics. Selection, application, operation, service, and maintenance of equipment used in agricultural mechanics for the specific instructional program.

5030. Agricultural Tractor and Engine Power

5031. Agricultural Machinery and Mechanization

5032. Electrical Power and Processing

5033. Farm Buildings and Environment Control

5034. Natural Resources Development and Management

5035. Metal Fabrication Materials and Techniques

5040. ADVANCED METHODS FOR TEACHING AGRICULTURAL MECHANICS. (3 cr; prereq #; 2 lect and 3 lab hrs per wk; off campus in fall and spring, on campus SSI)

Trends and role of agricultural mechanics in the mechanization of agriculture. Organization of instructional areas, selection of tools, supplies, reference materials, and facilities. Preparation of instructional materials and methods of effective teaching. Development of teaching demonstrations and procedures.

5091-5092. SPECIAL PROBLEMS IN AGRICULTURAL ENGINEERING. (2-5 cr per qtr; prereq #)
Individual study project in agricultural engineering at advanced level. Application of engineering principles to a specific problem.

5099. RCD INTERDISCIPLINARY SEMINAR I. (4 cr, 5099-5100, §RCD 5099, §AgEc 5099, §LA 5099, §Soil 5099; prereq resource and community development sr or #)
Selected speakers, readings, and discussion topics dealing with resource and community development analysis and implications for resource allocation. Students participate as a team, combining disciplinary skills to analyze complex resource problems.

5100. RCD INTERDISCIPLINARY SEMINAR II. (4 cr, 5099-5100; §RCD 5100, §AgEc 5100, §LA 5100, §Soil 5100; prereq 5099 or #)
(Continuation of 5099) Papers, presentations, and critiques on selected complex resource problems in Seminar I.

5400. DRAINAGE AND IRRIGATION. (4 cr, prereq Soil 3210; 3 lect and 2 lab hrs per wk)
Soil moisture excesses and deficiencies. Theory and design of tile drainage, surface drainage, and sprinkler irrigation systems. Development of irrigation water supplies. Selection of pumps and power units for drainage and irrigation. Economic feasibility. Legal problems and procedures.

5410. HYDROLOGY AND WATER QUALITY. (5 cr; prereq Math 1111, Phys 1041, Chem 1004, 1005, 3 lect, 3 lab, and 1 rec hrs per wk)
The hydrologic cycle—precipitation, infiltration, evaporation, surface and subsurface runoff, ground water recharge. Flow in streams, flow in aquifers, flow measurement. Soil erosion, sediment transport and deposition. Chemical pollution of surface water and groundwater.

Courses in Agricultural Engineering in IT (AgEn)

The following courses, offered by the Institute of Technology, are open to students in the four-year engineering curriculum and to those who have completed the prerequisite courses.

1031. COMPUTATIONS IN AGRICULTURAL ENGINEERING. (2 cr; prereq IT lower division, CSci 3101 or equiv, Math 1231; 1 lect and 2 rec hrs per wk) Introduction to problems in agricultural engineering. Elementary numerical and computational techniques. Applications involving FORTRAN programming.

1060. AGRICULTURAL ENGINEERING ORIENTATION. (1 cr; S-N only; 2 hrs per wk) Introduction to agricultural engineering practice through lectures, readings, demonstrations, and classroom discussions. Identification of professional opportunities and responsibilities.

3052. PHYSIO-ENGINEERING IN AGRICULTURE. (4 cr; prereq IT student, AEM 3016 or $\frac{1}{2}$ AEM 3016; 3 lect and 3 lab hrs per wk) Mechanical and hydraulic properties of porous media moisture relations; strength parameters for structural and mechanical design. Soil-machine action involved in tillage and traction. Energy and water balance in the soil-plant system. Plant structure and growth. Engineering and management requirements.

3060. ANALYSIS IN AGRICULTURAL ENGINEERING. (4 cr; prereq IT student, CSci 3101 or equiv, Math 3211; 4 lect hrs per wk) Introduction to probability. Normal and other frequency distributions. Elementary statistics with applications to problems in agricultural engineering. Engineering economics and benefit cost analysis.

3970. DIRECTED STUDIES IN AGRICULTURAL ENGINEERING. (Cr ar; prereq #) Independent study of topic(s) involving physical principles as applied to agricultural production and land resources.

5050. INTERN REPORTS. (2 cr per qtr; prereq IT student) Required of students in the engineering intern program during the employment periods.

5060. PROCESSING. (4 cr; prereq IT upper division or grad IT major, 3052, ME 5342; 3 lect and 3 lab hrs per wk) Size reduction, cleaning, and conveying of agricultural products. Properties of air, water vapors, and biological materials. Engineering principles of moisture and heat transfer applied to drying of grain crops. Theory and application of refrigerated and controlled atmosphere storage.

5070. AUTOMATIC CONTROL AND INSTRUMENTATION. (4 cr; prereq IT upper division or grad IT major; 3060, EE 3000 or EE 3002; 2 lect and 4 lab hrs per wk) Control of machines and processes. Linear feedback control. Linking of physical and biological control systems. Instrumentation for control systems and industrial development studies.

5072. FINITE ELEMENT METHOD: FUNDAMENTALS AND APPLICATIONS. (4 cr; prereq IT upper division or grad IT major, differential equations, and sr status or #; 4 lect hrs per wk) Basic theory and principles of implementation of the finite element method for fundamental engineering areas. Applications in heat transfer, fluid mechanics, solid mechanics, radial and axisymmetric field problems, and time-dependent field problems.

5074. MICROCOMPUTER INTERFACING. (4 cr; prereq IT upper division or grad IT major, AgET 3030 or CSci 3101 or CSci 3102; 2 lect and 4 lab hrs per wk) Introduction to digital components, integrated circuits and microcomputers. Interfacing of microcomputers for data acquisition and control.

5081, 5082, 5083, 5084. DESIGN. (4 cr per qtr; prereq IT upper division, completion of appropriate AgEn sr level courses, or #; 1 lect and 6 lab hrs per wk) An engineering design project in the student's interest area(s), integrating previous work and covering the whole range of the design process from conceptualization through preparation of the project report. 5081: Power and machinery. 5082: Soil and water. 5083: Structures and environment. 5084: Food engineering.

5130. FOOD ENGINEERING. (4 cr; prereq IT upper division or grad IT major, thermodynamics, 3060 or #; 4 lect hrs per wk) Fundamental requirements for handling food products. Separation processes in the food industry. Storage of foods. Optimization techniques, experimental design, project management methods, and engineering economics for the food industry.

5140. THERMAL PROCESSES FOR FOOD. (4 cr; prereq IT upper division or grad IT major, heat transfer, 5060 or #; 3 lect and 3 lab hrs per wk) Engineering principles of thermal processing of food, pasteurization, microwave heating, heat exchange, evaporation, refrigeration and freezing. Process design and evaluation.

5191-5192. SPECIAL PROBLEMS IN AGRICULTURAL ENGINEERING. (2-5 cr per qtr; prereq #) Individual study project at an advanced level involving application of engineering principles to a specific problem.

5330. AGRICULTURAL MACHINERY. (4 cr; prereq IT upper division or grad IT major, knowledge of agricultural mechanisms as assessed by instructor; 3 lect and 3 lab hrs per wk) Operation and performance characteristics of agricultural machines. Forces operating on selected machine components. Control systems, design for operator convenience and safety. Machinery selection and management. Design of machine elements and assemblies. Motion analysis.

5340. AGRICULTURAL TRACTORS. (4 cr; prereq IT upper division or grad IT major, ME 3301; 3 lect and 3 lab hrs per wk) Engineering principles governing performance of tractor and implement systems. Transmission design, hydraulic control systems, terramechanics, ergonomics, thermodynamics of diesel engines.

Course Descriptions

5540. EROSION CONTROL, WATERSHED ENGINEERING. (4 cr; prereq IT upper division or grad IT majors, 3052 or CE 3300, CE 5401 or #; 3 lect and 3 lab hrs per wk)

Measurement and mechanics of watershed runoff and soil erosion. Estimating peak runoff, soil losses, and sediment yields. Environmental effects. Principles of small watershed planning for flood control, water storage, and sediment control. Hydraulic design of graded and storage type terraces, grass waterways, diversions, and erosion control structures.

5550. DRAINAGE AND IRRIGATION ENGINEERING. (4 cr; prereq IT upper division or grad IT major, 3052 or CE 3300, CE 5401 or #; 3 lect and 3 lab hrs per wk)

Flow of water through agricultural soils. Irrigation and drainage requirements, salinity control, evapotranspiration, water supply development and control. Conveyance of drainage and irrigation waters. Considerations for design, layout, and construction of irrigation and drainage systems. Institutional, environmental, and economic aspects of soil moisture control.

5730. AGRICULTURAL STRUCTURES DESIGN. (4 cr; prereq IT upper division or grad IT major, 3052, AEM 3016; 3 lect and 3 lab hrs per wk)

Buildings and materials used in agricultural production. Static, live, snow, and wind loads. Codes and standards. Costs. Concrete formulation, quality, testing, footings, columns, beams, slabs. Wood terminology and characteristics, plywood, fasteners, protection. Systems, planning, and interaction of buildings with agriculture production.

5740. ENVIRONMENTAL CONTROL FOR AGRICULTURAL PRODUCTION. (4 cr; prereq IT upper division or grad IT major, ME 5603; 3 lect and 3 lab hrs per wk)

Ventilation, insulation, and condensation control in enclosed plant and animal production structures. Biological constraints upon the system. Temperature, humidity, light, and contaminants, e.g., dust, noxious gases, and pathogens. Simulation of weather phenomena for prediction of environmental conditions.

5910. AGRICULTURAL WASTE MANAGEMENT ENGINEERING I. (4 cr; prereq IT upper division or grad IT major, 3052, Chem 1005; 3 lect and 3 lab hrs per wk)

Sources and characteristics of agricultural wastes, including animal manures, crop residues, sediments, processing wastes, and domestic wastes. Effects on the environment. Sanitary collection, storage, treatment, and disposal. Utilization of liquid and solid wastes. Nonurban water supply and quality.

For Graduate Students Only

(For descriptions, see *Graduate School Bulletin*)

8100. SEMINAR

8190, 8191, 8192. ADVANCED PROBLEMS AND RESEARCH

8500. HYDROLOGIC MODELING—SMALL WATERSHEDS

8700. MOISTURE AND HEAT TRANSFER

Agronomy and Plant Genetics (Agro)

1001. SEMINAR: ORIENTATION TO AGRONOMY. (1 cr; S-N only)

Introduction to agronomy—its programs and objectives in teaching, research, and extension through informal seminars with staff and students. Visits to research and teaching facilities to acquaint students with personnel and facilities of the department.

1010. PRINCIPLES OF AGRONOMY. (5 cr, \$3010, \$3020, \$3030)

Principles and practices of plant and related sciences as they apply to increasing efficiency, productivity, and genetic improvement of field crops. Topics include crop selection, improvement of crops through plant breeding, seeds and seeding, growth and development, minimizing production hazards, harvesting and storage. Lecture and laboratory.

1020. SPECIAL PROBLEMS. (1-3 cr; prereq 5 cr agronomy, #)

In-depth research or studies in agronomy. Intended for students who wish to pursue aspects of agronomy in greater depth than that offered in formal courses or who wish to investigate areas not presently offered in courses. Tutorial instruction under staff guidance.

1100. MORPHOLOGY AND IDENTIFICATION OF CROPS AND WEEDS. (4 cr)

Developmental morphology of seeds, seedlings, and plants. Morphological features of seeds and plants as keys to help identify crops and weeds of major economic importance in the world. Lecture and laboratory.

1110. SEED ANALYSIS AND GRAIN GRADING. (3 cr; prereq 1100 or #)

Principles and practice in evaluating field crop seeds for purity and quality and in grading grain. Lecture and laboratory.

3001. PROFESSIONAL SKILLS ENRICHMENT. (1 cr; prereq Rhet 1101; Rhet 1222, agronomy major or #)

Students will complete some form of communication skills or leadership enrichment project, e.g., oral, audio, visual, essay, or any combination of activities, designed to enhance the students' professional competence and leadership abilities.

3010. ADAPTATION, DISTRIBUTION, AND ECOLOGY OF FIELD CROPS. (4 cr; prereq Biol 1009)

Principles of crop adaptation, distribution, and ecology in a context of current and projected world crop needs. Emphasis on the importance of adaptation to crop distribution and production and on the relationships of crops to the environmental factors of light, moisture, and temperature. Crop production practices as a means of managing environmental factors. Lecture and discussion.

3020. GROWTH, DEVELOPMENT, AND CULTURE OF FIELD CROPS. (5 cr; prereq Biol 1009, Chem 1005 or equiv)

Principles of growth and development of field crops and their management to achieve maximum crop productivity. Emphasis on seeds and seeding; physiological basis of growth and development; and effects of physical and biological environmental factors on crop growth, development, and culture. Lecture and laboratory.

3030. MATURATION, HARVEST, AND STORAGE OF FIELD CROPS. (4 cr; prereq Biol 1009, Chem 1005 or equiv)

Development and maturation of grains and forage crops, including the synthesis and accumulation of organic constituents and changes in these constituents as a result of the maturation process. Estimation of crop maturity and development of criteria for crop harvest, role of pre- and post-harvest treatments in preparation for storage, and losses associated with crop harvest. Principles of storage and preservation of crops in moist or dry state. Lecture and laboratory.

3031. MATURATION, HARVEST, AND STORAGE OF FIELD CROPS—DISCUSSION. (1 cr; S-N only; prereq #3030)

Informal small group discussion of questions and problems identified in lectures in 3030, readings, or other sources and review of examinations and papers.

3060. FIELD PLOT DESIGN IN AGRONOMY. (3 cr; prereq jr, Δ)

Principles of field plot technique and design as applied to field demonstrations and experiments involving one or two variables. Experiment interpretation procedures including analysis of data, tests of significance, and treatment comparisons. Computers will be utilized for some data processing and statistical procedures.

3150. ADVANCED SEED AND GRAIN EVALUATION. (4 cr; prereq 1100 or #; 1110 recommended)

Laboratory practice in identification of crops, weeds, and diseases and in grain grading and seed analysis. Members of the Intercollegiate Crops Team are selected from this class.

3200. SEMINAR. (1 cr; prereq jr or sr, #)

Investigation through literature review and group discussion of selected topics in agronomy. Major emphasis on recent advances in agronomy.

5000. PROFESSIONAL EXPERIENCE PROGRAM. (4 cr; prereq #; not for grad cr; S-N only; extension regis only)

Supervised practical professional experience in agromony industries and farm enterprise systems, together with studies of various aspects of the industry and related fields.

5001. PROBLEMS IN AGRONOMY FOR ADVANCED STUDENTS. (1-5 cr; prereq 20 cr agronomy, #)

In-depth research or studies in agronomy. Intended for advanced students who wish to pursue aspects of agronomy in greater depth than that offered in formal courses or who wish to investigate areas not presently offered in courses. Independent study and research under staff guidance.

5010. FORAGE PRODUCTION AND UTILIZATION. (4 cr; prereq 1010 or #)

Interrelationships between plants and animals as they relate to the selection, production, and utilization of forage crops. Crop management practices including establishment, maintenance, and harvesting of forages as pasture, hay, or silage. Physiological basis of forage management of various species. Forage quality and utilization as related to livestock feeding with emphasis upon ruminant nutrition. Lecture and laboratory.

5020. INTRODUCTION TO PLANT BREEDING. (4 cr; prereq GCB 3022 or equiv)

Application of genetic principles to improvement of crop plants. Includes self-pollinated, cross-pollinated, and asexually propagated crops.

5030. WEED CONTROL. (5 cr; prereq 1010 or #; Agro 3020 and/or PIPh 3131 recommended)

Survey of the magnitude of the weed problem. Regulatory aspects of weed control and herbicide usage. Principles and methods of weed control. Lecture and discussion.

5040. CORN AND SOYBEAN MANAGEMENT. (3 cr; prereq 3010, 3020, 3030, Soil 1122 or #)

Discussion and case-study approach to corn and soybean management in Minnesota, based on an integration of agronomic principles.

5060. SMALL GRAINS, SUNFLOWER, AND SUGAR BEET MANAGEMENT. (3 cr; prereq 3010, 3020, 3030, 5030, Soil 1122, or #)

Discussion and case study of agronomic principles for production of wheat, oats, barley, sunflowers, and sugar beets, including crop and variety selection and rotation, tillage and seedbed preparation, planting, cultural practices, pest control, harvest, and utilization.

5110. ADAPTATION, DISTRIBUTION, AND ECOLOGY OF FIELD CROPS. (3 cr, \$3010; prereq Biol 1009)

Principles of crop adaptation, distribution, and ecology in a context of current and projected world crop needs. Emphasis on the importance of adaptation to crop distribution and production and on the relationships of crops to the environmental factors of light, moisture, and temperature. Crop production practices as a means of managing environmental factors. Lecture and discussion.

Course Descriptions

5120. GROWTH, DEVELOPMENT, AND CULTURE OF FIELD CROPS. (5 cr, §3020; prereq Biol 1009, Chem 1005 or equiv)

Principles of growth and development of field crops and their management to achieve maximum crop productivity. Emphasis on seeds and seeding; physiological basis of growth and development; and effects of physical and biological environmental factors on crop growth, development, and culture. Lecture, laboratory, and discussion.

5130. MATURATION, HARVEST, AND STORAGE OF FIELD CROPS. (4 cr, §3030; prereq Biol 1009, Chem 1005 or equiv)

Development and maturation of grains and forage crops, including the synthesis and accumulation of organic constituents and changes in these constituents as a result of the maturation process. Estimation of crop maturity and development of criteria for crop harvest, role of pre- and post-harvest treatments in preparation for storage, and preservation of crops in moist or dry state. Lecture, laboratory, and discussion.

5200. WORLD FOOD SUPPLY PROBLEMS. (4 cr, §AgEc 5790, §FScN 5643, §Soc 5675, §LACS 5280; prereq sr or grad student with #)

A multidisciplinary approach to the social, economic, and technical problems of feeding the world's growing population. Principles sought from the social and economic sciences and plant, animal, and food sciences for their application to world food problems.

For Graduate Students Only

(For descriptions, see *Graduate School Bulletin*)

8000. SUPERVISED TEACHING EXPERIENCE IN AGRONOMY

8010. RESEARCH IN AGRONOMY

8020. SEMINAR: AGRONOMY

8030. MODE OF ACTION OF HERBICIDES

8050. PHYSIOLOGY OF FIELD CROPS

8055. SOURCE-SINK RELATIONS

8080. CURRENT TOPICS IN AGRONOMY

8100. PASTURE AND FORAGE RESEARCH TECHNIQUES

8200. PRINCIPLES OF PLANT BREEDING I

8210. PRINCIPLES OF PLANT BREEDING II

8220. APPLICATION OF QUANTITATIVE GENETICS TO PLANT BREEDING

8230. CYTOGENETICS

8240. PLANT GENETICS IN RELATION TO PLANT IMPROVEMENT

8270. SEMINAR: PLANT BREEDING

8280. CURRENT TOPICS IN PLANT BREEDING



8310.* ORIENTATION TO FIELD CROP BREEDING

8320. ORIENTATION TO AGRONOMY FIELD RESEARCH TECHNIQUES

8330.* RESEARCH IN PLANT GENETICS

Animal Science (AnSc)

1100. INTRODUCTORY ANIMAL SCIENCE. (5 cr)

Emphasis on fundamental concepts of physiology, nutrition, animal breeding, and management as they apply to production of livestock and poultry. Species surveys.

1110. DAIRY CATTLE EVALUATION. (2 cr)

Evaluation of dairy animals on the basis of anatomy, production performance, and breeding. Visits to one or more herds in the area.

1120. LIVESTOCK AND MEAT EVALUATION. (4 cr)

Evaluation, grading, and pricing of live meat animals, followed by evaluation of the conformation, quality, and finish of carcasses and cuts. Principles of judging and grading of meat.

1301. MANAGEMENT TECHNIQUE: SWINE. (1 cr; S-N only, #)

Practical experience in management skills and routines in the care of swine.

1302. MANAGEMENT TECHNIQUE: SHEEP. (1 cr; S-N only, #)

Practical experience in management skills and routines in the care of sheep.

1303. MANAGEMENT TECHNIQUE: BEEF. (1 cr; S-N only, #)

Practical experience in management skills and routines in the care and production of beef cattle.

1304. MANAGEMENT TECHNIQUE: DAIRY. (1 cr; S-N only, #)

Practical experience in management skills and routines in the care of dairy cattle and production of milk.

1305. MANAGEMENT TECHNIQUE: POULTRY. (1 cr; S-N only, #)

Practical experience in management skills and routines in the care of poultry and the production of poultry meat and eggs.

1510. CONSUMER MEAT SCIENCE. (2 cr)

Compositional variation, processing, selection, storage, cookery, palatability, and nutritional value of red meat.

1520. MILK PRODUCTION. (3 cr; prereq 1100 or #)

Relationships of production and management concepts to dairy farm planning and production and marketing of high-quality milk.

1600. HORSE PRODUCTION. (4 cr, \$5501)

Breeds, selection, diseases, feeding, reproduction, management, and color inheritance of light horses. Demonstrations of equitation, tack, and farriery.

1601. HORSE EQUITATION AND MANAGEMENT. (1 cr)

Equitation, dressage, tack, grooming, and schooling in Western and English styles of riding. Management, nutrition, and record keeping concerning riding horses.

3111. VERTEBRATE BEHAVIOR. (4 cr; prereq Biol 1009, 3011 or #)

Introduction to the nature and variety, development, motivation, and evolution of animal behavior, emphasizing social interactions and communication.

3113. ANIMAL WELFARE. (4 cr; prereq soph)

Socioeconomics of the use of other animals by humans. Assessment of animal suffering and welfare. Historical roots of attitudes toward other animals. Management practices and welfare of domestic and wild animals.

3120. ADVANCED MEAT ANIMAL, CARCASS EVALUATION. (1 cr; prereq 1120; 3130 or 3131, 3142, 3143 recommended)

Evaluation, grading, and pricing of live meat animals and carcasses; judging, placing, breeding animals using growth and reproduction records. Preparation for collegiate meat animal evaluation team competition.

3130. BEGINNING LIVESTOCK JUDGING. (2 cr; prereq soph or #; 1120 recommended)

Visual evaluation of beef cattle, swine, sheep, and quarter horses for type, muscling, degree of finish, structure, and soundness. Short oral presentations. For students with limited livestock judging experience; preparation for collegiate livestock judging team competition.

3131. LIVE ANIMAL PERFORMANCE AND SELECTION. (3 cr)

Meat animal performance and selection through the use of live animal, carcass, and record evaluation. Each class includes a one-hour lecture and a two-hour laboratory. Recommended for students planning vocations in meat animal production, extension, vocational agriculture, and agribusiness.

3141. ADVANCED DAIRY JUDGING. (1 cr; prereq 1110)

Evaluation and selection of dairy cattle. Visits to local dairy herds. Training in presentation of oral and written reasons. Students selected from this course participate in intercollegiate judging contests.

3142. ADVANCED LIVESTOCK JUDGING. (1 cr; prereq 1120, 3130)

Visual evaluation of beef cattle, swine, sheep, and quarter horses for type, muscling, finish, structure, and soundness. Use of production (growth and reproduction) records in evaluation. Oral presentations. For students with previous livestock judging experience; preparation for national collegiate livestock judging team competition.

Course Descriptions

3143. MEATS JUDGING AND GRADING. (2 cr; prereq 1120 or ¶1120)

In-depth training in beef, pork, and lamb judging, writing reasons, and carcass grading. Field trips to packing plants. Students selected from this course participate in Intercollegiate Meats Judging Contests.

3144. WOOL CLASSIFICATION, GRADING AND JUDGING. (2 cr)

Principles of classification and grading. Active learning with practical experience to determine fiber diameter, yield, and economic value of fleeces. Evaluation and judging of fleece classes. Preparation for collegiate wool judging team competition.

3220. PRINCIPLES OF ANIMAL BREEDING. (5 cr; GCB 3022 recommended)

Application of qualitative genetic principles to animal breeding. Introduction to quantitative genetics. Concepts of livestock improvements through breeding and selection systems.

3301. SYSTEMIC PHYSIOLOGY. (6 cr; prereq Biol 1009, BioC 1301)

Introduction to animal physiology, emphasizing the function of the organ systems.

3305. REPRODUCTIVE PHYSIOLOGY, ARTIFICIAL INSEMINATION, AND LACTATION. (5 cr; prereq 3301)

Functions of the reproductive organs, fertilization, the estrous cycle and its endocrine control, reproductive efficiency, and problems and principles of artificial insemination. Anatomy, physiology, and biochemistry of the mammary gland. Mammary growth, initiation and maintenance of lactation, milk synthesis, and factors influencing the lactation curve.

3401. PRINCIPLES OF ANIMAL NUTRITION. (3 cr, §1401; prereq Chem 1002 or BioC 1301 or Chem 3301)

Classification and function of nutrients; use of nutrients for body maintenance, growth, egg production, gestation, and lactation; comparative study of the digestive systems of farm animal species.

3402. APPLIED ANIMAL NUTRITION. (2 cr, §1401; prereq 3401)

Sources of nutrients (feedstuffs) for livestock and poultry, nutrient requirements, feeding standards and their uses, formulation using computer technology, practical considerations in livestock feeding.

3510. GROWTH AND DEVELOPMENT OF ANIMAL TISSUES. (3 cr; prereq 3301, BioC 3301, 1302 or Biol 5001; 1120 recommended)

Growth and structure of muscle, bone, and adipose tissue; whole animal growth; factors influencing rate and efficiency of muscle growth; influence of post-mortem factors on fresh meat properties.

3730H. HONORS SEMINAR IN ANIMAL SCIENCE. (1 cr; prereq jr or sr, #)

Faculty and graduate students discuss their research in terms of content, importance, and impact on animal agriculture.

3770H. HONORS SENIOR RESEARCH THESIS IN ANIMAL SCIENCE. (2 cr; prereq sr, #)

Participation in extension programs or in designing and conducting an experiment in area of student's interest. Will work closely with a faculty advisor; culminate with a thesis and seminar presentation.

5000. PROFESSIONAL EXPERIENCE PROGRAM. (4 cr; prereq #; S-N only; free elective for animal science undergrads; not for grad cr; extension regis only)

Professional experience in animal science firms or government agencies through supervised practical experience; evaluative reports and consultations with faculty advisers and employers.

5104. AGRICULTURAL SYSTEMS ANALYSIS AND MODELING. (4 cr, §PIPa 5104, §AgEc 5104, §Soil 5104; prereq Math 1142 or #)

Introduction to bioeconomic modeling as preparation for interdisciplinary agricultural systems analysis. Basic concepts; deterministic and stochastic models; delays, feedback, and clockwork; data acquisition; model verification and validation; role of models in agroecosystem management.

5231. DAIRY CATTLE BREEDING. (4 cr; prereq 3220 or #)

Application of quantitative genetic principles to the breeding of dairy cattle. Primary emphasis on evaluation of males, females, and systems of breeding. Rates of genetic improvement with and without artificial insemination.

5240. ANIMAL CYTOGENETICS. (4 cr; prereq GCB 3022 or #)

Application of cytogenetics to problems in animal biology. Emphasis on relationship of cytogenetic principles and practices to other fields such as animal breeding, pathology, cellular biology, and systematics.

5280. LIVESTOCK ENTOMOLOGY. (3 cr, §Ent 5280)

Biology and management of arthropods that are directly and indirectly significant to livestock health and animal production systems. Emphasis on regional and national problems.

5322. PHYSIOLOGY OF REPRODUCTION. (5 cr; prereq 6 cr systemic physiology)

Principles of reproductive physiology with emphasis on endocrinological aspects.

5325. PHYSIOLOGY OF FERTILIZATION AND GESTATION. (4 cr; prereq 5322 or #; offered winter 1989 and alt yrs)

Physiological events occurring during gametogenesis, capacitation, fertilization, the period of embryo, the period of fetus, and parturition.

5326. IMMUNOREPRODUCTION. (4 cr; prereq 5322 or #; offered spring 1989 and alt yrs)

Blood groups and polymorphic proteins affecting reproduction, immunoglobulin formation, antigens of semen, ova and genital secretions, immunopathology, maternal-fetal incompatibility, and antibodies to hormones.

5327. GENERAL ENDOCRINE PHYSIOLOGY.

(3 cr; prereq 3301 or #)

Biological effects, biochemistry, methods of assay, and regulatory aspects of hormones.

5328. GENERAL ENDOCRINE PHYSIOLOGY LABORATORY.

(2 cr; prereq 5327 or #)

Demonstration of concepts in endocrinology using experimental approaches.

5330. CURRENT TOPICS IN ENDOCRINOLOGY.(1 cr; prereq 3301, Biol 5001 or BioC 5001)
Current developments in endocrinology including introductory and review material, methodology, applicability of results to basic and applied research, and impact on existing endocrine principles.**5331. FERTILITY AND INCUBATION OF AVIAN EGGS.**

(3 cr; prereq 10 cr biology or #; offered winter 1988 and alt yrs)

Principles of physiology and management underlying the production of hatching eggs from a variety of avian species, including incubation of eggs and hatchery management.

5401. SWINE NUTRITION AND FEEDING.(4 cr; prereq 1401 or 3401)
Nutrient requirements of swine, all phases of life cycle considered; feed sources, their composition and utilization in formulation of adequate diets. Least cost formulations, nutritional interrelationships, and feeding systems. Use of feed additives.**5403. RUMINANT NUTRITION.**(4 cr; prereq 3401)
Nutrient requirements of ruminants (beef and dairy cattle, sheep); nutrient content of feedstuffs, primarily forages; protein and nonprotein nitrogen utilization; energy utilization; nutritional disorders; and formulation of adequate rations.**5405. POULTRY NUTRITION.**(3 cr; prereq 1401 or 3401)
Nutrient requirements of chickens and turkeys; feed composition and utilization in formulation of adequate diets. Role of feed additives. Least cost formulations, nutritional interrelationships, and feeding systems.**5407. LABORATORY ANALYSIS OF FEEDSTUFFS.**(2 cr; prereq sr or #)
The chemistry and theory of feedstuff analyses and interpretation of results. AOAC methods used. Students analyze samples of feedstuffs for dry matter, protein, ether extract, ash, crude fiber, neutral detergent fiber, acid detergent fiber, and lignin. Practical application of feed analyses stressed.**5512. MEAT AND PROTEIN TECHNOLOGY.**(4 cr; prereq BioC 1302 or #)
(Same as FScN 5512) Meat proteins: effects of pH, salt, and temperature on hydration and emulsification; methods of fractionation. Meat preservation: effects of heat, freezing, curing, and problems of product stability during storage. Sausage manufacture: chemistry, technology, least cost analysis (graphical and computer methods), and chemical methods of quality control (rapid and classical methods of proximate analysis).**5601. SWINE PRODUCTION.**(4 cr; prereq 3401; 3220 recommended)
Application of principles of animal breeding, nutrition, physiology, and economics. Swine production systems including swine feeding, breeding programs, selection of breeding animals, management of all classes of swine, housing, diseases, parasites.**5602. SHEEP PRODUCTION.**(4 cr; prereq 3401; 3220, 5403 recommended)
Status and characteristics of the sheep industry; application of principles of animal breeding, nutrition, physiology, and economics to management of sheep breeding flocks. Ration formulation, management, and marketing of feedlot lambs.**5603. BEEF CATTLE PRODUCTION.**(4 cr; prereq 3401; 3220, 5403 recommended)
Status and characteristics of the beef cattle industry; application of principles of animal breeding, nutrition, physiology, and economics to management of beef cattle breeding herds. Ration formulation, management, and marketing of feedlot cattle.**5604. DAIRY FARM MANAGEMENT.**(4 cr; prereq 1520, 5403 or #; 3220 recommended)
Application of principles of animal breeding, nutrition, physiology, and economics to planning and management of the dairy farm; genetic influences, housing requirements, health programs for large herds, feed budgets, and record analysis emphasized.**5605. POULTRY PRODUCTION.**(4 cr; prereq 3401; 5405 recommended)
Physiology, genetics, diseases, and nutrition of poultry and their relation to current management practices for production of eggs, broilers, and turkeys. Technical and practical phases of production and marketing in relation to their underlying principles. Visits to commercial production units.**5609. PRINCIPLES OF FARM ANIMAL ENVIRONMENT.**(3 cr; prereq jr, 3301, or #) El Halawani
Biological processes involved in the adjustment of animals to ambient environments, applications to farm animal management.**5703. LITERATURE AND SEMINAR.**(2 or 3 cr [3rd cr for 2nd seminar report]; prereq jr)
Introduction to library resources concerned with animal science. Techniques of searching, abstracting, and constructing reviews for written and oral reports from library materials. Evaluation of seminar reports.**5710. SPECIAL PROBLEMS.**(Cr ar; prereq #)
Research in an area of animal science under supervision of a staff member. Written report on the research required.**5715. TUTORIAL.**(Cr ar; prereq #)
Informally structured course to encourage study in depth of a specific discipline in animal science. Pertinent readings, centered on fundamental propositions, suggested; preparation of written essays of high quality required. Tutorials available in cryobiology, cytogenetics, genetics, meats, nutrition, and physiology.

Course Descriptions

For Graduate Students Only

(For descriptions, see *Graduate School Bulletin*)

8091. HORMONES AND BEHAVIOR
- 8220.* ADVANCED ANIMAL BREEDING
- 8221.* QUANTITATIVE INHERITANCE
8230. LINEAR MODEL METHODS
8332. PRESERVATION OF SPERMATOOZOA AND EMBRYO
- 8420.* ENERGY IN ANIMAL NUTRITION
- 8421.* PROTEIN AND AMINO ACID NUTRITION
- 8423.* MINERAL NUTRITION
- 8440.* RUMINANT NUTRITION
8441. RESEARCH TECHNIQUES IN RUMINANT NUTRITION
8603. GRADUATE SEMINAR
8740. CONCEPTS AND DEVELOPMENTS IN RUMINANT NUTRITION
8741. CONCEPTS AND DEVELOPMENTS IN AVIAN NUTRITION
8742. CONCEPTS AND DEVELOPMENTS IN SWINE NUTRITION
- 8750x. CONCEPTS AND DEVELOPMENTS IN MEAT SCIENCE AND TECHNOLOGY
- 8810x.* RESEARCH IN ANIMAL SCIENCE
- 8820x.* RESEARCH IN ANIMAL GENETICS
- 8830x. RESEARCH IN ANIMAL PHYSIOLOGY
- 8840x.* RESEARCH IN ANIMAL NUTRITION
- 8850x.* RESEARCH IN MUSCLE CHEMISTRY AND PHYSIOLOGY

Entomology (Ent)

1005. ECONOMIC ENTOMOLOGY. (4 cr; prereq Biol 1009 or #)
Brief introduction to structure and classification of insects; management of insect populations; life histories, habits, and recognition of insect pests of livestock, orchards, field crops, vegetables, and ornamentals.

3005. INTRODUCTORY ENTOMOLOGY. (5 cr; prereq Biol 1009 or equiv)
General morphology, life histories, habits, and classification of insects.

3020. PRINCIPLES OF BEEKEEPING. (4 cr; prereq Biol 1009 or #)

Lecture and laboratory demonstrations. History of beekeeping; life history and behavior of honey bees; colony and apiary management; pollination and hive products; honey bee diseases and their control.

5000. PROFESSIONAL EXPERIENCE PROGRAM. (4 cr; prereq #; S-N only; free elective for entomology undergrads; not for grad cr; extension regis only)

Professional experience in entomology firms or government agencies through supervised practical experience; evaluative reports and consultations with faculty advisers and employers.

5010. INSECT MORPHOLOGY. (5 cr; prereq 3175 or #)

Comparative studies of external and internal anatomy and histology of insects; phylogeny and function.

5020. INSECT TAXONOMY. (5 cr; prereq 3005 or equiv)

Identification of adults and immatures of taxa within insect orders.

5030.* INSECT PHYSIOLOGY. (5 cr; prereq #; BioC 5001 and 5002 or MdBc 5100 recommended)

Essential processes of insects. Includes 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.

5040.* INSECT ECOLOGY. (3 cr; prereq Biol 5041 or EBB 5122 or #)

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.

5200. APICULTURE. (4 cr; prereq 9 cr entomology or biology)

Characteristics and social behavior of honey bees; colony development and management; diseases and their control; hive products; pollination. Lectures and laboratory demonstrations.

5210. INTEGRATED PEST MANAGEMENT. (5 cr; prereq 1005 or #, ¶5211, ¶5212)

Management of insect, mite, and weed populations through integration of various methods and techniques (including biotic agents, host plant resistance, artificial measures, and cultural practices) as harmonious systems that, in the context of the associated environment and population dynamics, maintain subeconomic pest densities.

5215.* INSECTS IN RELATION TO PLANT DISEASES. (4 cr; prereq 5 cr entomology and 5 cr plant pathology or equiv or #)

(Same as PIPa 5215) Insect transmission and dissemination of plant pathogens; development of plant-insect relationships and habits of principal insect vectors.

5220. STORED PRODUCT PEST MANAGEMENT. (4 cr; prereq 1005 or 3005 or #)

Principles of management to protect stored food and fiber; pest identification, damage assessment, and prevention and control procedures based on interrelationships within storage ecosystems.

5250.* FOREST ENTOMOLOGY. (4 cr; prereq any two courses among the forestry, zoological, botanical, biological, and/or agricultural sciences)

Lectures and laboratory concerning ecology and population management of forest insects, with heavy emphasis on tree factors and biological control.

5275. MEDICAL ENTOMOLOGY. (4 cr; prereq 3175 or #)

Principal arthropods noxious to human beings and animals. Emphasis on those that serve as vectors of pathogenic organisms of human beings and animals.

5280. LIVESTOCK ENTOMOLOGY. (3 cr)

Biology and management of arthropods that affect livestock production systems.

5300. CHEMICALS AND INSECT BEHAVIOR. (2 cr; prereq 3175 or EBB 5112 and 12 cr organic chemistry)

Survey of the nature and behavioral role of chemicals affecting insect behavior, with emphasis on mating and host location. Research techniques also discussed.

5310. INSECT SAMPLING METHODS. (4 cr; prereq Stat 5021 or equiv)

Design of sampling plans for study of field populations with emphasis on pest insects.

5320. ECOLOGY OF AGRICULTURE. (4 cr, one 3000+ level course in Agron or Hort or An Sci and one 3000+ level course in Ent or Plant Path or Soils, or #)

Ecological perspective on post-industrial agriculture; origins of agriculture, social functions, and ecology of contemporary and extinct agricultural systems. Soils, plant development, pest ecology, forage quality, animal production, and food quality as an interactive network of factors.

5340. BIOLOGICAL CONTROL OF INSECTS. (2 cr; prereq 5210, introductory entomology and course in ecology)

Principles of biological control: history, ecological basis, classical biological control, augmentation, analysis of selected projects.

5350. INSECT PATHOLOGY. (5 cr; prereq 5027)

Survey of the major pathogenic microorganisms that cause diseases in insects; routes of infection of insects; laboratory propagation of disease agents; factors involved in application of disease to control of pest insects with safety considerations.

5360. AQUATIC ENTOMOLOGY. (2 cr; prereq 3005 or equiv or #)

Identification and biology of aquatic and littoral insects in all stages.

5370. PRINCIPLES OF SYSTEMATICS. (5 cr; prereq 3175 or equiv, 5133)

Procedures of systematic entomology, systematic literature, zoological nomenclature, use and construction of keys, and presentation of results of systematic research.

5380. LEPIDOPTEROLOGY. (2 or 3 cr with term paper; prereq course in entomology 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.

5600. FIELD ENTOMOLOGY AT ITASCA. (5 cr; prereq introductory biology; offered SSI at Itasca)

Insect fauna in various natural habitats of the park and surrounding areas. Includes field trips and collection and identification of insects, as well as studies of general morphology, life histories, and habitats of local species.

5610. AQUATIC ENTOMOLOGY AT ITASCA. (5 cr; prereq 3005 or 5600 or equiv or #; offered at Itasca)

Identification and biology of aquatic and littoral insects in all stages.

5620. RESEARCH PROBLEMS AT ITASCA IN ENTOMOLOGY. (Cr ar; prereq #)

Undergraduate students may develop a short-term research project during one or both summer terms.

5650. HOUSE AND GARDEN INSECTS. (3 cr; 3 lect and 6 lab hrs per week)

Identification and life history of commonly encountered Minnesota insects. Lectures by selected faculty and short field trips.

5900. BASIC ENTOMOLOGY. (Cr ar; prereq #)

Opportunity to make up certain deficiencies in biological background.

5910. SPECIAL PROBLEMS IN ENTOMOLOGY. (Cr ar; prereq #)

Individual field, laboratory, or library studies in various aspects of entomology.

5920. SPECIAL LECTURES IN ENTOMOLOGY. (Cr ar; offered when feasible)

Lectures and/or laboratories in special fields of entomological research given by a visiting scholar or regular staff member.

For Graduate Students Only

(For descriptions, see *Graduate School Bulletin*)

8030. ADVANCED INSECT PHYSIOLOGY**8050. INSECTICIDES AND THEIR ACTION****8055. INSECTICIDES LABORATORY****8200. COLLOQUIUM IN APICULTURE****8230. COLLOQUIUM IN INSECT PHYSIOLOGY****8240. COLLOQUIUM IN INSECT ECOLOGY**

Course Descriptions

8300. GRADUATE SEMINAR

8310. CURRENT TOPICS IN FOREST ENTOMOLOGY

8500.* RESEARCH IN ENTOMOLOGY

Food Science and Nutrition (FScN)

1010. MAN'S FOOD. (4 cr, §1012)

Human nutritional needs; food composition, world food supply, consumption patterns, acceptance, quality programs and regulations, food preservation, commercial processes, packaging, marketing, and national and international food programs.

1012. NUTRITION: CONCEPTS AND ISSUES. (3 cr, §1010)

Fundamental concepts of nutrition, including human nutritional requirements, function of nutrients in body, and nature of nutrient deficiencies. Selection of foods for balanced diet. Dietary survey. Vegetarianism, weight loss, fad diets. Relationship of nutrition to physical activity, obesity, cancer, heart disease, food processing, world food problems.

1020. INTRODUCTORY MICROBIOLOGY. (4 cr; especially for students in home economics; prereq 3rd-qr fr or #)

Fundamental principles of microbiology. Characteristics of bacteria, yeasts, molds, and other microorganisms, their importance in preparation and preservation of foods, relation to health and well-being of the individual and the family.

1030. UNDERSTANDING CHEESE. (2 cr; intended for nonmajors)

Conversion of milk into cheese; cheese curing; optimum characteristics of many varieties of natural cheeses; fondue, process, and club cheeses; nutritional value and care of cheese in the home.

1102. TECHNOLOGY OF FOOD PROCESSING. (4 cr; prereq high school chemistry and biology)

Introduction to the technology of processing foods with special reference to the prevention of biological, microbiological, physical, and chemical deterioration. Changes in food composition, microbiological safety, food laws and regulations, technologies of the major food processes such as canning, freezing, and drying.

1212. SCIENTIFIC PRINCIPLES OF FOOD PREPARATION. (5 cr; prereq Chem 1002 or 1005)

Introduction to composition and chemical and physical properties of foods; interaction and reaction of foods in preparation procedures; evaluation of food products prepared in the laboratory using quality standards.

1215. HOME PRESERVATION OF FOODS. (2 cr; intended for nonmajors)

Description and demonstration of safe methods of home food preservation. Students prepare various products in the laboratory. Methods covered include canning, freezing, fermenting, and drying.

3110. FOOD CHEMISTRY. (4 cr; prereq BioC 1302 or Biol 5001)

Structures, properties, reactions, and functions of basic chemical components of foods. Chemical properties of food systems, influence of processing, storage, and preparation.

3112. FOOD CHEMISTRY LABORATORY. (2 cr; prereq 3110 or §3110)

Laboratory experiments to investigate chemical properties and reactions of selected food systems and food components.

3123. MICROBIOLOGY OF FOODS. (5 cr, §MicB 3103, §VPB 3103; prereq Biol 1009 and 10 cr college chemistry, or 1020 or #; not for majors in food science and technology)

Incidence and sources of microorganisms in foods. Principles involved in control of microorganisms in foods for prevention of spoilage and public health hazards. Enhancement of keeping quality, nutritive value, and flavor attributes of food by the activities of microorganisms, as found in the manufacture of cheese or other fermented food products. Principles in sanitation and in destruction or inhibition of growth of microorganisms through use of physical and chemical agents.

3272. INTRODUCTION TO FOOD DECISION MAKING. (2 cr; prereq 3600)

Factors considered in planning nutritionally adequate and aesthetically pleasing menus for various eating patterns and cost levels. Use of computer to calculate menu nutrient content and to plan menus.

3400. FOOD COMMUNICATION TECHNIQUES. (3 cr; prereq 1212 or 3403)

Communication of information about food products (from proposal to marketing strategy) or recipes (from proposal to cookbook page). Individual and team oral and written presentations, demonstrations, food photography.

3403. EXPERIMENTAL FOODS. (4 cr; prereq 3110)

Principles and modern concepts of food systems and preparation; laboratory projects to illustrate effects of different procedures and ingredients.

3472. PRINCIPLES OF FOOD PURCHASING. (4 cr; prereq 5 cr in food science and nutrition)

Principles of purchasing the basic groups of foods. Relative cost of key nutrients from different foods within a food group. Food prices and indices of change. Laws and regulations pertinent to the labeling of food. Food standards and grades. Relation of these factors to the purchasing of food.

3600. PRINCIPLES OF NUTRITION. (4 cr; prereq Biol 1009 and Chem 1004 or equiv)

Fundamental principles of nutrition, including the essentiality and metabolism of nutrients and results of nutritional deficiencies or excesses, presented in the context of personal, national, and global aspects of human nutrition.

3602. NUTRITION IN PROFESSIONAL HEALTH CARE.

(4 cr, §3600; prereq chemistry, human physiology, pharmacology, pathophysiology, regis in a professional health discipline)
General principles of nutrition in professional health care. Nutrition as factor in attaining and maintaining health. Role of health practitioner in nutrition education.

3622. LIFE CYCLE AND COMMUNITY NUTRITION.

(4 cr; prereq 3600 or equiv, phsl or human biol, 6 cr psych, soc, anthro, or econ)
Application of principles of nutrition to meet specific requirements of growth, development, adult maintenance, and aging. Concepts and methodologies for application of nutrition principles to community nutrition practice. Community-based nutrition-related services and resources, public policy and government systems influencing them. Sociocultural factors affecting nutritional status.

3662. INTRODUCTION TO THE CLINICAL PRACTICE OF DIETETICS.

(2 cr; prereq 12 cr in food science and nutrition, regis in coordinated program in dietetics)
Introduction to the practice of dietetics in hospitals, outpatient clinics, public service agencies, and food services.

3703. FIELD EXPERIENCE IN FOODSERVICE MANAGEMENT.

(3-18 cr; prereq regis in coordinated program in dietetics or #)
Supervised foodservice production and management experience in a community or health care facility.

3730. QUANTITY FOOD PRODUCTION MANAGEMENT.

(5 cr; prereq 1212 or 3403, 3472)
Participation in management procedures used in selection, storage, preparation, pricing, and service of food in quantity. A quantity foodservice used as laboratory.

3732. LECTURE IN QUANTITY FOOD PRODUCTION MANAGEMENT.

(2 cr; prereq 3403, 3472, and #)
Understanding of management procedures used in selection, storage, preparation, pricing, and service of food in quantity.

5000. PROFESSIONAL EXPERIENCE PROGRAM.

(4 cr; prereq 15 cr in food science and nutrition and #; not for grad cr; A-F grading only; extension regis only)
Up to 12 weeks of planned experience in a selected position in the food industry; evaluative reports and consultations with faculty advisers and employers.

5100. GENERAL SEMINAR.

(1 cr; S-N only; prereq sr or #)
Literature review and presentation of papers in selected areas of food science and nutrition.

5111. INDEPENDENT STUDY IN FOOD SCIENCE AND NUTRITION.

(1-5 cr (may be repeated for cr); prereq Δ)
Individual laboratory or library research in some area related to food science or nutrition.

5120. FOOD MICROBIOLOGY.

(5 cr; prereq MicB 3103)
Relationship of environment to occurrence, growth, and survival of microorganisms in foods; evaluation of microbiological quality of dairy and food products; characteristics and activities of bacteria, yeasts, and molds related to food spoilage; utilization of microorganisms in manufacture of dairy and food products; recognition and control of food-borne pathogens and food poisoning.

5122. CONTROL OF MICROORGANISMS IN FOOD PROCESSING.

(2 cr; prereq 5120 or #; §5123 advised, especially for food science and technology majors)
Factors that influence control and destruction of microorganisms; chemical, physical, and microbiological principles in cleaning and sanitizing food processing equipment; inactivation of microorganisms and thermal process evaluation; microbiological preservation methods; development of sanitation programs; microbiological criteria; hazard analysis and critical control point concept.

5123. MICROBIOLOGY OF FOOD FERMENTATIONS.

(2 cr; prereq 5120 or #; §5122 advised, especially for food science and technology majors)
Characteristics of bacteria, yeasts, and molds involved in dairy and food fermentations; properties of lactic bacteriophages, methods of control in dairy fermentations; composition and factors that influence activity of dairy and food starter cultures; microbiology of natural and controlled fermentations; use of microorganisms in production of single-cell protein and products consumed in food, and in waste utilization.

5135. FOOD ENGINEERING UNIT OPERATIONS

(5 cr; prereq 1102 or §1102, Math 1142, Phys 1041-1046)
Principles and food system applications of following unit operations: fluid flow, heat transfer, drying, evaporation, contact equilibrium (distillation, extraction, crystallization, membrane processes), and mechanical separation (filtration, centrifugation, sedimentation, sieving).

5136. UNIT OPERATIONS LABORATORY.

(2 cr; prereq 5135)
Applications of food engineering unit operations; experiments involving fluid flow, heat and mass transfer.

5310. ADVANCED FOOD CHEMISTRY.

(3 cr; prereq 3110)
Changes in chemical structure and functional properties of foods as modified by processing. Additional topics in areas of flavor, color, safety, nutritive value, sweeteners, and irradiation of food.

5312. CHEMICAL AND INSTRUMENTAL ANALYSIS OF FOODS.

(5 cr; prereq 3112, BioC 5025 or #)
Application of quantitative physical, chemical, and instrumental methods of analysis to examination of food products; evaluation of methods and interpretation of results.

Course Descriptions

5320. FOOD BIOTECHNOLOGY. (3 cr; prereq 5123, Biol 5001)

Impact of biotechnology in agriculture, nutrition, and food processing. Discussion of recombinant DNA and related technologies, bioprocess engineering, and fermentation technology.

5350. APPLICATION OF EXPERIMENTAL DESIGN IN THE FOOD INDUSTRY. (4 cr; prereq course in statistics)

Application of concepts and techniques of experimental design to solution of food science problems. Case studies, computer programming and use emphasized.

5360. SENSORY EVALUATION OF FOOD QUALITY (4 cr; prereq 3110 and Stat 3081 or 5021 or equiv)

Fundamentals of sensory perception. Test designs and methods used in studying the sensory quality of foods.

5380. FOOD PACKAGING. (3 cr; prereq 3110, Phys 1042 or equiv)

Lecture and demonstration of principles of packaging as they apply to foods and the food industry.

5390. INTRODUCTION TO FOOD LAW. (4 cr; prereq 1102 or #)

Analysis of federal and state legal requirements and case law history affecting production, processing, packaging, marketing, and distribution of food and food products.

5402. MODERN FOOD PREPARATION PRINCIPLES AND PRACTICES. (2-4 cr; prereq organic chemistry and 15 cr food science and nutrition)

Experimental bases of principles underlying present-day food preparation practices; development of experiences illustrative of such principles in high school teaching, dietetics, and foods in business.

5403. EXPERIMENTAL STUDY OF FOODS. (5 cr; prereq 3112, 3403, 5360)

Individual laboratory experimentation and comprehensive literature search on a problem in foods. Statistics and computers as a research tool. Data analysis and interpretation for a scientific paper.

5404. CURRENT ISSUES IN FOOD AND NUTRITION. (2-4 cr; prereq 15 cr food science and nutrition or #)

Evaluation of popular and scientific literature dealing with nutrition, food additives, food safety, food fads, health foods, environmental contamination, the consumer movement, naturally occurring food toxicants, processed foods, synthetic foods, and organically grown foods.

5406. CURRENT LITERATURE IN FOODS. (2-4 cr [may be repeated for max 6 cr]; prereq 5413, Δ)

Assigned readings, reports, and discussions of topics in the experimental study of foods.

5412. PHYSICO-CHEMISTRY OF FOODS. (3 cr; prereq 3110)

Characterization of crystalline systems, gels, emulsions, foams, and rheological systems; functionality of food macromolecules in these systems.

5413. STRUCTURAL-FUNCTIONAL RELATIONS IN FOOD SYSTEMS. (3 cr; prereq 3110)

Food as a complex biochemical system. Functionality of various biological entities and chemical constituents of food systems.

5462. ADVANCED TOPICS IN SENSORY EVALUATION OF FOOD. (2-4 cr; prereq 5360)

Review of current literature pertinent to specific topics under active investigation.

5472. FOOD PURCHASING. (4 cr; prereq principles of economics and 15 cr food science and nutrition)

Cost-quality relationships of diverse food products as affected by technological changes. Composition and nutritive value of processed and formulated food products. Functional role of food additives. Recent legislation pertinent to labeling and grading of food products.

5473. ADVANCES IN THE MANAGEMENT AND PREPARATION OF FOOD. (2-4 cr; prereq 3403, 3472, or equiv)

Recent developments in food materials and methods of preparation; their implications in the management of time, money, and energy expenditures.

5474. FOOD CONSUMPTION ECONOMICS. (4 cr, \$AgEc 5550; prereq AgEc 3101 or #)

An analytical and empirical treatment of consumer food behavior. Concentrates on data and methods used to study economic and nutritional aspects of food consumption. Students pursue an individual project.

5512. MEAT TECHNOLOGY. (5 cr; prereq 3110, 5120)

Processing of meat, fish, and poultry products, including protein functionality, thermal processing, curing, smoking, and deterioration during storage. Use of pre-blending and least-cost analysis in product formulation. Recent developments, including restructured and gel-type products.

5522. TECHNOLOGY OF FLUID AND CONCENTRATED MILK PRODUCTS. (4 cr; prereq 3110, 5120, 5135, or #)

Application of scientific principles to problems involved in processing fluid and dehydrated milk systems and their control. Demonstration of basic processing operations including heating, cooling, homogenization, evaporation, drying, crystallization, and freezing.

5523. TECHNOLOGY OF FERMENTED DAIRY PRODUCTS. (4 cr; prereq 3112, 5123)

Integration of chemical, microbiological, and physical principles involved in the manufacture and storage of cheeses and fermented milks.

5524. SENSORY EVALUATION OF DAIRY PRODUCTS. (1 cr; prereq 3110 or #)

Laboratory and commercial procedures for evaluating sensory properties and market quality of dairy products. Causes and identification of common defects in flavor, physical properties, and appearance.

5530. INDUSTRIAL PROCESSING OF FRUITS AND VEGETABLES. (4 cr; prereq 3110, 5120, 5135 or #; 3 lect and 3 lab hrs per wk)

Relationship of chemical, physical, and microbiological principles to commercial processing of fruits and vegetables from procurement of raw products through preparation, preservation, packaging, storage, transportation, and merchandising. Emphasis on preservation methods involving heat sterilization, freezing, dehydration, and fermentation.

5540. FATS AND OILS CHEMISTRY AND TECHNOLOGY. (4 cr; prereq 3112 or #)

Nature of fats and oils; their structure, composition, and chemical and physical properties; raw materials for fat and oil products; extraction, refining, hydrogenization, and other industrial manipulations; handling, storage, and analysis and grading of raw materials and finished products.

5555. FREEZING AND DEHYDRATION OF FOODS. (5 cr; prereq 3110, 5120, 5135 or #)

Principles involved in the processing, handling, and storage of frozen, dry, and intermediate moisture foods, with emphasis on physicochemical properties of water in foods.

5562. FLAVOR TECHNOLOGY. (3 cr; prereq 1102, 3110 or #)

Flavor and off-flavor development in foods. Industrial production of food flavorings, their proper application to food systems.

5600. NUTRITION SEMINAR. (1 cr; prereq #)

Literature review and presentation of papers in selected areas of nutrition. (Extension only.)

5612. EXPERIMENTAL NUTRITION. (4 cr; prereq 5622 or #5622, BioC 5025 or #)

Principles and methods of diet formulation, dietary manipulation, energy and nitrogen balance, and body composition analyses in experimental animal models. Use and evaluation of methods and interpretation of results.

5622. MACRO NUTRIENT METABOLISM. (5 cr; prereq 3600, Biol 5001, Phsl 3051 or #)

Physiological function and metabolic fate of carbohydrates, lipids and proteins, and their involvement in fulfilling energy needs for maintenance, growth, and work.

5623. VITAMIN AND MINERAL BIOCHEMISTRY. (4 cr; prereq 3600, Biol 5001, Phsl 3051 or #)

Nutritional/biochemical and physiological function of essential vitamins and minerals in humans and experimental animal models.

5624. A METABOLIC APPROACH TO CLINICAL NUTRITION. (4 cr; prereq 5622, 5623)

Focus on individual human in clinical setting; the interaction of calorie deprivation, metabolic demands of illness, and nutritional implications of medical treatment.

5642. FIELD EXPERIENCE IN COMMUNITY NUTRITION. (3-18 cr; prereq at least one course in human nutrition and #)

Application of nutrition information to problems of health and welfare, involving assigned readings, discussions, and experience in a community agency.

5643. SEMINAR: WORLD FOOD SUPPLY PROBLEMS. (3 cr, \$AgEc 5790, \$Agro 5200, \$Soc 5675, \$LACS 5280; prereq sr or grad student with #)

A multidisciplinary approach to social, economic, and technical problems of feeding the world's growing population.

5662. CLINICAL NUTRITION. (3 cr; prereq 5622, Biol 3021 or #)

Application of principles of normal nutrition to clinical problems, with description of altered nutrient requirements under conditions of human disease. Nutritional therapy for common clinical conditions and effects of treatment on nutritional status of patient.

5664. FIELD EXPERIENCE IN CLINICAL NUTRITION. (3-18 cr; prereq course in human nutrition and #)

Application of nutrition information to problems of health and disease, involving assigned readings, discussions, and experience in a clinical facility.

5665. APPLIED CLINICAL NUTRITION I. (2 cr; prereq Biol 5001 or #5001, Phsl 3051 or 1002, LaMP 5177)

Description of fluid and electrolyte balance; common clinical tests; interrelationships of medications and nutrition. Description of diet therapies for common diseases of the gastrointestinal tract and selected acute medical conditions.

5666. APPLIED CLINICAL NUTRITION II. (2 cr; prereq 5665, 5622 or #5622 or demonstrated equiv)

(Continuation of 5665) Pathology, treatment, and diet therapy for diseases of cardiovascular system and common diseases of the endocrine system, notably diabetes mellitus.

5667. APPLIED CLINICAL NUTRITION III. (2 cr; prereq 5665, 5666, or demonstrated equiv)

(Continuation of 5666) Pathology, treatment, and diet therapy in diseases of kidney and urinary tract. Therapeutic management of selected central nervous system disorders, inborn errors of metabolism, and allergies. Special nutritional considerations in care of geriatric patients with common pathological disorders.

5668. ADVANCED CLINICAL NUTRITION. (2 cr; prereq 5662 or #)

An integrated approach to prevention and treatment of illness focusing on the role of nutrition in total medical care.

5675. CLINICAL NUTRITION LABORATORY I (1 cr; A-F only; prereq 5665 or #5665)

Application of nutrition principles to clinical problems related to hypermetabolic conditions and gastrointestinal disorders. Techniques of nutritional assessment and planning.

Course Descriptions

5676. CLINICAL NUTRITION LABORATORY II. (1 cr; A-F only; prereq 5666 or ¶5666)

Application of nutrition principles to clinical problems related to endocrine, cardiovascular, renal, and energy disorders. Techniques of diet calculation and patient education.

5693. SELECTED ASPECTS OF NUTRITION. (2-4 cr [may be repeated for max 12 cr]; prereq sr, 1212, 3600 or #)

In-depth investigation of a single, preselected aspect of nutrition in any one offering. Teaching procedure and approach determined by nature of topic and student needs. Specific topic announced in advance of course offering.

5694. METABOLIC BASIS FOR THERAPEUTIC NUTRITION. (4 cr; prereq 5664 or #)

Physiological and biochemical bases for dietary treatment and exploration of dietary principles related to adequate nutrition. Case study presentations and clinical experience included.

5702. SELECTED ASPECTS OF FOODSERVICE MANAGEMENT IN HEALTH CARE FACILITIES. (3 cr; prereq 3 cr elementary statistics, 6 cr economics, #)

Management techniques applied to foodservices for health care facilities. Methods of analyses and control.

5705. FIELD EXPERIENCE IN FOODSERVICE MANAGEMENT. (3-18 cr; prereq regis in coordinated program in dietetics or #)

Application of principles of foodservice management to problems in community, commercial, or health care facility.

5732. PRINCIPLES OF FOODSERVICE ORGANIZATION AND MANAGEMENT. (4 cr; prereq sr, 3732, Mgmt 3001, regis in coordinated program in dietetics)

Management of foodservice personnel, financial control, regulations, related administrative problems.

5750. PRINCIPLES OF FOODSERVICE MANAGEMENT. (4 cr; prereq 3730 or 3732, Mgmt 3001)

Application of management principles in a foodservice. Business procedures, personnel management, financial management, cost control, and related administrative problems. Field trips may be required.

5755. CURRENT TOPICS IN FOODSERVICE MANAGEMENT. (4 cr [may be repeated for max 8 cr]; prereq #)

In-depth examination of timely issues. Content varies from quarter to quarter.

For Graduate Students Only

(For descriptions, see *Graduate School Bulletin*)

8101. RESEARCH SEMINAR

8205. GENERAL SEMINAR

8311. FLAVOR CHEMISTRY

8312. REACTION KINETICS OF FOOD DETE-RIORATION

8313. TOPICS IN LIPID CHEMISTRY

8315. FOOD PROTEINS

8322. MICROBIOLOGY AND ENGINEERING OF FOOD STERILIZATION PROCESSES

8323. MICROBIAL STARTER CULTURES

8324. MICROBIAL TOXINS AND TOXIC MICROORGANISMS IN FOODS

8401. INDEPENDENT STUDY: FOOD SCIENCE

8403. ADVANCED TOPICS IN FOOD SCIENCE

8412. INTERRELATIONSHIPS AND FUNCTIONS OF FOOD COMPONENTS

8621. INDEPENDENT STUDY: NUTRITION

8622. ADVANCED HUMAN NUTRITION I

8623. ADVANCED HUMAN NUTRITION II

8624. ADVANCED HUMAN NUTRITION III

8627. HUMAN NUTRITION AND AGING

Nutr 8745. SEMINAR

Nutr 8990. GRADUATE RESEARCH

Horticultural Science and Landscape Architecture

Horticultural Science (Hort)

1010. HOME HORTICULTURE. (4 cr; no cr for horticulture majors or minors)

For non-horticulture majors. Applied knowledge of propagation and culture of fruits, vegetables, lawns, flowers, and house plants. Identification and use of trees and shrubs in the home landscape. Lectures and laboratory.

1015. APPLYING MICROCOMPUTERS TO HORTICULTURE. (3 cr; prereq #; 2 lect, 1 lab hr per wk; max 15 students)

Designed to improve competency in four areas of microcomputers: (1) operation of commonly available hardware (emphasis on IBM PC and Apple II Plus), (2) use of standard application software (emphasis on word processing, electronic spreadsheets, database management, statistics, data presentation), (3) use of specific application software in agricultural sciences (emphasis on horticulture), (4) basic programming skills (emphasis on BASIC). As much hands-on experience as possible. Short student project required.

1016. GREENHOUSE MANAGEMENT. (4 cr; prereq 1100)

Fundamentals of greenhouse construction and management; through discussion of cultural and physiological principles.

1021. WOODY PLANT MATERIALS. (5 cr)

Taxonomy, ecology, and landscape uses of trees, shrubs, and evergreens. Lectures, laboratories, and field trips.

1022. HERBACEOUS PLANT MATERIALS. (5 cr)

Taxonomy, ecology, and landscape uses of perennial and annual flowers, tender and hardy bulbs, ground covers, wild flowers. Lectures, laboratory, and garden experience.

1036. PLANT PROPAGATION. (4 cr; prereq 1100)

Principles and techniques of propagating plants by seeds, cuttings, grafts, buds, layers, and division. Lectures on principles; laboratories on practice of various propagating techniques; and field trips.

1099. ORIENTATION TO HORTICULTURE. (1 cr; S-N only)

A survey of the field of horticulture including discussion of job potentials for horticulture majors.

1100. BIOLOGY OF HORTICULTURAL PRODUCTION. (4 cr; prereq Biol 1103)

Discussion of factors influencing the successful production of horticultural crops. For horticulture majors and other students planning to take advanced horticulture courses. Lectures, experiments, and discussion.

1200. INTRODUCTION TO HORTICULTURAL FOOD CROPS. (1 cr)

Major horticultural crops grown in world, emphasizing those produced in United States, major areas of production, marketing distribution. Lectures.

3030. LANDSCAPE DESIGN OF RESIDENTIAL AND SMALL COMMERCIAL SITES. (4 cr; prereq 1021, LA 1025, or Ind 1600)

Theory and practice of design for home grounds and small commercial sites. Site analysis, needs assessment, space organization, selection of materials, and plan preparation. Lectures and graphics laboratory.

3033. POSTHARVEST HANDLING AND PHYSIOLOGY OF HORTICULTURAL CROPS. (3 cr; prereq 1100)

Fundamental principles in postharvest handling of horticultural crops; precooling, transporting, and storing. Postharvest changes, senescence, respiration, ripening and ethylene physiology. Government laws and regulations. Lectures, discussion, laboratory, field trips.

3053. ORNAMENTS FOR INTERIOR DESIGN. (4 cr; prereq 1036 or #)

Identification, utilization, and culture primarily of foliage plants used in interior decoration. Lectures, reference reading, and field trips.

3072. TURF MANAGEMENT. (4 cr; prereq Soil 1122 and either Hort 1100 or Agro 3020)

General landscape maintenance and turf culture. Work in areas of industrial grounds maintenance, park and recreation area maintenance, and general lawn care.

3081. FLORAL DESIGN AND FLORICULTURE BUSINESS. (4 cr; prereq GC 1513)

Principles of design from construction of simplistic line designs to complex commercial retail arrangements. History and theory of floral design, use of foliage, accessories, and color. Organization of floral industry, past and future trends, postharvest physiology, marketing, merchandizing, cost accounting, and seasonality of business.

3097. HORTICULTURE PRACTICUM. (2-4 cr; prereq upper division horticulture major, Δ)

Approved field, laboratory, or greenhouse experiences in application of horticultural information and practices.

3099. SEMINAR. (1 cr [may be repeated for max 2 cr]; prereq jr)

Horticultural problems, research projects, work experience, and employment opportunities.

5000. PROFESSIONAL EXPERIENCE PROGRAM. (4 cr; prereq #; S/N only; free elective for Hort undergrads, not for grad; extension regis only)

Professional experience in horticulture firms or government agencies through supervised practical work evaluation of reports, and consultations with faculty advisers and employers.

5020. HORTICULTURAL TECHNIQUES FOR EDUCATION MAJORS. (3 cr [no cr for horticulture majors]; prereq education major or #; offered 1987-88 and alt yrs)

Horticultural and botanical concepts and their impact on the use of horticultural plants in the classroom. Development of specific single-concept classroom demonstration and pupil-oriented activities relating to horticultural plants.

5021. ORNAMENTAL PLANT MATERIALS. (5 cr, \$1021, \$1022; offered 1988-89 and alt yrs)

Identification and use of wide range of ornamental plant materials including trees, shrubs, annuals, perennials, and plants for interior design. Application of information and personal observations to individual student's area of study.

5026. LANDSCAPE MANAGEMENT. (5 cr)

Application of basic biological principles to establishment and maintenance of horticultural plantings including commercial, private utility, recreational, highway, and park lands. Techniques and equipment for landscape plantings; adoptive management models for business and institutional organization.

5032. TREE FRUIT PRODUCTION. (4 cr; prereq 1100; PIPhy 3131 recommended; offered fall of even yrs)

Principles of tree fruit production. Three fruits of the world, with emphasis on temperate tree fruits. Site selection, cultural and management practices, taxonomic classification, physiological and environmental control of plant development, dwarfing, growth regulating compounds, pest control. Lectures, laboratory, field trips.

Course Descriptions

5033. SMALL FRUIT PRODUCTION. (3 cr; prereq 1100; PIPh 3131 recommended; offered fall of odd yrs)

Principles of small fruit production. Major small fruit crops of the U.S. Site selection, cultural and management practices, systematics, physiological and environmental control of plant development, pest control. Lectures, laboratory, field trips.

5034. COMMERCIAL VEGETABLE PRODUCTION I: TUBER, ROOT, AND BULB CROPS. (3 cr; prereq Hort 1036, Soil 1122, or #)

Crop culture, product handling, and use systems in various world cultures. Seed and stand establishment, emphasizing vegetative propagation. Pest problems, with emphasis on soilborn insects and diseases. Crop management as related to applied physiology and genetics of bulb and tuber initiation, sink development, maturation, and quality. Storage considerations.

5035. COMMERCIAL VEGETABLE PRODUCTION II: FRUIT, SEED, AND LEAFY CROPS. (3 cr; prereq 1036, Soil 1122 or #)

Fruit, seed, and leafy types as world food sources; nature and scope of production and distribution systems. Physiological and genetic control of plant and product development, including principles of stand establishment, maturation, and seed production. Impact of nutrition, irrigation, postharvest handling, and other variables on crop performance and product quality.

5037. SYSTEMATICS AND UTILIZATION OF VEGETABLE CROPS GERMLASM. (3 cr; prereq Agro 5020 or #; offered fall of odd yrs)

Systematic and historical relationships of germplasm resources of vegetable taxa. Product form, structure, quality, and development of improved types.

5038. RESEARCH METHODS IN PLANT PROPAGATION. (3 cr; prereq 1036 or #)

Basic concepts, theory, and techniques involved in propagating plants studied through literature search and discussion. Students design and conduct experiments with plants or propagation techniques of special interest.

5040. PLANT GROWTH REGULATION. (4 cr;

prereq 15 cr plant sciences incl 3 cr plant physiology) Principles of plant growth and development in relation to optimizing cropping efficiency and product quality. Emphasis on analysis of physiological and morphogenetic basis of horticultural practices to regulate growth and development. Exercises in use of these principles to solve horticultural problems.

5041. ENVIRONMENTAL PHYSIOLOGY OF HORTICULTURAL PLANTS. (3 cr; prereq 15 cr

plant sciences, PIPh 3131; offered 1988-89 and alt yrs) Lectures and assigned readings on the relation of water, temperature, and light to the growth and development of horticultural plants.

5042. TURF GRASS SCIENCE. (5 cr; prereq 3072, PIPa 1001, PIPh 3131)

For advanced students in turf with career objectives in professional turf management. All phases of the turf industry considered, with emphasis on the ecology, physiology, and theory of turf population dynamics and on specialized management situations such as golf course, commercial sod production, and fine turf athletic situations.

5046. NURSERY MANAGEMENT I. (4 cr, 5046, 5047, 5048†; prereq 1021, 1036, 1100)

Introduction, history, organization, and scope of the nursery industry. General nursery business administration, production schedules and cultural management for seed beds and field grown stock. *Field trips are required.*

5047. NURSERY SCHEDULING AND ENTERPRISE DEVELOPMENT. (2 cr, 5046, 5047, 5048†; prereq 5046)

Development of specific crop schedules using current technical and economic data for efficient production. Development of total nursery enterprise designed for workable and profitable business establishment.

5048. NURSERY MANAGEMENT II. (4 cr, 5046, 5047, 5048†; prereq 5046, 5047)

Pest management and government regulations concerning the nursery industry. Container growing operations and marketing of all products. Specific topic research and nursery operation development by the student. Laboratory will include field trips and greenhouse and field training in nursery operations. *Field trips will be required.*

5052. COMMERCIAL FLORICULTURE, FALL CROPS. (4 cr; prereq 1016)

Physiological and cultural aspects of optimized production of principal florist crops of economic importance. Chrysanthemums, cut flowers, and potted plants especially adapted to Christmas sales. Lectures, reference reading, and field trips to greenhouses, wholesalers, and retail flower stores.

5053. COMMERCIAL FLORICULTURE, WINTER CROPS. (4 cr; prereq PIPh 3131 or #)

Physiological and cultural aspects of bulbous plants (tulips, narcissi, bulbous irises, hyacinths, crocuses, and lilies) and year-round production of azaleas. Emphasis on latest research in growth, developmental, and flowering physiology of these commercially important floricultural crops. Lectures, reference reading, laboratory experience, and field trips.

5054. COMMERCIAL FLORICULTURE, SPRING CROPS. (4 cr; prereq 1016)

Physiological and cultural aspects of optimized production of principal florist crops of economic importance. Roses, snapdragons, gloxinias, geraniums, bedding plants, and other spring crops. Lectures, reference reading, and field trips to greenhouses, wholesalers, garden centers, and retail stores.

5091. DIRECTED STUDIES. (2-6 cr; prereq 8 cr upper division horticulture course, Δ)
Opportunities for in-depth exploration of concepts, technology, materials, or programs in specific area to expand professional competency and self-confidence. Planning, organizing, implementing, and evaluating knowledge obtained from formal education and experience.

Landscape Architecture (LA)

LA 1001. THE DESIGN OF ENVIRONMENTS. (2 cr)

A survey of the role of landscape architecture in design and planning the environment for people. Exploration of the profession, from design of gardens, parks, and open spaces to siting buildings, urban design, and planning communities to regional design and visual assessment.

LA 1021. HISTORY OF ARCHITECTURE. (4 cr, §Arch 1021, 4 lect hrs per week)

History and theory of architecture. Survey of architecture from ancient through modern periods.

LA 1022. HISTORY OF LANDSCAPE ARCHITECTURE. (4 cr, §Arch 1022, 4 lect hrs per week)

History and theory of landscape architecture. Survey of landscape architecture from ancient through modern periods.

LA 1023. HISTORY OF CITIES. (4 cr, §Arch 1023, 4 lect hrs per week)

History and theory of urban design. Survey of urban design from ancient through modern periods.

1024. LANDSCAPE THEORY. (4 cr; 3 lect and 3 lab hrs per wk)

Analysis of design elements and forms involving direction, shape, proportion, and color, with emphasis on their function in design; perception and our relationship to the environment; the social effects and psychological basis for design.

1025. BASIC VISUALIZATION I. (4 cr; 2 lect and 4 lab hrs per wk; prereq LA major or #)

Perspective drawing, landscape sketching, visual analysis of landscape materials, presentation techniques for plans, sections, elevations, and diagrams.

1026. BASIC VISUALIZATION II. (4 cr; prereq 1025; 6 studio hrs per wk)

Continued refinement of the student's ability to execute acceptable line drawings developed in 1025. Emphasis on aiding students to develop their own technique(s). Continued emphasis on perspective sketching, color sense, psychology of graphic interpretation, mixed media, and printing reproduction processes.

1031. INTRODUCTION TO LANDSCAPE ARCHITECTURE. (4 cr; 4 lect hrs per wk)

Design potential of materials of the landscape; exercises in assessment of land developments and detail landscapes; the role of the landscape architect in shaping the natural and cultural environment; brief historical review of site developments.

3001. ENVIRONMENTAL DESIGN: PEOPLE AND ENVIRONMENT. (4 cr, §Arch 3001)

Interaction of people with the environment, using natural and social sciences and the arts as background for readings, lectures, discussions, and workshop sessions.

3002. ENVIRONMENTAL DESIGN: TOOLS AND PROCESSES. (4 cr, §Arch 3002; prereq 3001)

Nature and the effects of various tools and processes of environmental change, ranging from buildings and landscapes to economic policies, climate, and myths. Readings, lectures, discussions, and workshop sessions.

3003. ENVIRONMENTAL DESIGN: IMPLEMENTATION AND EVALUATION. (4 cr, §Arch 3003; prereq 3002)

Design projects, discussions, and readings exploring personal abilities to implement and evaluate environmental change.

3071. LANDSCAPE TECHNOLOGY: GROUND FORM DESIGN. (4 cr; prereq 3082 or #, CE 3100 or AgET 1400; 2 lect, 4 lab hrs per wk)

Lectures, exercises, and projects in ground form manipulation, earthwork computation, and surface drainage techniques.

3072. LANDSCAPE TECHNOLOGY: CIRCULATION AND UTILITIES DESIGN. (4 cr; prereq 3071 and 3083 or #; 2 lect and 4 lab hrs per wk)

Lectures, exercises, and projects in layout of circulation and landscape utilities systems.

3075. LANDSCAPE TECHNOLOGY: MATERIALS AND CONSTRUCTION DESIGN. (4 cr; prereq 3072; 2 lect and 4 lab hrs per wk)

Lectures, exercises, and project in materials and construction techniques and working document preparation.

3081-3082-3083. BASIC DESIGN. (6 cr per qtr; prereq LA student; 2 lect and 10 lab hrs per wk)

Lectures and projects to expand awareness of the design potential of environment, develop processes and graphic techniques for problem solving, and develop methods of presenting ideas verbally and visually. Design of small-scale site systems with simple variables.

3091-3092. INTERMEDIATE DESIGN. (6 cr per qtr; prereq 3083; 2 lect and 10 lab hrs per wk)

Lectures and projects in the design potential of natural land materials, landscape survey and analysis techniques, elements of the environment as they condition design potential, methodologies for solving design problems, methods of expressing landscape form both geographically and through models; design of site systems with simple variations.

3093. DETAIL SITE DESIGN. (6 cr; prereq 3092)

Design of small-scale site systems with complex variables.

Course Descriptions

3094. INDEPENDENT STUDY IN GRAPHICS. (1-4 cr; prereq LA student, #)

Independent study of topics, of student's choice, in graphic communication. Proposal must be submitted for approval by LA faculty member.

3095. INDEPENDENT STUDY IN PLANTING DESIGN. (1-4 cr; prereq LA student, #)

Independent study of topics, of student's choice, related to planting design. Proposal must be submitted for approval by LA faculty member.

3096. INDEPENDENT STUDY IN HISTORY OR THEORY. (1-4 cr; prereq LA student, #)

Independent study of topics, of student's choice, related to history and/or theory of landscape architecture. Proposal must be submitted for approval by LA faculty member.

3097. INDEPENDENT STUDY IN COMPUTER-AIDED DESIGN. (1-4 cr; prereq LA student, #)

Independent study of topics, of student's choice, related to use of computers to aid design and analysis. Proposal must be submitted for approval by LA faculty member.

3098. INDEPENDENT STUDY IN DESIGN. (1-4 cr; prereq LA student, #)

Independent study of topics, of student's choice, related to landscape architecture or design theory or practice. Proposal must be submitted for approval by LA faculty member.

3099. INDEPENDENT STUDY IN TECHNOLOGY. (1-4 cr; prereq LA student, #)

Independent study of topics, of student's choice, related to landscape architecture technology. Proposal must be submitted for approval by LA faculty member.

3101. COMMUNICATING LANDSCAPE QUALITY. (4 cr; 2 lect and 4 lab hrs per wk; prereq 1025 and 3091)

Lectures and exercises in drawing techniques focused on developing graphic skills for designers working predominantly with exterior environments.

3200. LANDSCAPE ARCHITECTURE PRACTICUM. (1-6 cr; prereq LA student, #; S-N only)

Approved design, planning, engineering, contracting, or travel experience in application or development of landscape architecture theory. Proposal must be submitted for approval by LA faculty; final written, graphic, and/or oral presentation must be submitted.

5010. PRINCIPLES OF OUTDOOR RECREATION DESIGN AND PLANNING. (4 cr, \$FR 5233; 4 lect hrs per wk)

For advanced students associated with design, management, and planning of recreation facilities. Planning and design principles related to recreational land use and development; parks, campsites, water areas, highways, and summer and winter recreational facilities.

5073. LANDSCAPE TECHNOLOGY; LAND ANALYSIS TECHNIQUES. (4 cr; prereq LA 3082 or #; 2 lect, 4 lab hrs per wk)

Lectures, exercises, and projects in land analysis techniques for use in assessment of land development potential. Graduate students will do a brief library research paper.

5099. RCD INTERDISCIPLINARY SEMINAR I. (4 cr, 5099-5100†, \$RCD 5099, \$AgEc 5099, \$AgET 5099, \$Soil 5099; prereq resource and community development sr or #)

Selected speakers, readings, and discussion topics dealing with resource and community development analysis and implications for resource allocation. Students participate as a team, combining disciplinary skills to analyze complex resource development problems.

5100. RCD INTERDISCIPLINARY SEMINAR II. (4 cr, 5099-5100†, \$RCD 5100, \$AgEc 5100, \$AgET 5100, \$Soil 5100; prereq 5099 or #)

(Continuation of 5099) Papers, presentations, and critiques on selected complex resource problems in Seminar I.

5101. SITE PLANNING AND DESIGN. (6 cr; 2 lect and 10 lab hrs per wk; prereq 3093)

Case study analysis and design of site organizational systems.

5103. URBAN LANDSCAPE DESIGN. (6 cr; 2 lect and 10 lab hrs per wk; prereq 3093)

Case study analysis and design of urban environments.

5105. RECREATIONAL PLANNING AND DESIGN. (6 cr; prereq 3093; 2 lect and 10 lab hrs per wk)

Analysis development and presentation of landscape design solutions for diverse recreational land use.

5107. REGIONAL LANDSCAPE DESIGN. (6 cr; prereq 3093; 3 lect and 10 lab hrs per wk)

Emphasis on large-scale land areas. Analyzing development potential and evolving solutions for integration of divergent land use patterns such as agricultural, residential, commercial, industrial, and recreational.

5109. SPECIAL PROBLEMS: THESIS PROPOSAL. (2 cr; hrs ar)

Individual research resulting in a proposal for thesis project to be developed in LA 5110.

5110. ADVANCED LANDSCAPE PLANNING AND DESIGN. (6 cr; prereq terminal qtr of study; 2 lect and 10 lab hrs per wk)

Advanced studies in area of student's option.

5117. PLANTING DESIGN: AESTHETIC AND FUNCTIONAL CRITERIA. (4 cr; prereq 3083 or # and Hort 1021)

Lectures, presentations, field trips, readings, and projects exploring aesthetic and functional design principles related to the use of plants in the landscape. Exploration of both historic and modern principles through design projects of various scales.

5119. PLANTING DESIGN: ECOLOGICAL PRINCIPLES/LAND USE CONCEPTS AND IMPLEMENTATION OF PLANTING DESIGN. (4 cr; prereq 5117 or #)

Lectures, presentations, field trips, readings and projects related to the principles and practices of using plants in an ecologically sound and environmentally sensitive manner. Principles derived from prairie, northwoods, riverine, and wetland environments. Integration of naturalized materials within a range of environments of various scales.

5131. DIRECTED STUDIES IN LANDSCAPE ARCHITECTURE HISTORY AND THEORY. (1-6 cr; prereq third yr LA student, Δ)

Advanced independent studies. Student expected to have successfully completed 3000-level independent study courses in previous quarters.

5132. DIRECTED STUDIES IN LANDSCAPE ARCHITECTURE DESIGN. (1-6 cr; prereq third yr LA student, Δ)

Advanced independent studies. Student expected to have successfully completed 3000-level independent study courses in previous quarters.

5133. DIRECTED STUDIES IN LANDSCAPE ARCHITECTURE TECHNOLOGY. (1-6 cr; prereq third yr LA student, Δ)

Advanced independent studies. Student expected to have successfully completed 3000-level independent study courses in previous quarters.

5134. DIRECTED STUDIES IN EMERGING AREAS OF LANDSCAPE ARCHITECTURE. (1-6 cr; prereq third yr LA student, Δ)

Advanced independent studies in areas of student's choice that relate to new or renewed direction in landscape architecture. Student expected to have successfully completed 3000-level independent study courses in previous quarters.

5136. GOVERNMENT RECREATION FACILITIES PLANNING. (4 cr; prereq 3rd yr LA student or #)

Exploration of design policies in regard to development of specific recreational facilities at federal water resource projects. Lectures, discussions, and field trips in analyzing criteria for organization of federal recreational environments.

5140. INTERDISCIPLINARY STUDIES IN LANDSCAPE ARCHITECTURE. (2-6 cr per qtr; prereq #)

Interdisciplinary research, planning, and/or design project. Topics may include natural resource conservation, downtown revitalization, recreational facilities and programming, energy-efficient design, historic preservation, agricultural land utilization, land reclamation, environments for the aged, computerized land use planning, visual assessment, housing, new towns.

5224. CONTEMPORARY ISSUES IN LANDSCAPE ARCHITECTURE. (4 cr; prereq terminal yr of study; 4 discussion hrs per wk)

Analysis of design principles and design goals in modern society. Review of current site development projects. In-depth investigation into specific areas of land development.

5225. LANDSCAPE TECHNOLOGY: WORKING DRAWINGS AND SPECIFICATIONS. (4 cr; prereq 3072; 3 lect, 3 lab hrs per wk)

Lectures, exercises, and projects in working drawing and specification.

5226. PROFESSIONAL PRACTICE. (4 cr; prereq terminal yr of study)

Professional ethics, responsibility, and relations in business. Office management, preparation of professional communications, estimates, specifications, and contracts. Lectures, written exercises, and office visits.

5227. IMPACT ASSESSMENT AND ENVIRONMENTAL MEDIATION. (5 cr; prereq sr, grad, or #; offered at Itasca only)

Lectures in history, laws, and analysis of impact assessment and environmental mediation. Integrated with interdisciplinary emphasis on fieldwork related to a selected issue, actual document preparation, presentation, and individual responsibility.

5228. SEMINAR: TOPICS IN CAMPUS PLANNING. (4 cr; prereq 3093 or #)

Lectures and discussion, presentations, field trips, readings, and paper exploring aspects of contemporary and historic issues in campus planning, the use of energy-efficient buildings, and related issues dealing with efficient land use and site planning.



5261. HISTORY OF LANDSCAPE ARCHITECTURE: THE EUROPEAN, ORIENTAL, AND AMERICAN TRADITION. (4 cr; prereq first yr LA student; 4 hrs lect and discussion per wk)

Influences and forms that have established a basis for the landscape architecture tradition in Europe, the Orient, and the United States. Emphasis on principles and techniques and on the continuity of design imagination inherent in specific examples of the altered environment.

5265. HISTORY OF LANDSCAPE ARCHITECTURE: INDIVIDUAL INFLUENCES. (4 cr; prereq second yr LA student; 4 hrs lect and discussion per wk)

Personal influences of noteworthy designers (current and historic), and how such influence precipitated design structures by these creative people within the affective domain of personal expression.

For Graduate Students Only

(For descriptions, see *Graduate School Bulletin*)

Agro 8270.* SEMINAR: PLANT BREEDING

GCB 8900. SEMINAR: GENETICS

Hort 8022. BREEDING ASEXUALLY PROPAGATED CROPS

Hort 8023. EVOLUTION OF CROP PLANTS

Hort 8041. DISCUSSIONS IN ADMINISTRATIVE ORGANIZATION

Hort 8042. HORTICULTURAL SEMINAR

Hort 8045.* PLANT HARDINESS

Hort 8051x.* ADVANCED PROBLEMS IN HORTICULTURAL CROP BREEDING

Hort 8052x.* ADVANCED PROBLEMS IN PHYSIOLOGY OF HORTICULTURAL CROPS

Hort 8060. DISCUSSIONS IN POTATO RESEARCH

Hort 8061.* DISCUSSIONS IN INCOMPATIBILITY

Hort 8062.* DISCUSSIONS IN PLANT HARDINESS

Hort 8063.* DISCUSSIONS IN HORTICULTURAL PLANT BREEDING

Hort 8064.* DISCUSSIONS IN FLORICULTURAL SCIENCE

Hort 8065.* DISCUSSIONS IN POSTHARVEST PHYSIOLOGY

Hort 8066. DISCUSSIONS IN HORTICULTURAL RESEARCH

Large Animal Clinical Sciences (LACS)

Offered by the College of Veterinary Medicine

3502. ANIMAL HEALTH AND DISEASE. (5 cr)
Designed for nonveterinary students to give a broad understanding of veterinary science as it applies to health and disease of domestic animals. Emphasis on basic concepts of disease and common animal diseases that demonstrate these concepts. How stress and management practices aggravate and create new disease conditions.

5190. COMPUTERS IN ANIMAL HEALTH. (3 cr; prereq vet med or grad student)

Seminar and directed study covering current computer technology and operations; special reference to veterinary applications. Principles and practice of developing computer systems for processing, analyzing, and interpreting various categories of animal health data, with examples.

5280. SEMINAR: WORLD FOOD SUPPLY PROBLEMS. (3 cr, \$AgEc 5790, \$FScN 5643, \$Soc 5675; prereq major in agriculture, veterinary medicine, nutritional sciences, social science field or #; grad students by #)

A multidisciplinary approach to the social, economic, and technical problems of feeding the world's growing population. Principles sought from the social, economic, plant, animal, and nutritional sciences for their application to food problems.

5650. VETERINARY EPIDEMIOLOGY AND STATISTICS. (4 cr; prereq 10 cr biology, 12 cr chemistry or #)

Principles of epidemiology, ecology, and veterinary public health. Biostatistics applied to the measurement of health and disease in populations.

Plant Pathology (PIPa)

1001. INTRODUCTORY PLANT PATHOLOGY: LECTURE AND INTRODUCTION TO DIAGNOSTIC PROCEDURES AND LABORATORY. (4 cr; prereq soph, 9 cr plant science)

Biotic and abiotic causes of plant disease. Representative plant diseases of significance in Upper Midwest that illustrate principles of plant pathology. Theory of laboratory and diagnostic techniques.

3001. INTRODUCTORY PLANT PATHOLOGY: LECTURE, LABORATORY, AND INTRODUCTION TO DIAGNOSIS. (6 cr, \$5002; prereq soph, 9 cr plant science)

Biotic and abiotic causes of plant disease. Representative plant diseases of significance in Upper Midwest that illustrate principles of plant pathology. Laboratory and diagnostic techniques. "Plant Disease Situation" problem solving.

3090. RESEARCH IN PLANT PATHOLOGY. (Cr ar; prereq 1001 or equiv or #)
Assignment of special problems to undergraduate students who desire opportunity for independent research in plant pathology.

5000. PROFESSIONAL EXPERIENCE PROGRAM. (4 cr; prereq 15 cr in plant pathology and #; not for grad cr; extension regis only)
Open to advanced students in plant health technology program. Up to 12 weeks of experience in a selected agricultural industry; evaluative reports and consultations with faculty advisers and employers.

5002. INTRODUCTORY PLANT PATHOLOGY FOR ADVANCED STUDENTS. (5 cr, §3001; prereq 14 cr plant science or #)

5005. VIRUSES AND BACTERIA IN PLANT DISEASE. (4 cr; prereq 20 cr biology including botany and biochemistry; offered fall qtr yearly)
Plant diseases caused by bacteria and viruses with emphasis on effects, symptoms, pathogen identification, and control.

5006. FUNGI, ALGAE, AND PARASITIC SEED PLANTS IN PLANT DISEASE. (4 cr; prereq 20 cr biology including botany, biochemistry, and mycology, P1Pa 5105; offered winter qtr yearly)
Fungi, algae, and parasitic seed plants as plant pathogens, representative types with particular reference to the techniques used in their identification and control.

5007. AIR POLLUTION AND OTHER ABIOTIC CAUSES OF PLANT DISEASE. (3 cr; prereq 20 cr biology, including biochemistry; offered spring quarter yearly)
Lectures, assigned readings, and discussions about the characteristics and effects of phytotoxic air pollutants (60%) and water, temperature extremes, soluble salts, mineral elements, allelopathy, and pesticides (40%) as causes of plant disease.

5008. INTRODUCTION TO PLANT NEMATODOLOGY. (2 cr; prereq 3001 or 5002 or #; offered spring quarter yearly)
Characteristics, strengths, and weaknesses of plant and soil nematodes as seen through study of the biology and morphology of five important genera of plant parasitic nematodes. Field and laboratory experiences in sampling, processing of soil and plant tissues, identification and counting, and control of plant nematodes.

5015. PLANT NEMATODOLOGY. (4 cr; prereq 5008 or #, offered winter quarter 1989 and alt years)
Lectures, assigned readings, and laboratory exercises and experiments with emphasis on identification of plant parasitic nematodes to species; experimental techniques for studying plant nematodes; attraction, movement, and feeding by plant nematodes; and biological, chemical, and physical factors that affect nematode survival and multiplication.

5050. FOREST PATHOLOGY. (4 cr; prereq Biol 1103 or equiv)
Diseases of forest and shade trees; wood decay. Symptoms, etiology, and control. Lectures, laboratory, and fieldwork.

5102. FIELD MYCOLOGY. (5 cr; prereq 9 cr botany or #; offered at Itasca)
General characteristics of fungi, especially those used in identification; cultural and taxonomic procedures and practices.

5104. AGRICULTURAL SYSTEMS ANALYSIS AND MODELING. (4 cr, §AgEc 5104, §AnSc 5104, §Soil 5104; prereq Math 1142 or #)
Introduction to bioeconomic modeling as preparation for interdisciplinary agricultural systems analysis. Basic concepts; deterministic and stochastic models; delays, feedback, and clockwork; data acquisition; model verification and validation; role of models in agroecosystem management.

5105. INTRODUCTION TO THE STUDY OF FUNGI. (4 cr; prereq 9 cr botany or Biol 1002 or #)
Structures, habits, classification, and identification of fungi.

5106. MYCOLOGY: ASCOMYCETES—FUNGI IMPERFECTI. (4 cr; prereq 3001 or 5050 or MicB 3103; offered 1988 and alt yrs)
Lectures and laboratory exercises on taxonomy, identification, life histories, genetics, and ecology of fungi.

5107. MYCOLOGY: BASIDIOMYCETES. (4 cr; prereq 1001, 3001 or 5050 or MicB 3103; offered 1988 and alt yrs)
Lectures and laboratory exercises on the taxonomy, identification, life histories, genetics, and ecology of fungi.

5109.* BIOCHEMISTRY AND PHYSIOLOGY OF FUNGI. (3 cr; prereq 8 cr biochemistry or #; offered 1988 and alt yrs)
Lectures, assigned readings, and discussions of the chemical structure and activities of the fungus cell, including growth, nutrition, regulation of intermediary metabolism and protein and nucleic acid syntheses, sporulation and spore germination, mitochondrial biogenesis, photobiology, mycoviruses, and natural products.

5200. POISONOUS PLANTS. (2 cr; prereq Biol 1011, 3 cr botany)
Plants poisonous to animals and people; plant families and species, symptoms of poisoning, and toxic principles. Lectures and field trips.

5215.* INSECTS IN RELATION TO PLANT DISEASES. (4 cr; prereq 5 cr entomology, 5 cr plant pathology or equiv or #)
(Same as Ent 5215) Insect transmission and dissemination of plant pathogens; development of plant-insect relationships; habits of principal insect vectors with emphasis on methods of control.

Course Descriptions

5500. PLANT DISEASE EPIDEMIOLOGY AND MANAGEMENT. (4 cr; prereq 3001 or 5050 or #) Concepts, principles, and methodology in the quantitative study of plant disease epidemics, their crop losses, and disease management using contemporary technology. Emphasis on computer-based systems analysis techniques and their use in understanding the biology of epidemics and in integrating research for management practices. Case studies from agricultural and horticultural crops.

5650. CLINICAL PLANT PATHOLOGY. (2, 4 or 6 cr; prereq 3001 or 5002 or #; offered summer session yearly)

Field trips, clinical and laboratory experience in diagnosis, prevention, and control of plant diseases affecting field, fruit, and vegetable crops, ornamentals and trees. Field plot experiences.

5700. PLANT DISEASE CONTROL. (4 cr; prereq 1001 or #)

Control of plant diseases utilizing biological and cultural practices, disease resistance, and chemicals in an integrated manner. Emphasis on use and action of fungicides.

For Graduate Students Only

(For descriptions, see *Graduate School Bulletin*)

8001. PLANT DISEASE THEORY I: MOLECULAR TO CELLULAR

8002. PLANT DISEASE THEORY II: TISSUES TO WHOLE PLANTS

8003. PLANT DISEASE THEORY III: POPULATIONS

8090. RESEARCH IN PLANT PATHOLOGY

8095. ADVANCED PROCEDURES AND RESEARCH IN MYCOLOGY

8111. GENETICS OF PLANT PATHOGENS

8200. PLANT PATHOLOGY COLLOQUIUM

8201. SEMINAR

8202. SEMINAR

Plant Physiology (PIPh)

Students in the College of Agriculture may be interested in the following courses in plant physiology. With the approval of your adviser, you may use the introductory courses in plant physiology in partial fulfillment of the science requirement. You may take 3000- and 5000-level courses in plant physiology after you have completed the necessary prerequisites.

These courses introduce the field of plant physiology and illustrate how knowledge in this special area of plant science may be utilized in private and government research and in college and university teaching and research. If you are interested in plant physiology as a professional career, contact one of the faculty members listed in this area in the *Graduate School Bulletin*.

3131. SURVEY OF PLANT PHYSIOLOGY. (4 cr, \$5131, \$Bot 3131, \$Bot 5131; prereq Biol 1103 or 3012, BioC 1302 or ¶BioC 1302 or Biol 5001)

Physiological principles underlying processes that occur in living plants with emphasis on higher plants. Growth and development, mineral nutrition, transport, water relations, and metabolism with emphasis on photosynthesis and nitrogen assimilation. For laboratory see PIPh 5132.

5131. SURVEY OF PLANT PHYSIOLOGY. (4 cr, \$3131, \$Bot 3131, \$Bot 5131; prereq Biol 1103 or 3012, BioC 1302 or ¶BioC 1302 or Biol 5001)

Same as PIPh 3131 with the addition of a weekly discussion and advanced reading session.

5132. PLANT PHYSIOLOGY LABORATORY. (2 cr, \$Bot 5132; prereq 5131 or ¶5131)

Laboratory course to accompany PIPh 3131 and 5131.

5167.* PHYSIOLOGY OF THE PLANT CELL. (3 cr; prereq plant anatomy, inorganic and organic chemistry or biochemistry; offered 1988-89 and alt yrs)

Characteristics of the living state, general aspects of cell metabolism, development of the cell, polarity, differentiation, and irritability of the cell and cellular movements.

5168.* EXPERIMENTAL PROTOPLASMATOLOGY. (3 cr; prereq #; offered 1987-88 and alt yrs)

Physical and physicochemical properties of living protoplasm in plant cells including viscosity, wall attachment, permeability, primary and secondary fluorescence, and vital staining.

5182.* PLANT METABOLISM. (3 cr, \$Bot 5182; prereq 5131, a course in biochemistry)

Plant metabolism including photosynthesis, respiration, and synthesis of macromolecules by plants. Structure-function relations at the plant, cell, and subcellular level. Energy flow in the plant system and regulation of plant metabolism.

5183.* WATER, MINERALS, AND TRANSLOCATION. (4 cr, \$Bot 5183; prereq 5131)

Membrane phenomena and osmotic properties of cells. Uptake, movement, and loss of water in plants including effects of external factors. Translocation of organic substances. Absorption, distribution, and function of inorganic elements.

5184.* PLANT GROWTH AND DEVELOPMENT. (3 cr, §Bot 5184; prereq 5131)

Control of seed germination, mobilization of macromolecular breakdown products during germination and seedling growth, photomorphogenesis, chloroplast development, flowering and photoperiodism, fruit development and ripening, seed formation, senescence, mechanism of action of plant growth substances.

5188.* RESEARCH PERSPECTIVES IN PLANT PHYSIOLOGY. (Cr ar; prereq Chem 3100, 3101, 8 cr biochemistry and #, Δ)

A laboratory course in which the student undertakes a well-defined research problem of limited scope.

5703. INTERNAL WATER BALANCE. (3 cr; prereq #; offered 1987-88 and alt yrs)

Laboratory course in which components of water balance in plants (turgor, osmotic, water potentials) are measured using various techniques. Discussion of matching method to experimental goals.

5721, 5723, 5726. METHODS OF PLANT ANALYSIS. (Cr ar; prereq Chem 3100, 3101, 8 cr biochemistry, #)

In-depth experimental laboratory approach to microscopic analysis, sample preparation, fractionation, isolation, and measurement of plant compounds employing modern methods of plant physiology. Discrete and independent units in:

5721. The Primary Plant Metabolites. (Cr ar; offered 1988-89 and alt yrs)

5723. Plant Hormones and Tissue Culture. (Cr ar; offered every yr)

5726. Analysis of Cell Structure. (Cr ar; offered 1988-89 and alt yrs)

5970.* SPECIAL PROBLEMS IN PLANT PHYSIOLOGY. (Cr ar; prereq Δ)

Research, readings, instruction.

For Graduate Students Only

(For descriptions, see *Graduate School Bulletin*)

8055. SOURCE—SINK RELATIONS

8251. SEMINAR: PLANT PHYSIOLOGY

8281.* GROWTH AND DIFFERENTIATION OF PLANTS

8285. PHOTOSYNTHESIS

8310. METHODS IN PLANT PHYSIOLOGY

Additional courses dealing with topics related to plant physiology are offered by several other University departments. Interested students should consult listings in agronomy, horticultural science, plant pathology, and soil science (College of Agriculture); biochemistry, botany, and ecology (College of Biological Sciences); and forest resources (College of Forestry).

Resource and Community Development (RCD)

1010. ISSUES IN THE ENVIRONMENT. (3 cr)

Interdisciplinary offerings exploring five areas of environmental concern: aspects of environmental design that provide maximum compatibility of human beings with their environment, sources of water pollution and their control, disposal and control of solid wastes from agriculture, minimization of pesticide pollution of the environment, and managed use of forest resources to maintain environmental quality. A televised course involving 20 taped lectures and 10 discussion periods.

3010. THE MINNESOTA COMMUNITY: ANALYSIS OF ITS ORGANIZATION, CHANGE, AND DEVELOPMENT. (4 cr; prereq one social science course and #)

Community problem solving and decision making. How local problems are defined, what communities can do in dealing with their problems, and how information (primarily scientific knowledge) may be applied to local problems. Conceptual analysis of communities and their problems. Secondary data analysis as a research technique for use in analysis of community problems in Minnesota.

3118. SEMINAR: SOIL AND WATER POLLUTION AND PUBLIC POLICY. (1 cr, §Soil 3118; S-N only; offered fall 1988 and alt yrs)

Public policies as they influence land use and soil and water resources.

5099. INTERDISCIPLINARY SEMINAR I. (4 cr, 5099-5100+, §AgEc 5099, §AgET 5099, §FR 5269, §LA 5099, §Soil 5099; prereq resource and community development sr or #)

Selected speakers, readings, and discussion topics dealing with resource and community development analysis and implications for resource allocation. Students participate as a team, combining skills to analyze complex resource problems.

5100. INTERDISCIPLINARY SEMINAR II. (4 cr, 5099-5100+, §AgEc 5100, §AgET 5100, §FR 5270, §LA 5100, §Soil 5100; prereq 5099 or #)

(Continuation of 5099) Papers, presentations, and critiques on selected complex resource problems in Seminar I.

5110. SPECIAL PROBLEMS. (1-4 cr [may be repeated for max 12 cr]; prereq resource and community development sr, #)

Projects, plans, and written reports related to 5100, 5101; resource and environmental inventory and analysis.

Course Descriptions

5120. ENVIRONMENTAL PROBLEMS. (3 cr, §1010)

Interdisciplinary offering exploring five areas of environmental concern: aspects of environmental design that provide maximum compatibility of human beings with their environment, sources of water pollution and their control, disposal and control of solid wastes from agriculture, minimization of pesticide pollution of the environment, and managed use of forest resources to maintain environmental quality. A televised course involving 22 taped lectures and 10 discussion periods. Report on a specific environmental problem also required. Offered in Extension only.

5200. COMMUNITY DEVELOPMENT SIMULATION. (4 cr for undergrad, 3 cr for grad; prereq #)

Participation in a water and land resource use and a fiscal management simulation of a community development process. Use of gaming simulation techniques in devising, testing, and negotiating alternative strategies of environmental and economic regulation and in assessing their private and social costs.

Rhetoric (Rhet)

1101. WRITING TO INFORM AND PERSUADE. (4 cr; §Comp 1011)

Relationship of fact finding and clear thinking to informative and persuasive writing. Importance of thesis sentence, evidence, coherence, clarity, and correctness. Emphasis on the writing process in producing several short papers (250-750 words).

1104. LIBRARY RESEARCH METHODS. (1 cr; S/N only)

On-site and interactive video instruction in information retrieval techniques to strengthen skills in using the library. Students work independently to satisfactorily complete all exercises and problem-solving assignments. Students must attend an orientation session. Contact the reference desk of the St. Paul Campus Central Library. (Course Fee.)

1147. EFFICIENT READING. (4 cr)

Exploration of the adult reading process with emphasis on comprehension, speed, and vocabulary development. For persons of average or above-average reading ability who wish to develop and refine college-level reading skills. Not a basic course. (Meets with 5147.)

1151. WRITING IN YOUR MAJOR. (4 cr; prereq freshman communication requirement, and soph status)

Students investigate and write on subjects related to their majors. The criterion of appropriateness: good writing meets the expectation of readers and the conventions of a particular form. Assignments such as literature review, abstract, fact sheet, instructions, and feature article.

1220. PRINCIPLES OF HUMAN COMMUNICATION. (4 cr)

Introduction to the elements and contexts of human communication. Readings, discussions, lectures, and experiential assignments; focus on communication that affects interpersonal gatherings and that entertains, persuades, and instructs public audiences.

1222. PUBLIC SPEAKING. (4 cr; prereq freshman communication requirement)

Practical course in fundamentals of speechmaking. Emphasis on organizing the speech and projecting it to the audience.

1251. EFFECTIVE LISTENING. (3 cr)

Designed to increase listening comprehension by developing four central abilities. Readings, research, theory, and practice.

1301. HUMANITIES: MODERN THOUGHT AND THE ENLIGHTENMENT. (4 cr)

Introduction to humanities tracing the impact of the scientific revolution on human thought. Scientific and religious movements and countermovements as they influence modern thinking.

1302. HUMANITIES: MODERN THOUGHT AND THE INDUSTRIAL REVOLUTION. (4 cr)

The industrial transformation of Europe; laissez-faire capitalism and liberalism; the romantic response; socialism.

1303. HUMANITIES: MODERN THOUGHT AND THE IMPACT OF EVOLUTION. (4 cr)

The impact of evolutionary thought; philosophy, religion, and morality in a changing society.

1310. HUMANITIES: THE LAND IN AMERICAN EXPERIENCE. (4 cr)

American attitudes toward the land from colonial times to the present as expressed in social history, literature, and the fine arts. Social thought and the relationship between farm and city, wilderness and countryside. The changing appearance of America.

1311. HUMANITIES: THE FAMILY IN AMERICAN EXPERIENCE. (4 cr)

American attitudes toward family life from colonial times to the present as expressed in literature, the fine arts, and social history. The impact of Protestantism, democracy, capitalism, and reform movements, including women's rights, on the family ideal.

1376. HUMANITIES: TOPICS IN HUMANITIES AND LITERATURE. (4 cr)

Topics vary from quarter to quarter and are listed in the *Class Schedule*. For full details, inquire at the department office prior to registration.

1500. INTRODUCTION TO WORD PROCESSING. (2 cr; prereq #, Δ; 5 weeks long; S-N only)

Individualized programmed instruction in the use of the Xerox 820 Word Processing System. Students work independently through five two-hour lessons, learning how to log onto the system, create and edit files, type and edit a text, use seven menus to perform basic text editing processes, and print a text. Three hours of lab time each week for practicing and conferencing with instructor or lab assistant.

3101. FUNCTIONAL PHOTOGRAPHY. (4 cr; prereq Design 1501 or Rhet 3562)

Practical course in basic photographic communication. Techniques of producing 35mm color transparencies for use in group presentations, teaching, publications, and audiovisual productions.

3254. ADVANCED PUBLIC SPEAKING. (4 cr; prereq 1222)

Training for specific speech situations most likely to be encountered professionally. Emphasis on analysis, design, preparation, and delivery of presentations to provide greater flexibility within a variety of speech environments.

3266. COMMUNICATION, DISCUSSION IN SMALL GROUP DECISION MAKING. (4 cr; prereq Rhet 1222 or #)

Role of communication techniques in the small group decision-making process. Emphasis on discussion within a variety of decision-making modes such as voluntary groups, business meetings, and conflict groups.

3270. SPEECH: SPECIAL PROBLEMS. (1-5 cr; prereq #, Δ)

Supervised reading and research on advanced speech-communication topics not covered in regularly scheduled speech offerings.

3370. AMERICAN HUMANITIES. (4 cr)

Examination of the American character and changes it has undergone in the 19th and 20th century as exemplified by the social, artistic, literary, and architectural record.

3374. HUMANITIES: SPECIAL PROBLEMS. (1-2 cr; prereq #, Δ)

Primarily for supervised reading and research on topics not covered in regularly scheduled humanities offerings.

3375. HUMANITIES: AGRICULTURAL HERITAGE. (4 cr)

Examination and analysis of significant events or periods affecting rural agricultural peoples as expressed in historical, cultural, and literary documents. Understanding of major values, attitudes, and philosophies related to agricultural change and development.

3380. HUMANITIES: THE LITERATURE OF SOCIAL REFLECTION. (2 cr; A-F or S-N)

A brief examination of contemporary social issues as reflected in cultural documents. The uses of imaginative literature as a forum where social questions are discussed, evaluated, and resolved.

3381. HUMANITIES: 20TH-CENTURY CULTURE. (4 cr)

The changing structure of 20th-century culture from World War I to the present. Communism, fascism, and democracy. Modern movements in literature, the visual arts, and architecture.

3562. WRITING IN YOUR PROFESSION. (4 cr; prereq freshman communication requirement, 1151, and jr status)

Projects in professional writing. Relationship between structuring information to meet the needs of particular readers and writing effectively. Assignments such as the feasibility report, proposal, memorandum, letter of application, and résumé.

3572. GRAMMATICAL EDITING FOR TECHNICAL WRITERS. (2 cr; prereq Tech Comm major; 5 weeks long; S-N only)

Students work independently through exercises in grammar and punctuation, learning proofreading marks and correcting manuscripts. Completing the exercises and passing a final exam required to receive credit. Not a remedial grammar course.

3582. SENIOR SEMINAR. (2 cr; prereq sr)

Discussions of professional and ethical issues and problems related to technical communication. A capstone course, integrating oral, written, visual, organizational, and theoretical competencies.

3700. RHETORICAL THEORY: PERSUASION AND THE LITERATURE OF SCIENCE. (4 cr; prereq completion of freshman communication requirement)

Introduction to principles of rhetorical analysis. Emphasis on Aristotelian theory. Practice in rhetorical criticism of contemporary communication.

5000. PROFESSIONAL EXPERIENCE PROGRAM. (4 cr; prereq #; S-N only; free elective for rhetoric undergrads; not for grad cr; extension regis only)

Professional experience in firms or government agencies through supervised practical experience; evaluative reports and consultations with faculty advisers and employers.

5100. TECHNICAL COMMUNICATION: SPECIAL PROBLEMS. (Cr ar; prereq #, Δ)

Designed for supervised reading, research, and work on advanced technical communication projects not covered in regularly scheduled courses.

5147. EFFICIENT READING. (4 cr)

Exploration of the adult reading process with emphasis on comprehension, speed, and vocabulary development. For persons of average or above-average reading ability who wish to develop and refine college-level reading skills and to understand linguistic, psychological, and physiological aspects of the complex human skill of reading. An evaluative paper and some seminar meetings are required. (Meets with 1147)

Course Descriptions

5150. DIRECTION OF TRAINING IN BUSINESS AND SERVICE ORGANIZATIONS. (4 cr; prereq freshman communication or equiv)

Business, industrial, and service organizations and their in-post and out-post training programs. Scope and sequence of specialized training and development programs, job of typical director of training and development, and skills required for entry into field. Students visit a training and development office in a selected business or service organization and conduct descriptive research on effectiveness of program involved.

5165. STUDIES IN ORGANIZATIONAL COMMUNICATION, CONFLICT, AND CHANGE. (4 cr; prereq freshman communication or equiv)

The roles of internal and external organizational communication, conflict-problem identification, and change processes. Contemporary theory and research in organizational development. Methods of problem identification and diagnosis. Change processes and applications to actual organizational settings.

5170. MANAGERIAL COMMUNICATIONS. (4 cr; prereq freshman communication or equiv)

Analysis of a manager's position in an organizational communication network. Focus on the possible forms, contexts, and functions of a manager's communication. Assessing and developing personal competence and confidence in managerial communication. Lectures, discussions, readings, experiential exercises, and field research.

5180. INTERNSHIP IN TECHNICAL COMMUNICATION. (2-6 cr; prereq #, Δ)

Designed to give technical communication majors on-the-job experience at the University or in industry or government.

5257. SCIENTIFIC AND TECHNICAL PRESENTATIONS. (4 cr; prereq 1222, 3562 or #)

Presentations for specific situations related to technical or scientific topics. Audience analysis and adaptation, techniques of support and visualization, organization for clarity and accuracy, and techniques of interpreting and answering questions. Students will make and evaluate technical and scientific presentations. Emphasis on seminar reports and professional conference papers.

5258. INTERVIEWING: DYNAMICS OF FACE-TO-FACE COMMUNICATION. (4 cr)

Designed to improve intrapersonal and interpersonal skills in interviewing situations. Students learn to understand and use appraisal, reprimand, complaint, persuasion, problem solving, and counseling interview techniques, and participate in a research interview project. Equal emphasis on the interviewer and interviewee roles.

5375. HUMANITIES: SEMINAR IN AMERICAN AGRARIANISM. (3 cr; prereq #)

Interdisciplinary seminar in humanities. The roots of the agrarian ideal in European thought and in early America. Individual research into and evaluations of the agrarian tradition in American social and political philosophy, and in history of imaginative literature, fine arts, and popular culture.

5400. DISSEMINATION AND UTILIZATION OF INFORMATION. (4 cr; prereq jr, sr, or grad standing)

Methods and processes of using specialized information. Study of cases and development of materials for application in professional fields. Emphasis on channels for dissemination and utilization.

5500. RESEARCH IN COMMUNICATION STRATEGIES. (4 cr)

Introduction to basic research design and methodology in communication. Emphasis on application of various research methods to particular communication strategies or settings.

5531. TECHNICAL WRITING COURSE DEVELOPMENT. (2 cr; prereq 3562, sr status)

Students plan and develop a technical writing course. Special attention to development of course objectives, syllabus, and bibliography of readings on teaching technical writing. Textbook selection.

5541. READINGS IN SCIENTIFIC AND TECHNICAL PROSE. (2 cr; S-N only; prereq sr status, Δ)

Tutorial in which students read selected books, essays, and reports exemplifying effective scientific and technical communication (actual scientific and technical discourse as well as philosophical and historical discussions about science and technology).

5551. REPORT AND THESIS WRITING. (3 cr; prereq 3562 or #)

For graduate students and seniors actually working on reports or theses. Organization of reports and theses; library investigation; presentation of data; methods of documentation. Emphasis on revision of manuscripts and improvement in style of writing.

5561. ADVANCED EDITING SEMINAR: ELECTRONIC PUBLISHING. (2 cr; A-F only; prereq 1500, 3562, 3572)

Procedure for copy preparation for publication. Practice copy coding for electronic publishing; use of telecommunications systems; coding and transmitting tables and charts; editing copy and code. Principles of composing and typesetting an article for publication, communicating with typesetters and printers electronically.

5565. WRITING FOR PUBLICATION. (4 cr; prereq 3562 and #)

The professional as communicator; analysis of markets; professional, trade, and general publications; information sources and topic selection; adaptation to specialized and general reader; writing and preparing manuscripts for publication; marketing techniques.

5571. WRITING FOR SPECIAL PURPOSES. (2 cr; 5 weeks long; prereq technical communication major or minor, freshman communication, 3562 or #) Analysis of and writing practice in a specific genre of practical writing (grant proposal, procedures and policies manual, operations manual, newsletter). Content varies from quarter to quarter.

5581. DOCUMENT DESIGN. (4 cr; A-F only; prereq 3562, sr status, #)

Designing document to meet user's need, completing draft, and evaluating effectiveness. Forms and software documentation (user guides, reference manuals, tutorials, and input sheets) for databases, decision aids, computer-aided instruction, on-line programs, or visual displays. Mandatory lab time as part of project team of programmers, subject matter specialists, and communication specialists.

5600. TRANSFER OF TECHNOLOGY. (4 cr; prereq work experience in scientific communication or #) Methods of transferring scientific and technical knowledge and practice. Review of research in diffusion and transfer methods at different technical levels. Tools, methodologies, and assessment procedures for managing a program. Assessment and design plan.

5700. COMMUNICATION IN TECHNOLOGICAL AND ENVIRONMENTAL IMPACT ASSESSMENT. (4 cr; prereq sr or grad standing, one course in statistics, #)

Theories and processes involved in technological assessment and environmental impact statement preparation. Case studies of technology assessments, forecasts, and environmental impact statements. Term project on planning of process and project management in an actual impact assessment.

8110. THEORY AND RESEARCH IN AUDIENCE ANALYSIS. (3 cr; prereq MS students in Tech Comm only)

Review of research on human learning and understanding. Theories of audience analysis and the preparation of written messages to reach defined audiences. Applications to problem-solving strategies in technical communication.

8120. READING AND WRITING PROCESSES AND THE TECHNICAL COMMUNICATOR. (4 cr; prereq Rhet 5147 or #)

Theories and processes involved in critical reading and writing in the workplace. Case studies of reading/writing processes of technical communicators, and design of documents based on greater understanding of these processes. Potential effects of promoting higher-level reading and writing processes in the workplace.

8180. DESIGN PROJECT. (8 cr req, 4 cr per qtr; prereq MS students in Tech Comm Plan B only)

The Design Project consists of an extended problem-solving situation in business, government, or industry in which the student acts as a consultant to explore a problem, identify possible solutions, introduce a solution, and apply it. Scheduled workshops will provide guidance, support, and research findings to assist students in solving the problems assigned to them.

8210. THEORY AND RESEARCH IN MEDIA SELECTION. (3 cr; prereq MS students in Tech Comm only)

Assists decision making for technical communication problem solvers. Students survey the media available for transmitting messages between communication sources and receivers and analyze the factors that influence media choices.

8500. QUALITATIVE RESEARCH: STRATEGIES IN TECHNICAL COMMUNICATION. (4 cr; prereq grad student in Tech Comm or #)

Study of qualitative methods of communication research, including qualitative observation and analysis, nonobtrusive methods, focus group research, and organizational climate assessment. Systematic qualitative research project and report.

8510. THEORY AND PRACTICE IN DESIGNING MESSAGES. (3 cr; prereq MS students in Tech Comm only)

Examination, using case studies, of how purpose and situation shape written discourse. Implementation of strategies for delivering specific information to a specific audience for a specific purpose.

Rural Sociology (Soc)

Offered by the College of Liberal Arts

1651. RURAL SOCIOLOGY. (4 cr)

Factual data necessary to understand problems of rural social life.

3315. LATIN AMERICAN SOCIETIES IN TRANSITION. (4 cr; prereq 12 cr in sociology, economics, anthropology or political science or #)

Relationship of population, technology, and organization structure to levels of modernization among Latin American nations. Differentiation, diffusion, innovation, and social conflict as precipitants of social change.

3671. COMPARATIVE RURAL SOCIETIES: LATIN AMERICAN. (4 cr; prereq 8 cr in sociology, anthropology, economics or political science or #)

Social and cultural change in Latin America. Demographic and ecological characteristics, institutional structure and its accompanying associations; linkages with outside and world views.

5651. RURAL SOCIAL INSTITUTIONS. (4 cr; prereq any 3xxx sociology course or equiv or #)

Factors in the rural environment that condition the functioning of rural social institutions—family, school, church, local government, health, welfare.

5661. RURAL COMMUNITY ANALYSIS. (4 cr; intended for persons in rural community organization, rural teaching, extension work, and related fields; prereq any 3xxx sociology course or equiv or #)

Tools, techniques, and methods of making community field studies.

Course Descriptions

5675. WORLD FOOD SUPPLY PROBLEMS. (4 cr, §AgEc 5790, §FScN 5643, §PIPa 5220, §LACS 5280; prereq major in agriculture, veterinary medicine, nutritional sciences, social science field or #; grad students by Δ only)
Multidisciplinary approach to social, economic, and technical problems of feeding the world's growing population. Principles from social, plant, animal, and nutritional sciences and their application to food problems analyzed.

For Graduate Students Only

(For descriptions, see *Graduate School Bulletin*)

8651, 8652, 8653. SEMINAR: RURAL SOCIOLOGY. (3 cr per qtr; offered when feasible)

8661. SEMINAR: RESEARCH METHODS IN RURAL SOCIOLOGY. (3 cr; offered when feasible)

Soil Science (Soil)

1001. ORIENTATION TO SOIL SCIENCE. (1 cr; S-N only)

Information discussions with teaching, research, and extension staff in the various disciplines of soil science. Visits to research and teaching facilities to acquaint students with department and faculty.

1122. INTRODUCTORY SOIL SCIENCE. (4 cr; prereq Chem 1001 or 1004)

Basic physical, chemical, and microbiological properties of soil. Soil genesis, classification, and principles of soil fertility. Lectures and laboratory.

1262. INTRODUCTION TO METEOROLOGY. (4 cr)

(Same as Geog 1425) Pre-calculus introduction to nature of atmosphere and its behavior. Atmospheric composition, structure, stability, and motion; precipitation processes, air masses, fronts, cyclones and anticyclones; general weather patterns; meteorological instruments and observations; plotting and analysis of maps; forecasting.

1428. SEMINAR: ORGANIC AGRICULTURE. (1 cr; S-N only)

Round table discussions and assigned readings concerning organic farming methods.

3104. COMPUTER APPLICATIONS IN SOIL SCIENCE. (2 cr)

General understanding of microcomputer hardware and software. Practical problem-solving modules in soil science. Hands-on experience in computer laboratory.

3118. SEMINAR: SOIL AND WATER POLLUTION AND PUBLIC POLICY. (1 cr; S-N only)

Round table discussions of assigned readings in the subject matter.

3210. PHYSICAL SOIL MANAGEMENT AND TILLAGE. (4 cr; prereq 1122, Math 1111, Phys 1041 or #)

Physical characteristics of soil related to plant growth and development. Seedbed preparation, tillage, water storage and availability, soil heat, aeration and their modification for greater crop yields where feasible. Lecture and laboratory.

3218. SEMINAR: CONSERVATION TILLAGE. (1 cr; S-N only)

Round table discussions of assigned readings in the subject matter.

3220. SOIL CONSERVATION AND LAND USE MANAGEMENT. (4 cr)

Factors affecting soil and water losses. Techniques used in soil and water conservation. Use of soil survey computer data for conservation and land use decisions. Organizations involved in conservation activities.

3416. SOIL FERTILITY. (5 cr; prereq 1122)

Fundamental concepts in soil fertility evaluation. Emphasis on the dynamics of mineral elements in the soil and evaluation and interpretation of plant and soil relationships. Introduction to diagnostic techniques through measurement of specific soil fertility parameters. Lectures and laboratory.

3419. FERTILIZER TECHNOLOGY. (2 cr; prereq 3416 or #)

Introduction to the theory and principles of fertilizer manufacture, fertilizer mixing, and fertilizer application procedures used in agronomic and horticultural operations.

3520. SOIL MORPHOLOGY, CLASSIFICATION, AND GENESIS. (4 cr; prereq 1122)

Field observation and identification of the morphological characteristics of soils. Interpretation of soil profiles for water-related characteristics. Identification of soil landscapes and the influence of soil-forming factors on soil morphology. Lecture and field laboratory.

3521. COLLEGIATE SOIL JUDGING. (1 cr, prereq 3520)

Methods of collegiate soil judging. Participation on soil judging team during regional or national contests required.

3918. SENIOR SEMINAR. (1 cr; prereq jr or sr)

Techniques in seminar preparation and presentation for soil scientists. Presentation of selected research topics.

5000. PROFESSIONAL EXPERIENCE PROGRAM. (4 cr; prereq 12 cr in soils and #; not for grad cr; extension regis only)

Up to 12 weeks of experience in a position related to soil science. Evaluation of work experience by employer and faculty adviser in consultation with student and employer.

5099. RCD INTERDISCIPLINARY SEMINAR I. (4 cr, 5099-5100†, §AgEc 5099, §AgET 5099, §LA 5099, §RCD 5099; prereq sr or #)

Selected speakers, readings, and discussion topics dealing with resource and community development analysis and implications for resource allocation. Discussions reflect diverse disciplinary contributions.

5100. RCD INTERDISCIPLINARY SEMINAR II. (4 cr, 5099-5100†, §AgEc 5100, §AgET 5100, §RCD 5100; prereq 5099)

Designed to help students develop the ability to identify and analyze resource development problems. Discussions reflect diverse disciplinary contributions. Students participate as members of a team, combining disciplinary skills. Guest speakers and student assignments.

5104. AGRICULTURAL SYSTEMS ANALYSIS AND MODELING. (4 cr, §PIPa 5104, §AgEc 5104, §AnSc 5104; prereq Math 1142 or #)

Introduction to bioeconomic modeling as preparation for interdisciplinary agricultural systems analysis. Basic concepts; deterministic and stochastic models; delays, feedback, and clockwork; data acquisition; model verification and validation; role of models for agroecosystem management.

5114. SPECIAL PROBLEMS IN SOILS. (1-5 cr [may be repeated for max 10 cr]; prereq 1122 or #)

Research, readings, and instruction.

5228. SEMINAR: CLIMATOLOGY, METEOROLOGY, AND AGRICULTURE. (1 cr per qtr [max 3 cr]; prereq #; offered fall, winter, and spring)

Round table discussions and assigned readings.

5230. SOIL-PLANT-WATER RELATIONS. (3 cr; prereq 1122, Biol 1103)

Water flow in soil-plant-atmosphere continuum; emphasis on soil-root interface. Influence of soil physical and biological properties on growth and function of plant root systems; transpiration and factors affecting water transport in plants. Dynamic properties of soils affecting water flow and soil water management.

5232. SOIL PHYSICS. (5 cr; prereq Math 1142, 2 qtrs physics or ¶ or #)

Basic physical laws governing processes occurring in soils and their quantification. Physical basis for water, air, and heat transport processes. Lectures, laboratory demonstrations, and problem-solving help sessions.

5240. MICROCLIMATOLOGY (SOILS). (3 or 4 cr; prereq Math 1111, 10 cr physics or #)

Meteorology and climatology in relation to the soil-atmosphere interface, with emphasis on the microclimate, physical processes taking place within the microclimate, modification of the microclimate description of meteorological instruments, and use of weather data.

5310. SOIL CHEMISTRY. (4 cr; prereq 1122, analytical chemistry or #)

Composition of soil mineral and organic matter. Solubility models applied to mineral stability. Oxidation reduction, acidity and pH, ion exchange. Acid, alkaline, calcareous, and alkalai soils. Lecture and lab.

5340. ORGANIC AND PESTICIDAL RESIDUES. (5 cr; prereq 1122, sr or #)

The fate of crop residues, animal wastes, sewage materials, petroleum hydrocarbons, detergents, and pesticides in soils with emphasis on the chemical, physical, and biological factors of the soil that influence decomposition or persistence.

5360. SOIL CLAY MINERALOGY. (4 cr; prereq sr or grad)

Origin, extent, importance, and identification of soil clay minerals. Crystalline and non-crystalline. Pedologic implications.

5416. SOIL FERTILITY. (4 cr, §3416; prereq 1122)

Fundamental concepts in soil fertility evaluation. Emphasis on dynamics of mineral elements in the soil and evaluation and interpretation of plant and soil relationships. Introduction to diagnostic techniques through measurement of specific soil fertility parameters. Lectures, laboratory, and discussion.

5424. APPLIED CLIMATOLOGY. (3 cr; prereq 5240 or Geog 3421 or #)

Intended for advanced undergraduates and beginning graduate students who have a background in the principles of climatology or microclimatology. Sources of climatic data, methods of analysis, and selected set of specific applications that focus on agricultural and environmental management problems.

5510. MORPHOLOGY, CLASSIFICATION, AND GENESIS OF SOILS. (4 cr, §3520; not open to soil science and soil and water science majors; prereq 1122)

Field observation and identification of the morphological characteristics of soils. Interpretation of soil profiles for water-related characteristics. Identification of soil landscapes and the influence of soil-forming factors on soil morphology. Lecture and field laboratory.

5515. SOIL DEVELOPMENT, CLASSIFICATION, AND GEOGRAPHY. (4 cr; prereq 3520 or #)

Soil profile characteristics; influence of parent material, climate, topography, vegetation, and time on soil development; system of soil classification, and geographical distribution of soil orders.

5550. PEATLANDS: FORMATION, CLASSIFICATION, AND UTILIZATION. (3 cr; prereq 1122 or #)

Formation, properties, and management of peatlands important to crop, forestry, and energy production in this state and worldwide. Lecture.

Course Descriptions

5570. FIELD TOUR OF MINNESOTA SOILS. (3 cr; prereq 3520 or #)
Two-week field tour of both northern and southern Minnesota's soils. Soil formation, soil profiles, land use and management practices discussed while visiting representative soils. Travel expenses are student's responsibility.

5610. SOIL BIOLOGY. (4 cr; prereq 1122, P1Pa 1001 or #)
Soil environment and its biological population. Role of living organisms in soil-plant environment and mineral transformations of agronomic importance (carbon, nitrogen, phosphorus, sulfur and heavy metals). Effects of soil microflora on soil fertility and plant nutrition. Lectures, laboratory, and weekly discussion.

5710. ADVANCED FOREST SOILS. (3 cr [4 cr with paper]; prereq 1122, FR 5114)
Factors affecting tree growth; estimation, modification, and management effects on site productivity; regeneration.

For Graduate Students Only

(For descriptions, see *Graduate School Bulletin*)

8111. COLLOQUIA IN SOIL SCIENCE

8122. ADVANCED SOIL SCIENCE

8124. RESEARCH PROBLEMS IN SOILS

8128. SEMINAR

8250. FLUID FLOW IN SOILS

8330. ADVANCED SOIL CHEMISTRY

8630. NITROGEN FIXATION

8632. SOIL MICROBIOLOGY AND PLANT GROWTH

Statistics (Stat)

Offered by the College of Liberal Arts

1001f,w,s. INTRODUCTION TO IDEAS OF STATISTICS. (4 cr; prereq high school algebra)
Controlled vs. observational studies; presentation and description of data; correlation and causality; sampling; accuracy of estimates; tests.

3011-3012. STATISTICAL ANALYSIS. (4 cr; prereq college algebra)
3011: Descriptive statistics; elementary probability; estimation; one- and two-sample tests; introduction to regression and ANOVA.
3012: ANOVA; randomized blocks; multiple comparisons; factorial experiments; multiple regression; transformations; goodness of fit; nonparametric methods; contingency tables; selected topics.

3091f,w,s. INTRODUCTION TO PROBABILITY AND STATISTICS. (4 cr, \$5121, \$5131; prereq differential and integral calculus)
Elementary probability and probability distributions, sampling and elements of statistical inference. Treatment more mathematical than that in 1051.

5021f,w,s. STATISTICAL ANALYSIS I. (5 cr; prereq \$3012, college algebra or #)
Intensive version of 3011/3012 designed for graduate students needing statistics as a research technique.

5022w,s. STATISTICAL ANALYSIS II. (5 cr; prereq 5021 or #)
(Continuation of 5021) Multiple regression and correlation; multiway analysis of variance, variance components, covariance; elementary principles of design; basic nonparametric methods.

5101. INTRODUCTION TO DECISION THEORY. (4 cr; prereq Econ 5111 or Math 1142 or 1211 or #)
Elements of probability; basic concepts in statistical decision theory; relationship to game theory and other types of decision problems; prediction and inference.

5121w-5122w,s. THEORY OF STATISTICS. (4 cr per qtr, \$5131-5132-5133; prereq Math 1231 or 1331 or 1621)
Univariate and multivariate distributions, law of large numbers, sampling, likelihood methods, estimation and hypothesis testing, regression and analysis of variance and covariance, confidence intervals, and distribution-free methods.

5131f-5132w-5133s. THEORY OF STATISTICS. (4 cr per qtr, \$5121-5122; prereq Math 3211 or 3411)
5131: Probability models, univariate and bivariate distributions, independence, and basic limit theorems.
5132-5133: Statistical decision theory, sampling, estimation, testing hypotheses, parametric and nonparametric procedures for one-sample and two-sample problems, regression, and analysis of variance. Treatment more mathematical than that of 5121-5122.

5134f-5135w-5136s. THEORY OF STATISTICS. (1 cr per qtr; prereq \$5131, \$5132, \$5133)
5134: History of statistics. Original works in statistics, from 17th century to present.
5135: Distributions in statistics. Practice in solving problems.
5136: Theories of inference. Classical inference, Bayesian inference, decision theory, and other approaches.

5161f-5162w-5163s. APPLIED STATISTICAL METHODS. (4 cr per qtr, \$5201, \$5301, \$5302, \$5421; prereq \$5022 or \$5131, admission to grad study in statistics or #)
5161: Sampling methodology. Estimation from sample surveys. Simple and multiple regression. Use of statistical packages.
5162: Advanced topics in linear regression. Nonlinear models. Generalized linear models. Categorical data analysis. Logistic regression.
5163: Variance reduction designs for experiments. Factorial, fractional, and confounded designs. Optimal designs. Analysis of covariance. Unbalanced data analysis.

5201w. SAMPLING METHODOLOGY IN FINITE POPULATIONS. (4 cr; prereq 5021 or 5121 or 3091 or #)
Simple random, systematic, stratified, and unequal probability sampling. Ratio and regression estimation. Multistage and cluster sampling.

5211. THEORY OF SAMPLE SURVEYS. (4 cr; prereq 5122 or 5133)
Mathematical treatment of survey sampling, including stratified and multistage sampling, models for nonsampling errors.

5271-5272. BAYESIAN DECISION MAKING. (4 cr, \$Econ 5271-5272; prereq \$5122 or \$5132 for 5271, Econ 1002 and 5122 or 5132 for 5272; 5271 recommended for 5272)

5271: Axioms for personal probability and utility. Elements of statistical decision theory. Bayesian analysis of linear models.

5272: Expected utility models for economic decisions made under conditions of uncertainty. Application to portfolio selection, forward and futures trading, betting, contingency markets, and business planning.

5301f,s. DESIGNING EXPERIMENTS. (5 cr, \$5163; prereq 3012 or 5021 or 5133 or #)

Control of variation, construction, and analysis of complete and incomplete block, split plot, factorial, and groups of similar experiments. Confounding, crossover, and optimum seeking designs.

5302f,s. APPLIED REGRESSION ANALYSIS. (5 cr, \$5161; prereq 3012 or 5021 or 5133 or #)

Simple, multiple, and polynomial regression. Estimation, testing, and prediction. Stepwise and other numerical methods; examination of residuals; weighted least squares; nonlinear models; response surface. Experimental research and economic applications.

5401s. INTRODUCTION TO MULTIVARIATE METHODS. (4 cr; prereq 5302 or 5133)

Bivariate and multivariate distributions. Inference based on multivariate normal distributions. Discrimination and classification. Multivariate analysis of variance. Partial, canonical correlation and independence. Principal component analysis, factor analysis, analysis of repeated measurements, cluster analysis, and profile analysis.

5421. ANALYSIS OF CATEGORICAL DATA. (4 cr; prereq 5301 or 5302 or 5133 or #)

Varieties of categorical data, cross-classifications and contingency tables, tests for independence. Multidimensional tables and log-linear models, maximum-likelihood estimation, and tests of goodness-of-fit. Analysis of Markov chain data. Smoothing counts.

5601w. NONPARAMETRIC METHODS. (4 cr; prereq 5021 or 5122 or 5132 or #)

Necessary discrete and continuous probability distributions. Goodness-of-fit, sign tests, order statistics, rank tests for location and for scale, two-sample and k-sample comparisons, association. Methods and applications.

5890. SENIOR PAPER. (2 cr; prereq sr Stat major)
Satisfies senior project requirement. Directed study. Paper on specialized area, consulting project, or original computer program.

5900. TUTORIAL COURSE. (Cr ar; prereq #)
Study in areas not covered by regular offerings. Directed study.

5911-5912-5913. TOPICS IN STATISTICS. (3 cr per qtr [may be repeated for cr with Δ]; prereq 5122 or 5133 and #)

Topics vary.

Veterinary Biology (VB)

Offered by the College of Veterinary Medicine

1120. COMPARATIVE VERTEBRATE MORPHOLOGY. (6 cr; not open to vet med students; prereq Biol 1106 or #)

Comprehensive treatment of morphology, embryogenesis, and phylogeny of vertebrate organ systems; emphasis on structure-function relationships. Lectures complemented by extensive individual student dissections of various organ systems of representative animals from each major vertebrate class, including lamprey, shark, perch (Fishes); mudpuppy, frog (Amphibia); turtle (Reptilia); pigeon (Aves); dog (Mammalia).

5120. COMPARATIVE VERTEBRATE MORPHOLOGY.

Same as VB 1120.

5140. VERTEBRATE MICROANATOMY. (1-6 cr; prereq 5120 or #)

The microscopic structure and cytochemical and functional aspects of cells, tissues, and organs of representative examples of vertebrates. Four units: basic tissues (2 cr); gastrointestinal tract (1 cr); respiratory and integumentary systems (1 cr); and excretory, reproductive, and endocrine systems (2 cr). Depending on background and interest, students may register for any or all units.

5320. AVIAN PHYSIOLOGY. (5 cr; prereq AnSc 3301 or 6 cr systemic physiology or equiv, #; offered alt even yrs)

Physiology of wild and domestic birds.

5330. WILD BIRD MEDICINE. (2 cr; prereq vet med [3rd or 4th yr] or grad student or #)

Brief summary of important aspects of avian anatomy and physiology. Survey of diseases common to wild birds and surgical repair of common injuries and fractures.

Veterinary Medicine, College of (CVM)

Offered by the College of Veterinary Medicine

1100. ORIENTATION TO VETERINARY MEDICINE. (1 cr)

History of the veterinary profession, careers within the profession, and employment trends. Resources available to those interested in a career in the profession, including the College of Veterinary Medicine and the animal health technology courses offered in Minnesota.

Course Descriptions

3100. PERSPECTIVES: INTERRELATIONSHIPS OF PEOPLE AND ANIMALS IN SOCIETY TODAY. (2 cr)

(Same as PubH 3301 and 5301) Interrelationships of people and animals from several viewpoints. The social, economic, and health consequences of these relationships, including issues such as pets and people sharing an urban environment, animal rights, and the influence of cultural differences on animal-human relationships.

Veterinary Pathobiology (VPB)

Offered by the College of Veterinary Medicine

3103. GENERAL MICROBIOLOGY. (5 cr; not open to vet med students; prereq 10 cr chemistry, 4 cr biological sciences)

Lectures and laboratory exercises morphology, taxonomy, genetics, physiology, and ecology of microorganisms. Practical application of fundamental principles of microbiology to other phases of science and industry.

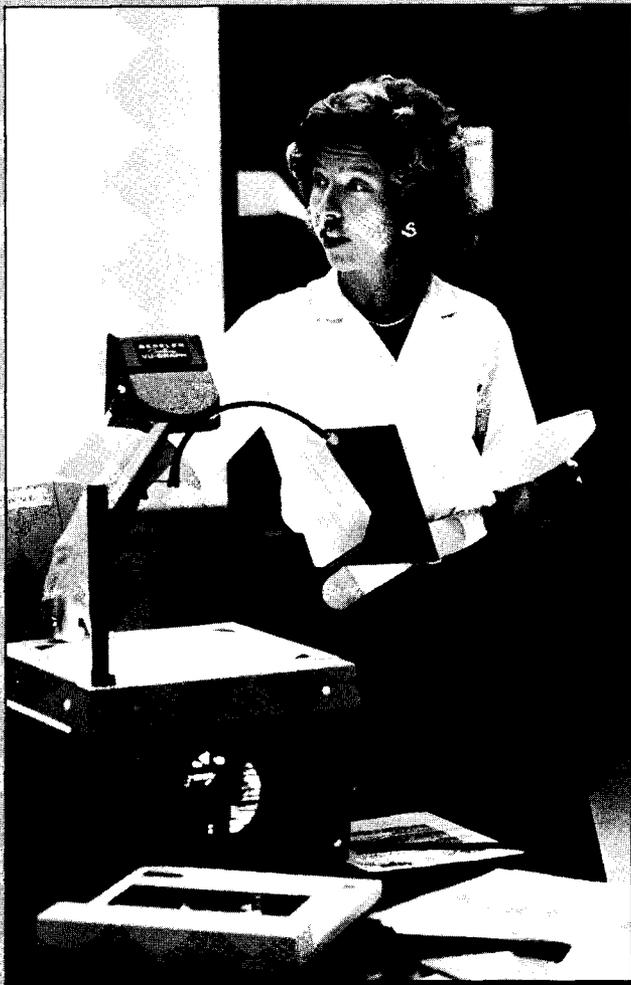
5603. PARASITES OF WILDLIFE. (3 cr; prereq #; offered alt odd yrs)

Biologic relationships of animal parasites and disease to regional wildlife.

5707. POULTRY DISEASE CONTROL. (3 cr; not open to vet med students; prereq Biol 1102, AnSc 1100, MicB 3103 or equiv)

General anatomy; physiology of digestion and reproduction; prevention and control of the more important diseases affecting poultry.

Administration and Faculty



Administration and Faculty

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Jack P. Grahek, Ely
Wally Hilke, St. Paul
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Mark Hill, Coordinator
Prospective Student Services
James C. Sentz, Student Training Officer
International Agricultural Programs

College of Agriculture Faculty

Agricultural and Applied Economics

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Selmer A. Engene, Ph.D.

Paul R. Hasbargen, Ph.D.
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John S. Hoyt, Ph.D.
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Claudia Parliament, Ph.D.
JoAnn Paulson, Ph.D.
Stanley Stevens, Ph.D.
Steven Taff, Ph.D.
Harold von Witzke, Ph.D.

Agricultural Education

Professor Emeritus

R. Paul Marvin, Ph.D.

Professor

Edgar A. Persons, Ph.D., *head*
W. Forrest Bear, Ph.D.
George H. Copa, Ph.D.

**Recipient of the Horace T. Morse-Amoco Foundation Award for Outstanding Contributions to Undergraduate Education.*

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Assistant Professor
 George Wardlow, Ph.D.

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 Robert A. Young, Ph.D.

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 Jonathan Chaplin, Ph.D.
 Charles J. Clanton, Ph.D.
 Larry D. Jacobson, Ph.D.
 Ian Moore, Ph.D.
 Jerry A. Wright, M.S.

Agronomy and Plant Genetics

Professor Emeritus
 Richard Behrens, Ph.D.
 Charles R. Burnham, Ph.D.
 Verne E. Comstock, Ph.D.
 *Laddie J. Elling, Ph.D.
 Herbert W. Johnson, Ph.D.
 Jean W. Lambert, Ph.D.
 Robert G. Robinson, Ph.D.
 Alois R. Schmid, Ph.D.

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Professor
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 William A. Brun, Ph.D.
 Robert H. Busch, Ph.D.
 *Vernon B. Cardwell, Ph.D.
 R. Kent Crookston, Ph.D.
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 Dale R. Hicks, Ph.D.
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 Robert E. Stucker, Ph.D.
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 Howard W. Rines, Ph.D.

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 Charlotte E. Eberlein, Ph.D.
 Nancy J. Ehke, Ph.D.
 John W. Gronwald, Ph.D.
 Jeffery L. Gunsolus, Ph.D.
 Daniel H. Putnam, Ph.D.
 David A. Somers, Ph.D.

Adjunct Assistant Professor
 Frank Forcella, Ph.D.
 Mark Westgate, Ph.D.

Animal Science

Professor
 *Richard D. Goodrich, Ph.D., *head*
 Paul B. Addis, Ph.D.
 C. Eugene Allen, Ph.D.
 Robert D. Appleman, Ph.D.
 Raymond L. Arthaud, Ph.D.
 William J. Boylan, Ph.D.
 Charles J. Christians, Ph.D.
 Bernard J. Conlin, Ph.D.
 Bo G. Crabo, Ph.D.
 William R. Dayton, Ph.D.
 John D. Donker, Ph.D.
 Mohamed E. El Halawani, Ph.D.
 Richard J. Epley, Ph.D.
 Edmund F. Graham, Ph.D.
 Melvin L. Hamre, Ph.D.
 Jerry D. Hawton, Ph.D.
 Alan G. Hunter, Ph.D.
 Robert M. Jordan, Ph.D.
 James G. Linn, Ph.D.
 Jay C. Meiske, Ph.D.
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Richard E. Phillips, Ph.D.
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Charles W. Young, Ph.D.

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Hans-Joachim Jung, Ph.D.
Leslie B. Hansen, Ph.D.
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Gerald R. Steuernagel, Ph.D.
Jonathan E. Wheaton, Ph.D.

Assistant Professor

Brian A. Crooker, Ph.D.
Kevin Guise, Ph.D.
Marcia R. Hathaway, Ph.D.
Sally L. Noll, Ph.D.
Eric A. Wong, Ph.D.

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Professor Emeritus

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Edward B. Radcliffe, Ph.D.

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Phillip K. Harein, Ph.D.

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David W. Ragsdale, Ph.D.

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and Extension Specialist

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Timothy J. Kurtti, Ph.D.

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Extension specialist

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*Lura M. Morse, Ph.D.
Elmer L. Thomas, Ph.D.

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Joseph J. Warthesen, Ph.D., *assistant head*
Paul B. Addis, Ph.D.

*C. Eugene Allen, Ph.D.

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A. Saari Csallany, D.Sc.

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H. William Schafer, Ph.D.

Associate Clinical Specialist

Margaret L. Olson, M.A.

Assistant Clinical Specialist

Carolyn P. Thomas, Ph.D.

Lecturer

Lorraine F. Anderson, M.S.

Alfred T. May, B.Ph.

Karen E. Moxness, M.S.

Horticultural Science and Landscape Architecture

Professor Emeritus

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Robert E. Nylund, Ph.D.

Leon C. Snyder, Ph.D.

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 Sharon Desborough, Ph.D.
 Wesley P. Hackett, Ph.D.
 C. Gustav Hard, Ph.D.
 Leonard B. Hertz, Ph.D.
 Florian I. Lauer, Ph.D.
 Pen H. Li, Ph.D.
 Jane P. McKinnon, MS
 Robert Mullin, Ph.D.
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 Joseph R. Sowokinos, Ph.D.
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 Bert T. Swanson, Ph.D.
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 Peter J. Olin, M.L.A.
 Luther Waters, Jr., Ph.D.

Assistant Professor

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 Vincent A. Fritz, Ph.D.
 Emily E. Hoover, Ph.D.
 James J. Luby, Ph.D.
 Carl Rosen, Ph.D.

Plant Pathology

Regents Professor Emeritus
 Clyde M. Christenson, Ph.D.

Professor Emeritus

Carl J. Eide, Ph.D.

Professor

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 Ward C. Stienstra, Ph.D.
 P.S. Teng, Ph.D.

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 Richard J. Zeyen, Ph.D.

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 Donald V. McVey, Ph.D.
 Thomas H. Nicholls, Ph.D.
 James A. Percich, Ph.D.

Assistant Professor

Carol E. Windels, Ph.D.

Resource and Community Development

Note: In addition to the following faculty members from various departments of the College of Agriculture, others participate from outside the college.

Professor

Russell S. Adams, Ph.D.
 George A. Donohue, Ph.D.
 Wilbur R. Maki, Ph.D.

Assistant Professor

Randolph L. Cantrell, Ph.D.
 Charles J. Clanton, M.S.
 Warren Y. Gore, M.A.
 Steven J. Taff, Ph.D.

Rhetoric

Professor Emeritus

James I. Brown, Ph.D.
 James R. Holloway, D.D.
 Sarah E. McBride, Ph.D.
 Ralph G. Nichols, Ph.D.
 Marjorie H. Thurston, Ph.D.
 Eugene S. Wright, Ph.D.

Professor

Thomas E. Pearsall, Ph.D., *head*
 James E. Connolly, Ph.D.
 Richard O. Horberg, Ph.D.
 William M. Marchand, Ph.D.
 Earl E. McDowell, Ph.D.
 Edward B. Savage, Ph.D.
 L. David Schuelke, Ph.D.
 Donald E. Wells, Ph.D.

Associate Professor

J. Michael Bennett, Ed.D.
 Richard W. Ferguson, Ph.D.
 Laurie S. Hayes, Ph.D.
 Victoria M. Mikelonis
 Thomas M. Scanlan, Ph.D.
 Arthur E. Walzer, Ph.D.

Assistant Professor

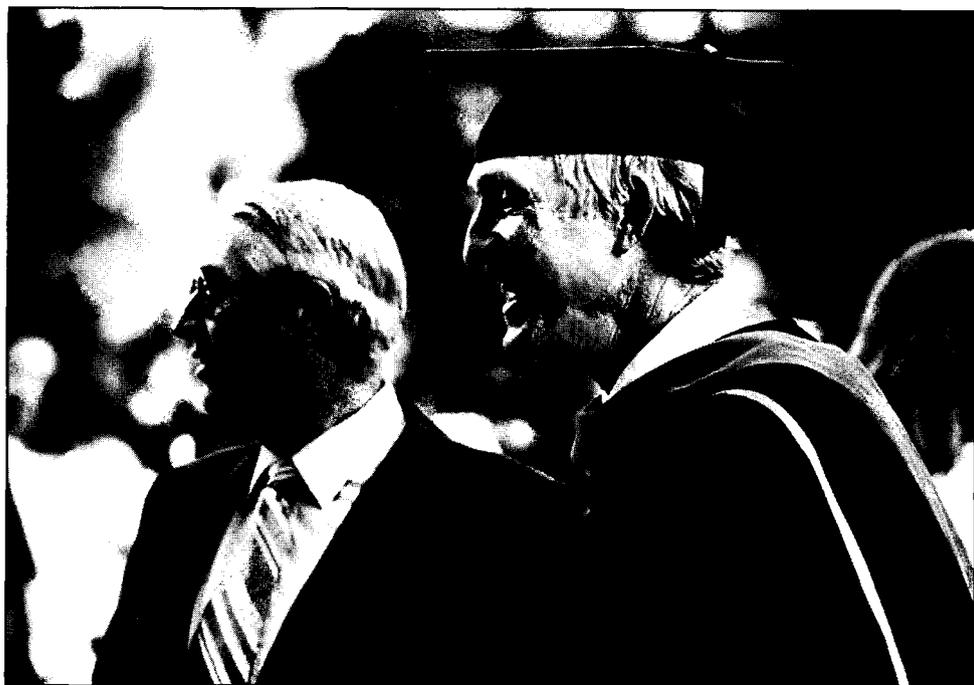
Warren Y. Gore, M.A.

Soil Science

Professor Emeritus

*Harold F. Arneman, Ph.D.

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William P. Martin, Ph.D.
Curtis J. Overdahl, Ph.D.

Associate Professor Emeritus
Clifton F. Halsey, M.S.

Professor

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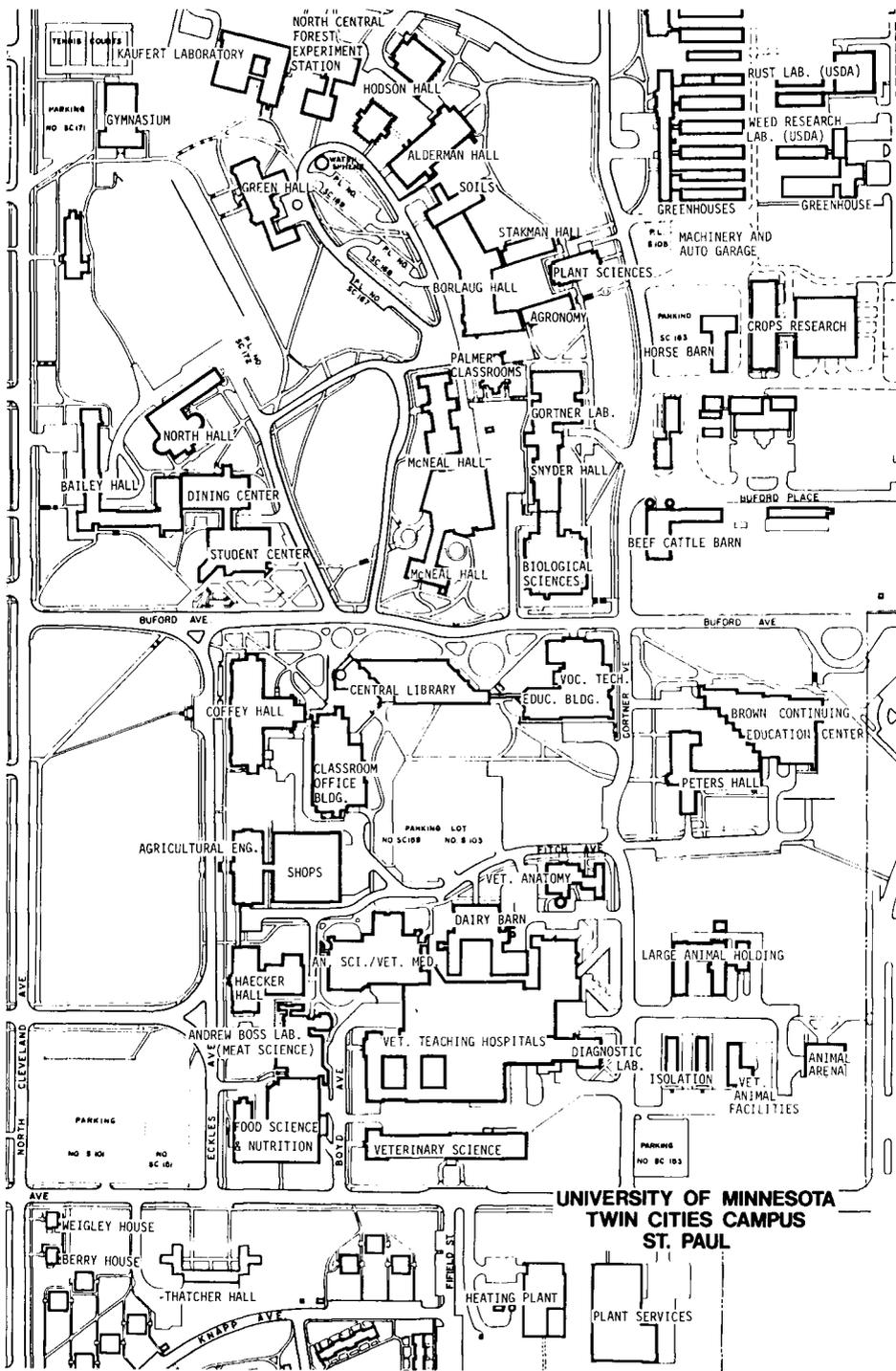
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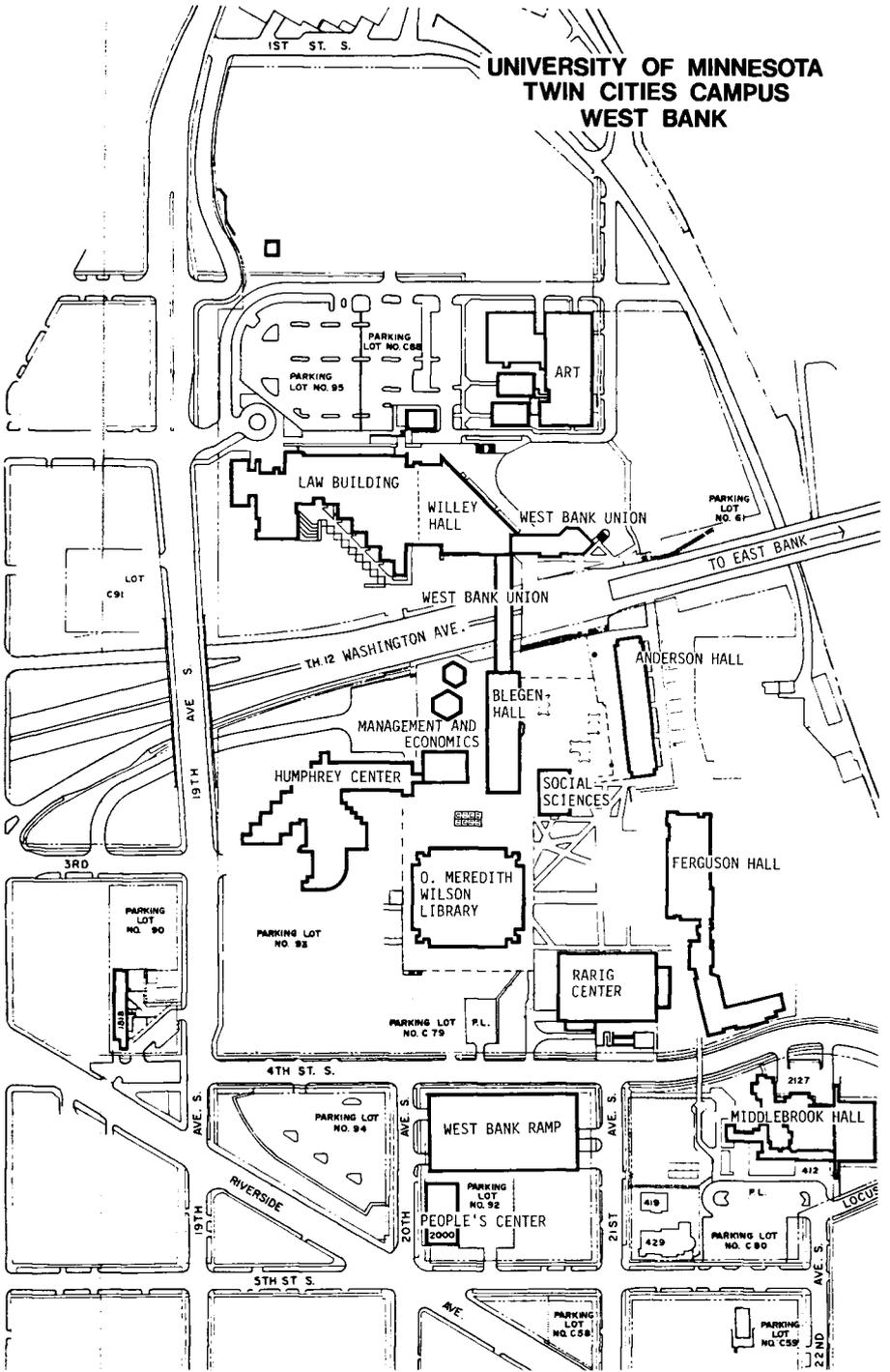
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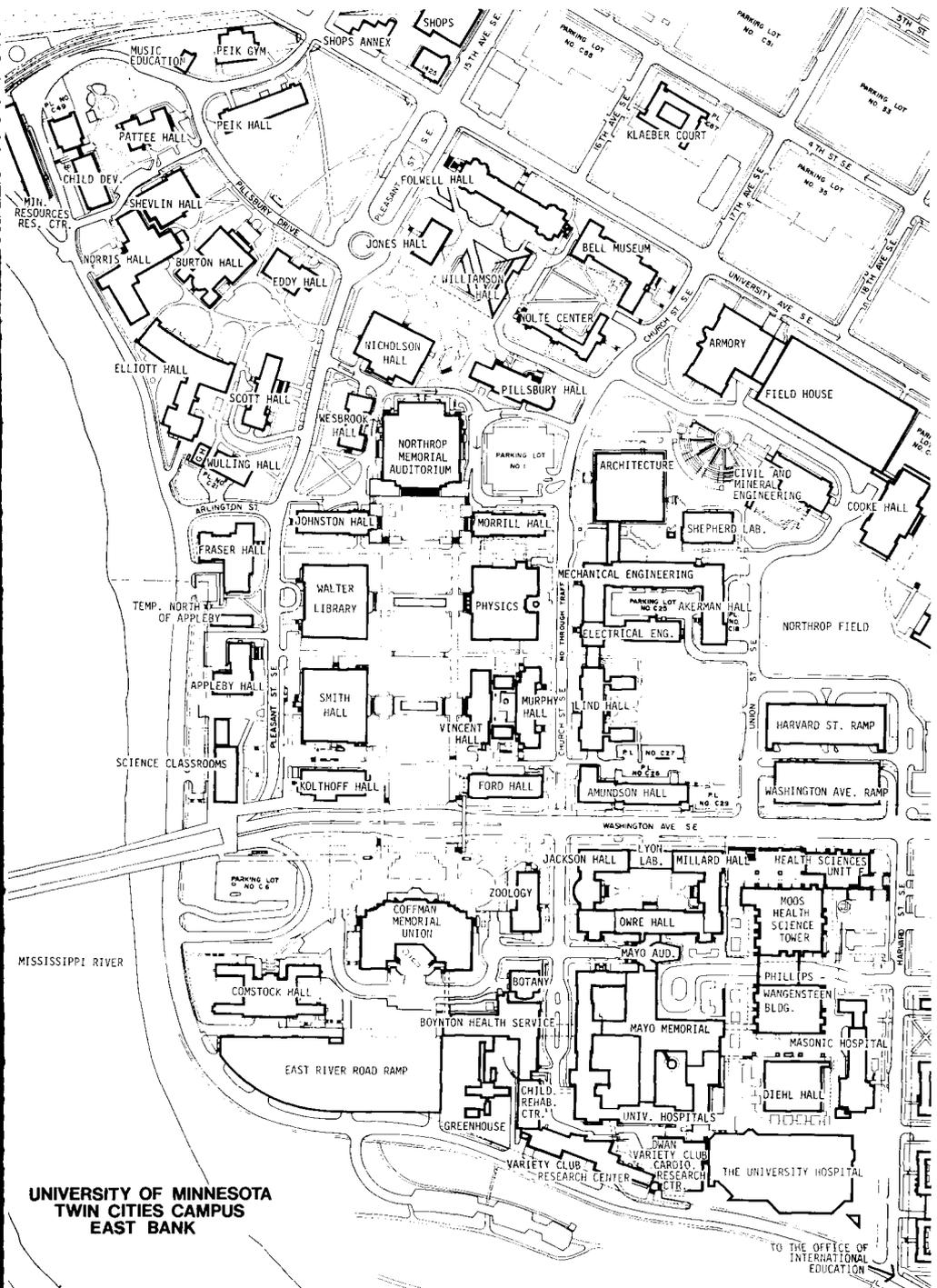
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