NIVERSITY OF MINNESOTA BULLETIN

How to Use This Bulletin

The "General Information" section of this bulletin is your official source of information about the policies of the Graduate School and about procedures in earning graduate degrees.

The section entitled "Fields of Instruction" contains statements of the policies and requirements of the various departments and listings of the course offerings in those departments.

Do Not Fail to Read . . .

(1) The complete description of conditions and requirements for the degree you expect to earn (for the Master's degree, page 10; for the Ph.D. degree, page 17).

(2) The paragraphs headed "Time Limit for Earning the Ph.D. Degree," page 18.

(3) The section entitled "Symbols and Explanations," page 50. This is your guide to the understanding of terms and symbols used in course descriptions.

The office of the Graduate School is located in Johnston Hall. During the academic year the Registration and Information Office, 316 Johnston Hall, is open from 8 a.m. to 12 noon and from 1 p.m. to 4 p.m. Summer hours of the Registration and Information Office are 8 a.m. to 12 noon and 1 p.m. to 3:30 p.m.

UNIVERSITY OF MINNESOTA

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GRADUATE SCHOOL

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Volume LXIX Number 14 July 15, 1966

UNIVERSITY OF MINNESOTA BULLETIN

Published semimonthly January 1 to December 15 inclusive. Second-class postage paid at Minneapolis, Minnesota. Send change of address notices and other communications to Office of Admissions and Records, University of Minnesota, Minneapolis, Minnesota 55455.

The contents of this bulletin and of other University bulletins, publications, or announcements are subject to change.

GRADUATE SCHOOL

General Information

Though the Graduate School was not organized as a separate unit until 1905, the University of Minnesota awarded its first Master's degree as early as 1880 and its first Ph.D. degree 8 years later. From 1888 to 1913, when Guy Stanton Ford assumed the deanship of the Graduate School, 54 Ph.D., degrees were earned at Minnesota. Since 1913 the school has expanded greatly both in fields and areas and in numbers of students. By June 1965, the Graduate School had awarded 6,113 Ph.D. degrees and 22,310 Master's degrees.

A central purpose of the Graduate School is the advanced training of men and women in a wide variety of fields for service and leadership in state and country and the promotion of research resulting in contributions to knowledge by faculty and students in an atmosphere of freedom of inquiry.

The Graduate School is organized under seven advisory group committees in the areas of Agriculture; Biological Sciences; Education, Philosophy, Music, Psychology, Child Development, Speech Pathology; Language, Literature, and Art; Medical Sciences; Physical Sciences, Mathematics, Engineering; and Social Sciences. The dean, the associate dean, and the chairmen of these committees form the Executive Committee of the Graduate School. In addition there are special committees which administer graduate work in Allied Health Sciences, American Studies, Biochemistry, Biophysics, Genetics, Nutrition, and Statistics.

Graduate work crosses the boundaries of the departments, schools, and colleges comprising the University including those at the Mayo Graduate School of Medicine at Rochester. Its faculty of full and associate members, numbering more than 1,500, teaches both in the Graduate School and in the several undergraduate and professional colleges.

The following pages contain detailed information with respect to the structure and rules of the Graduate School, fellowships and assistantships open to graduate students, the programs of study made possible by the offerings in 145 majors, and a list of courses offered.

ADMISSION

Any student with a Bachelor's degree or its equivalent from a recognized college or university may apply to the dean of the Graduate School for admission. University of Minnesota undergraduates who lack not more than 9 quarter credits toward the Bachelor's degree (*counting required and sequence courses*), if they meet admission requirements, may register in the Graduate School to begin a graduate program while simultaneously completing work for the Bachelor's degree. An applicant with the necessary background for his chosen major field, an excellent scholastic record from an approved college or university, and satisfactory character and professional qualifications may be admitted for graduate work on recommendation of the graduate faculty in the proposed major field and approval of the dean of the Graduate School.

Credentials Examination Fee

A credentials examination fee of $10 is required for each applicant. Persons who were previously officially admitted to and registered in a college of the University of Minnesota are exempt from this requirement. (This exemption *does not* extend to students previously registered only in the General Extension Division or as "Summer Only" students.) Residents of the United States must submit the fee by personal check or money order; foreign applicants must submit the fee by certified bank check. All checks should be made payable to the University of Minnesota. The fee will not be refunded.

Test Data

Miller Analogies Test—A graduate level form of the Miller Analogies Test is required of applicants for the following major fields:

American Studies
Anthropology
Area Studies (except Classical Area Studies)
Biometry
Child Psychology
Education (for Ph.D.)
Educational Administration (for Specialist Certificate and Ph.D.)
Educational Psychology (for Specialist Certificate and Ph.D.)
Emphasis in Special Education under any major and for any degree
Industrial Relations
International Relations
Journalism
Library Science
Political Science
Psychology
Public Administration
Public Health when the emphasis is on public health nursing
Social Work
Sociology
Speech and Theatre Arts
Speech Science, Pathology, and Audiology
Theatre Arts
Zoology

The Graduate School will, upon receipt of the application for admission forms, inform the applicant of the Miller test center nearest him.

Admission Test for Graduate Study in Business—Applicants in business administration are required to present an official report of their performance on the Admission Test for Graduate Study in Business as part of the application for admission to graduate work in that field. Since this test is given at limited times and places during the year, applicants would be well advised to make early arrangements for registration for this test. For information concerning registration for the examination, students should write to the Educational Testing Service, P.O. Box 592, Princeton, New Jersey 07110.

Graduate Record Examination—Although the Graduate Record Examination is not a general requirement for admission, it may be requested in individual cases to determine admissibility. It would be wise therefore for applicants to complete this test either in the senior year of undergraduate work or before filing an application for admission. For further information on this examination and places where it may be taken, applicants should write to the Educational Testing Service, P.O. Box 592, Princeton, New Jersey 07110, or to the Student Counseling Bureau, 101 Eddy Hall, University of Minnesota, Minneapolis, Minnesota 55455.

The Graduate School reserves the right to request data in any case where it is believed necessary.

Test of English as a Foreign Language (TOEFL)—This test is required of all foreign applicants whose native language is not English. The University of Minnesota reserves the right to require additional testing upon arrival.

Applications will be considered prior to the time that TOEFL results are available, but the Certificate of Eligibility necessary to obtain the visa will not be issued until we have evidence of satisfactory performance on the test.

Application Procedure

Requests for application materials must be sent to the Graduate School, 322 Johnston Hall, Minneapolis, Minnesota 55455, and should specify the applicant's proposed major field.

Applications for admission must be received in the Graduate School, complete in every detail—one official transcript from each college attended, and the credentials examination fee, and test results, if required—*at least 4 weeks* prior to the opening of the quarter or summer term in which the applicant expects to register.

Because members of the graduate faculty are not in official residence between the close of the second term of the Summer Session and the middle of September, it may not be possible either for students to arrange interviews with them or for the Graduate School to process applications for admission during this period. It is wise, therefore, to submit applications for admission to the fall quarter prior to August 1.

Transient Graduate Student

A student currently engaged in a graduate degree program in another recognized graduate school who wishes to enroll for a summer session or a single quarter in the Graduate School of the University of Minnesota, and who intends thereafter to return to the graduate school in which he is carrying forward his program of studies for a graduate degree, may be admitted as a transient graduate student. He will not be required to submit a full transcript of his credits but may ask the dean of his graduate school to complete our Form 218 and return it to the Graduate School, 322 Johnston Hall, University of Minnesota, Minneapolis, Minnesota 55455.

Under no circumstances will a student be permitted to register for more than 1 quarter or summer session as a transient student. Persons originally registering in this status who wish to apply for regular admission must follow the directions outlined above.

Readmission, Change of Major, or Change of Degree Objective

Persons who have withdrawn from the Graduate School for 2 consecutive years or more and who wish to request readmission, or persons currently enrolled who intend to change their major field or degree objective from that originally approved by the Graduate School, should request a copy of the

Change of Status form (GS #72) from the Graduate School, Room 322, Johnston Hall. Processing of these requests requires a minimum of 4 weeks.

REGISTRATION

Students who have received notification of admission to the Graduate School may obtain directions for registration at the Graduate School, 316 Johnston Hall, when they arrive at the University.

Registration in the Graduate School includes making out a program for the next quarter, which program must be approved by a departmental adviser and the dean. A physical examination is required of all students entering the Graduate School. Students who have met the physical examination requirement for entrance into one of the other colleges of the University of Minnesota will not regularly be required to repeat this examination. When students are admitted to the Graduate School and are required to take the physical examination, the forms on which their physicians will report the results of the examination will accompany the letter of acceptance.

Registration by Mail (Ph.D. Candidates)—The student who has been admitted to candidacy for the Ph.D. (for definition of candidacy see page 18) and is not registered for course work may register by mail. He must return his registration form and check or money order in the appropriate amount to the Office of Admissions and Records, Morrill Hall, University of Minnesota, Minneapolis, Minnesota 55455. Registration forms for this purpose will be mailed to the candidate prior to the opening of each academic quarter.

Back-Registration and Cancellation of Courses—Graduate students must complete registration, including addition of courses and cancellation of courses, each quarter by the last day of class and before examinations begin.

Joint Registration with the Extension Division—In the event that such registration is approved during the biennium of this Bulletin, students planning to earn their graduate degrees using credits earned in the Extension Division will apply for admission to the Graduate School in the usual way. Once they are admitted, they will pick up registration forms at the Graduate School office and register as all graduate students do. When their registration is complete, students will go to the Extension Division and register this information there. In no instance may a student register under joint registration or receive graduate credit through the Extension Division until he is admitted to the Graduate School. Only General Extension courses which have been approved as graduate level by the Graduate School will receive joint registration graduate credit.

Courses taken in the Extension Division will be identified on the student's transcript by a symbol, and the percentage of courses on a student's program which may be taken in Extension will be announced. Only course work done in the Extension Division under joint registration will receive graduate credit.

NOTE: The student must inquire both of the faculty in his major field and of the faculty in his minor field as to their use of joint registration. Additional restrictions with respect to joint registration may be imposed by the graduate faculty of any department.

DIRECTORS OF GRADUATE STUDY

In his initial contact with the graduate faculty in his proposed major or minor field of study, the student should seek advice from the director of graduate study in the field. In most areas the director of graduate study is so designated in the list of faculty at the beginning of the departmental statement. Where no faculty member has been so designated, he might approach the head of the department.

FEES

For 1966-67 the following fees apply. See *Bulletin of General Information* for possible changes.

Credentials examination fee	$ 10.00
Tuition fees for residents** (except in dentistry, pharmacy, clinical medicine, veterinary medicine) per quarter	
6 credits or less, or thesis only	52.00
More than 6 credits	104.00
Tuition for nonresidents per quarter (except in dentistry, pharmacy, clinical medicine, veterinary medicine) per quarter	
6 credits or less, or thesis only	140.00
More than 6 credits	280.00
Tuition fees for Ph.D. candidates (for definition of candidacy, see page 18)	
6 credits or less or to meet continuous registration requirement (resident or nonresident) per quarter (Incidental fee optional for students in residence)	20.00
More than 6 credits (residents)	104.00
More than 6 credits (nonresidents) (Incidental fee required)	280.00
Incidental fee (per quarter)	27.00
Foreign students—special instruction in English (per quarter) (consult Graduate School office or Office of Adviser to Foreign Students)	15.00
Health fee for foreign students (per quarter)	5.00
Special deposit for chemistry laboratory	10.00
Graduation fee	10.00
Fee for binding Master's thesis	5.00
Fee for microfilming Ph.D. thesis	25.00

For the Summer Session fees, see *Bulletin of the Summer Session.*

Tuition Fees for Ph.D. Candidates—The new special fees for Ph.D. candidates are listed under "Fees" above. It should be noted that the new requirement of continuous registration at $20 per quarter will in many cases involve less expense to the student than the former requirement of registration in the quarter when the degree is conferred. Candidates in residence may choose whether they wish to use and pay for the services covered by the incidental fee.

** All college teachers new to the state of Minnesota, including new full-time University faculty members with the rank of instructor or above, may pay tuition at the resident rate from the time they begin their teaching in this state.

Residence—Candidates for advanced degrees must be registered for a minimum of 3 academic quarters and must pay not less than the full normal tuition for 3 quarters before receiving the degree. (See also Requirements for the Doctor's Degree.) Even though a petition is approved for a student to complete the work for the M.A. in 5 summer terms, the nonresident student is required to pay for 6 summer terms, the equivalent of 3 full quarters of tuition.

Health Fee—Because of the possibility of accidents, illness, or other unanticipated health problems the University maintains its own health service to provide medical care for students. Since University fees cover only a small part of the expense of such care, a special health service fee is required of all foreign students except those who already have a University-approved health insurance policy.

Exemptions from the Incidental Fee—Two classes of graduate students are exempted from the incidental fee, and their exemption is to be determined at the time of registration in the office of the Graduate School. These classes are:

(1) Teachers currently employed full time in elementary and secondary schools (public, private, parochial) in the Twin Cities and surrounding areas and whose quarterly credit load does not exceed 5 credits or thesis research only.

(2) Graduate students who are living beyond commuting reach of the campus and whose registration is for thesis only, research or topics courses, or starred papers.

Late Fees—Registration blanks filled out by the student and approved by his adviser and by the Graduate School office must be turned in at the Office of Admissions and Records to obtain a statement of fees which must be paid not later than the close of the first week of each quarter to avoid late fee. The fee for the privilege of late registration, or late payment of fees, is $5 through the end of the second week of classes, and $10 thereafter. Penalty for late registration shall be charged to all students except those registering for thesis only. For the dates when Summer Session fees are due, see the *Bulletin of the Summer Session.*

CANDIDACY FOR DEGREE

Admission to the Graduate School does not admit a student to candidacy for a degree. Admission to candidacy indicates a judgment by members of the graduate faculty that the student shows sufficient promise to be permitted to proceed toward a degree, and depends on the student's ability and the quality of his work in the University of Minnesota and his personal and professional qualifications. No student will be admitted to candidacy until he has been in residence for at least 1 quarter or 1 Summer Session and has removed any deficiencies that may have conditioned his admission to the Graduate School. The procedure in achieving candidacy is included with the description of the requirements for the Master's and Doctor's degrees.

Academic Rank and Candidacy for a Graduate Degree

A member of the staff of instruction above the rank of instructor or research fellow is not permitted to take a graduate degree at this University. He may register for graduate work, however, and credit thus obtained may be presented elsewhere.

ADVANCED STANDING AND TRANSFER OF CREDITS

From an Undergraduate College of the University of Minnesota—Credits for advanced courses earned while the student is registered in an undergraduate college can be transferred to the Graduate School only under the following conditions:

> If not more than 9 quarter credits of undergraduate credit are lacking (taking into account required sequence courses), a limited amount of graduate work may be carried (approved courses numbered 100 and above) for graduate course credit, such courses not to be applied toward an undergraduate degree. The conditions stated apply to the beginning of the quarter in which the courses for graduate credit are carried. Transfer of credit must be arranged by petition to the Graduate School and may not exceed the credits earned in a single academic quarter or summer term.

From Other Institutions—No transfers of graduate credits from other institutions will modify the minimum requirement of 1 academic year, or its equivalent, in residence for the earning of a graduate degree. The minimum credit requirements for the Master's degree under Plan A and Plan B, as stated elsewhere in this bulletin, must be fulfilled in the Graduate School of the University of Minnesota. No transfer of credit from other institutions to apply to the Master's degree at Minnesota is permitted. Exceptions to this ruling will be made (1) only in areas and programs for which the stated degree requirements go beyond the normal Master's degree minimums in credits or residence or both, or (2) in cases where the Executive Committee has granted approval before course work at another institution is taken.

From Other Institutions to Apply Toward the Ph.D. Degree—Credit so earned may be submitted as part of the progress toward the Ph.D. See Requirements for the Doctor's degree.

From Adult Special Status or Summer Special Status—A student admitted to, and registered in, the Graduate School may petition to transfer to his graduate record *only* the credits earned *in his first academic quarter or summer term* as an adult or summer special student. Such work must be of graduate caliber and taught by a member of the graduate faculty. If his petition is approved, the student will be granted both residence and credit on his graduate record.

From Correspondence Study—Graduate credit is *not* allowed for credits earned through correspondence study.

ATTENDANCE AT COMMENCEMENT

Candidates upon whom degrees are to be conferred are expected to be present at commencement, but may petition to be excused by the dean of the Graduate School.

REQUIREMENTS FOR THE MASTER'S DEGREE**

The degree of master of arts is, in general, conferred for advanced non-technical study; the degree of master of science, for advanced technical study in such areas as agriculture, chemistry, engineering, etc. It is the graduate major field and not the Bachelor's degree that determines whether the degree is master of arts or master of science. In several of the sciences such as physics, geology, zoology, etc., the student may elect the form he prefers.

The Two Plans for the Master's Degree

The Graduate School offers the Master's degree under two plans: Plan A, involving a thesis, and Plan B, which substitutes additional course work for the thesis. Departmental statements in this bulletin announce policies as to use of Plan A and Plan B. At the time of matriculation, the student will indicate his intention to be a candidate for the Master's degree and choose the plan he proposes to follow.

In either of the two plans, it is possible and acceptable under the rules (except in certain specified areas) for the student who is adequately prepared and who can devote full time to graduate study to complete the requirements for the Master's degree in 1 academic year of 3 quarters,‡‡ or its equivalent in summer sessions.†† (Not all major fields afford sufficient course work in summer sessions to meet degree requirements.) A nonresident student who completes his work for the Master's degree in less than 3 academic quarters or 6 summer terms is required to pay tuition for 3 quarters or the equivalent in summer terms. The completion of a Master's program ordinarily requires, however, from 4 to 6 quarters in residence, or its equivalent in summer sessions. Students who are planning to earn the Master's degree under either Plan A or Plan B, therefore, should take into account this customary rate of progress, as well as the minimum possible time interval of 1 academic year. If such matters as self-support, prerequisite work, or special study of foreign languages (or English for foreign students) are involved in attaining the Master's degree, students should anticipate and definitely plan for a period of residence longer than the minimum 3 academic quarters.

** A limited number of graduate students of exceptional scholastic standing who take the Master's degree may be certified for high school teaching in Minnesota though they lack formal residence in the College of Education. To qualify for certification under this plan students must meet requirements in the College of Education and secure the approval of its dean at the outset of their program.

†† One summer term is the equivalent in residence of one-half a school quarter of the regular academic year.

‡‡ Certain programs for the Master's degree require more than 1 academic year. For example, the programs for the master of social work and the master of fine arts degrees require a minimum of 2 years.

Grading System—In courses *open to graduates only,* the student may receive a grade of S—"satisfactory." This indicates the instructor's approval of the quality of the student's work on the graduate level. It signifies a letter grade of B at least. Grades A, B, C, or D may be received for these courses. In courses open to both graduates and undergraduates the system of marking by letters is used. A grade point average of at least 2.8 must be maintained over all courses included in the approved degree program and may apply also to all graduate courses taken by the student even if they are not a part of his approved program; a higher level of performance may be required in certain fields.

Course instructors may at their discretion place a time limit for removal of incomplete grades. In general it is recommended that grades of incomplete be removed within 1 calendar year.

Admission to Candidacy—Following completion of 9 to 15 graduate credits, at least 3 of which must be in the major, and not later than the opening of the quarter preceding the final quarter or final summer term, the student who expects to obtain a Master's degree shall present his program and his thesis title (for Plan A) or his program (for Plan B) for his adviser's signature. He shall then submit his signed program to the Graduate School for group committee action. Blanks for this purpose are provided by the Graduate School. A transcript of all graduate work the student has taken must accompany the program. Approval by the graduate group committee and the Graduate School indicates the student's admission to candidacy for the degree.

Transfer from One Plan for the Master's Degree to the Other—A student accomplishes such a transfer by submitting to the Graduate School a revised program signed by his adviser.

Plan A: Master's Degree with Thesis

Major and Minor Work—In choosing a field for major or minor work, the student must present the minimum undergraduate preparation prescribed in the departmental statements. He must complete in the Graduate School a minimum of 18 quarter credits in the major and 9 in the minor with a combined grade point average in the major and minor of 2.8. No graduate credit is allowed for course work of D quality.

In cases where the student takes course work beyond the minimum requirements already stated, both the adviser and the graduate group committee may demand comparable standards of performance for all work taken, in evaluating and approving the minimum program submitted, and may reject the minimum degree program if the total record falls below a 2.8 GPA and may also terminate candidacy.

The student's work for the minor must be logically related to his major work. The dean and the group committee may in exceptional cases allow the minor subject to be taken in the same department as that of the major.

All requirements for the Master's degree under Plan A must be completed within 7 years. The 7-year period specified includes all work transferred to the graduate record of the individual, whether this transferred work was taken as

an adult special student at the University of Minnesota or under any other conditions in which transfer is permitted.

Admission to the Graduate School involves a specified major field. Any subsequent proposal for a change in major necessitates a formal request to the Graduate School.

Language Requirement—Reading knowledge of a foreign language, modern or ancient, the language to be determined by the major department and the appropriate graduate group committee, is required of candidates for the Master's degree, unless exemption is made in individual cases with the approval of the adviser and appropriate group committee or the requirement is specifically waived in a given area. The requirement can be satisfied either

(1) by passing a proficiency examination or

(2) by presenting to the appropriate language department certification of a grade of A in the third quarter of study of a language or a grade of B in the fourth quarter of study of a language, assuming: (a) that the course work was completed at the University of Minnesota; (b) that the course work was completed no longer than 5 years prior to the time the student applies for language certification; and (c) that any language department at Minnesota has the right to specify minimal course requirements in excess of those mentioned above. **Note:** Courses taken in the Extension Division for credit or in Correspondence Study may not be used in lieu of the proficiency examination or

(3) by successful completion of the examination at the end of a course established in the Extension Division (by the Departments of German, French, Italian, Portuguese, Russian, and Spanish) to aid students in meeting the language requirement or

(4) the French and German language requirements can be satisfied by passing at the appropriate level special courses offered through Correspondence Study.

For further information, consult the Graduate School office and the major department. Forms for making application for the language examination may be obtained in the Graduate School office. The language department concerned will submit to the office of the dean of the Graduate School a certificate of proficiency in the designated language. The language requirement must be completed before the student may be admitted to the written or oral examinations required for this degree.

For regulations on transfer of language certificates from other institutions, see page 20.

For regular dates of language examinations, see page 20.

Master's Thesis—The student shall submit the title of his thesis and a complete program of the work to be offered for the degree on a form secured at the Graduate School office. The thesis title must be approved by his adviser and by the appropriate group committee. The thesis should be on a topic falling within the field of the major. The candidate will ordinarily devote approximately half of his time to the preparation of the thesis, including courses on which the thesis is based. The thesis must be written in acceptable English,

show ability to work independently, and give evidence of power of independent thought both in perceiving problems and making satisfactory progress toward their solution. Familiarity with the bibliography of the special field and correct citation of authorities are expected.

The thesis must be in quadruplicate in order to facilitate its consideration. Two copies are for the University Library (as noted below), one for the candidate, and normally one goes to the adviser or major department. Some departments require more than four copies; the student should consult his major adviser on this point. Two copies must be upon 16-pound or 20-pound linen stock of 75 per cent rag content, and the other carbon copies shall be on 13-pound bond paper. The original and first carbon copy must contain all illustrative material. Ample margins should be left for binding purposes. The body of the thesis should be double spaced, but footnotes may be single spaced. Multigraph, multilith, and xerox methods of reproduction may be accepted, provided that 16- or 20-pound, rag content bond is used.

The thesis must be finished and registered in the office of the dean of the Graduate School *at least 8 weeks* before the commencement convocation at which the candidate presents himself for his degree. The group committee or the examining committee may require a 30-day interval between the thesis registration and the date of the final oral examination.

The thesis will be examined by a committee of not less than three, appointed by the dean of the Graduate School upon recommendation of the appropriate group committee. The examining committee will include at least two representatives of the major field and one representative of the minor field. This committee must be unanimous in certifying that the thesis is ready for defense, and a record of this action must be filed in the Graduate School office on the appropriate form before the candidate may be admitted to the final written or oral examination.

A candidate contemplating publication of any material that he expects to present for a thesis should arrange through the Graduate School office to obtain approval, since no material that has been published prior to its approval by the thesis committee may be used to meet the thesis requirement.

If the thesis is accepted, the candidate must pay to the bursar, *at least 5 weeks* before commencement, $5 for binding the two copies of his thesis which will be catalogued and deposited in the University Library, one copy for reserve and one for loan purposes.

Examinations—All candidates for the Master's degree will meet the regular requirements as to examinations, reports, etc., of the classes in which they are registered.

In addition to the usual course examinations, the candidate for the Master's degree Plan A must pass a final written examination, a final oral examination, or both, at the discretion of his examining committee, which must meet collectively and determine the appropriate course of procedure.

If only a final written examination is specified, it must be held not later than 5 *weeks* before the end of the quarter in which the student takes his degree. It will cover the major and minor fields and may include any work fundamental thereto. This examination will be arranged by the adviser as chairman of the thesis committee, the questions to be prepared with the co-operation of the graduate faculty of the major and minor concerned. The chairman will

report the results of the examination to the Graduate School office on the appropriate form. A majority vote of the committee is required for approval of the written examination.

If only a final oral examination is specified, it also must be held not later than *5 weeks* before the end of the quarter in which the student takes his degree. This examination, normally 1 hour in length, will be conducted by the committee appointed to examine the thesis, with the adviser serving as chairman, and will cover both the major and minor fields, including any work fundamental thereto. At the close of the examination, the committee will vote upon the candidate's performance, and a majority vote is required for approval. The chairman of the committee will then report the result of the vote to the Graduate School office on the appropriate form.

If both a written and an oral examination are specified, the written examination must precede the oral examination, and the time of completion of the oral examination indicated above must be adhered to. Committee certification of the thesis must precede the final oral examination.

Students eligible for the "preliminary examination" for the Doctor's degree may, at the discretion of the preliminary oral examination committee, substitute this examination for the final oral examination for the Master's degree, if all other requirements for the preliminary examination have been met and if there is no conflict in majors or minors.

Reports—Forms are provided for signed reports concerning the thesis and the final written or oral examinations. All reports must be filed in the office of the dean of the Graduate School *5 weeks before the end of the last quarter.*

SUMMARY OF REQUIREMENTS FOR MASTER'S DEGREE WITH THESIS

Requirements	*Under the Direction of*	*Date*
Initial registration	Adviser and dean of the Graduate School	On entrance
Approval of degree program, language choice, thesis subject, and candidacy	Adviser, committee (normally from the major department, division, or college), group committee, and dean	After completion of 9 to 15 credits or no later than the opening of quarter preceding final quarter
Language requirement (completion)	Adviser and language department	Before admission to written or oral examination
Registering of thesis	Graduate School office	8 weeks before graduation
Certification of thesis	Thesis committee	Before admission to final written or oral examination
Final examinations, written or oral or both	Major adviser and committee	Not later than 5 weeks before commencement in which the student takes his degree
Filing of thesis	Graduate School office	
Graduation fee and fee for binding thesis	Office of Admissions and Records	

Plan B: Master's Degree Without Thesis

The requirements under this plan in matters of admission, residence, and language requirements follow Plan A. Under Plan B, the student must pass

either a final written examination or a final oral examination or both, at the discretion of his committee. The committee must meet collectively and determine the appropriate course of procedure. This examination, if oral, will normally be an hour long. Plan B differs in substituting for the thesis a heavier course requirement which if met in summer sessions means more than the minimum four sessions under Plan A (see page 29). While it does not permit an indiscriminate scattering of courses over unrelated fields, it does not stress concentration on one major and one minor field. It is understood that more than one field will be included outside the field of concentration. Insofar as it has a professional aspect, the Master's degree under Plan B is less a test of research interest and more adapted to individuals who will profit by a broader range of knowledge in their fields. Whether taken for professional or cultural purposes, the requirements under Plan B are meant to test interests and intellectual abilities for a different purpose but not on a different level from those for Plan A.

Under Plan B, candidates for the Master's degree must complete, with a GPA of 2.8, a minimum of 45 quarter credits in graduate courses. Certain departments require a B average. No graduate credit is allowed for course work of D quality. At least 21 of the 45 credits hours should be in the major field. Not less than 18 of the 45 credits should be offered in at least two related fields with a minimum of 6 credits required in each. It should be kept in mind that these are minimum requirements and that some major fields require more. Papers representing the quality but not the range of the Master's thesis shall be prepared in three advanced courses or seminars or in problems courses or courses which permit independent work under faculty supervision and involve 9 credits. This requirement may be satisfied with a combination of the above which is acceptable to the Graduate School. The work may be done either in the major field or in related fields. In most major fields, such courses are identified by a single asterisk; in fields where courses are not so identified, the student should consult his adviser.

In cases where the student takes course work beyond the minimum requirements stated, both the adviser and the graduate group committee may demand comparable standards of performance for all work taken and may reject the minimum degree program if the total record falls substantially below the B average required for the Plan B degree.

All requirements for the Master's degree Plan B must be completed within 7 years. The 7-year period specified above includes all work transferred to the graduate record of the individual, regardless of whether this transferred work was taken as an adult special student at the University of Minnesota or under any other conditions in which transfer is permitted.

Intelligent planning of the student's program requires that he present to his adviser a statement of all college work completed with credit. In planning his program the student should not include in "related fields" courses from the field of concentration.

Under this plan, the candidate will be examined by a committee of not less than three members, normally two from the major and one from a related field, appointed by the dean of the Graduate School upon recommendation of the appropriate group committee. This examination may be written or oral or both, at the discretion of the examining committee. The student will make available to the examining committee for its review the papers prepared to fulfill the requirement of 9 hours of independent work. Procedures for the ex-

amination are the same as those already described for the Master's degree Plan A.

The student is expected to call at the Graduate School office before his final examinations for the degree to get an examination report form for the use of his examining committee.

SUMMARY OF REQUIREMENTS FOR MASTER'S DEGREE WITHOUT THESIS

Requirements	*Under the Direction of*	*Date*
Initial registration	Adviser and dean of the Graduate School	On entrance
Approval of program of all graduate work, with credits, showing major field and language choice, and of candidacy**	Adviser, committee (normally from the major department, division, or college), group committee, and dean	After completion of 9 to 15 credits or no later than the opening of quarter preceding final quarter or summer term
Language requirement (completion)	Adviser and language department	Before admission to written or oral examination
Final examinations, written or oral or both	Adviser and committee	Not later than 5 weeks before commencement in which student takes his degree
Graduation fee	Office of Admissions and Records	

REQUIREMENTS FOR THE MASTER OF FINE ARTS DEGREE

The candidate for the master of fine arts degree must complete a program of approximately 2 full years of graduate credits, 45 of which must be earned in graduate courses at the University of Minnesota. He must execute and leave a record of a creative project (production, recital, or exhibition) which will be accompanied by a supporting paper that deals with the planning and/or execution of the creative work. A minimum of 9 credits will be required in history or literature of art, theater, or music; and the departments will require a minimum of 9 credits in areas of study outside of the major department. The individual program must be approved by the departmental M.F.A. committee. The candidate will be subject to a final oral examination.

Prerequisites—For the master of fine arts degree, admission to candidacy is limited to a selected group of students with the Bachelor's degree from an approved university or college or the equivalent and to those who provide evidence of exceptional promise as creative artists in one or more of the following subfields of the departments: Art (painting, sculpture, printmaking, film and photography, ceramics), Theater (playwriting, directing, acting, design), Music (applied music, theory and composition, conducting, church music).

** All areas listed under education, as well as the Department of Music, are required to submit candidacy application forms to the college or department office for approval before filing the Master's program.

REQUIREMENTS FOR THE DOCTOR'S DEGREE

In the Graduate School, one Doctor's degree, the doctor of philosophy (Ph.D.), is conferred by the University of Minnesota. This degree is granted not on the basis of successful completion of a definite amount of prescribed work but chiefly in recognition of the candidate's high attainments and ability in his special field, as shown, first, by passing of the required examinations covering both the general and the special fields of the candidate's subjects as detailed later, and second, by the preparation of a thesis. Grades A, B, and C are permitted on the Ph.D. program. The student who is working toward the Ph.D. degree is expected to maintain a higher level of work than the grade point average of 2.8, which has been established for the candidate for the Master's degree.

The candidate for the Doctor's degree must register for at least 3 academic years (9 quarters) of graduate study in approved subjects and thesis research and writing. For the student who transfers work from other graduate schools, the first 2 years or the last year must be spent in residence at the University of Minnesota. In fulfilling the residence requirement, he must pay tuition fees appropriate to his residence or staff status. The required period of 3 years will normally suffice only for students who devote full time to graduate study. Students who intersperse graduate study between periods of professional or other regular employment will need to extend the total period of study over a longer time.

Program of Study

Upon entrance to the Graduate School, the student shall select and be accepted by an adviser from the graduate faculty. The first year is devoted primarily to completion of courses in his program. Attention should also be given to meeting requirements pertaining to the foreign language, collateral field, and research technique (see discussion under Language Requirement).

After successful completion of the equivalent of a full academic year of course work, but at least 5 calendar months before the preliminary oral examination is to be scheduled, the student shall submit to the Graduate School office a language declaration form and doctoral program blank.

Language Declaration Form—On this form the student will indicate and justify the appropriateness of the foreign languages to be presented in fulfillment of the requirements for the Ph.D. When a collateral field of knowledge or a research technique is offered as a substitute for one of the foreign languages, he will indicate on the reverse side of the form the course work he has completed or proposes to complete to satisfy the requirement and will justify its appropriateness.

Doctoral Program Form—On the doctoral program blank the student will submit a complete statement of all work to be offered for the degree:

1. A list of all graduate courses completed and proposed in the major.
2. A list of all graduate courses completed and proposed in the minor.
3. Courses offered as a collateral field or special research technique when either is being proposed.

4. For the student who transfers work from other graduate schools to his doctoral program at Minnesota, the first 2 years or the last year must be spent in residence at the University of Minnesota. Whatever the amount of transferred credit, he must pay tuition fees appropriate to his residence or staff status for at least 3 quarters of graduate study in residence at the University of Minnesota. Transfer of credit from other institutions will be considered when the doctoral program is approved, and no petition for transfer of credits or residence is necessary.

A transcript of all completed graduate work the student lists on his program, whether taken here or elsewhere, must accompany the program.

Programs should be submitted to the Graduate School office in the first or fifth week of any quarter to insure action within the quarter by the appropriate graduate group committee. These committees are convened only twice each quarter, and some do not meet routinely during the summer.

Candidacy—Admission to candidacy for the Ph.D. degree will be determined by the dean of the Graduate School upon recommendation of the group committee and can be defined as that point where the student has passed the preliminary oral examination.

Time Limit for Earning the Ph.D. Degree—Effective with the quarter immediately following admission to candidacy for the Ph.D. the student must:

1. Complete all requirements and receive the Ph.D. degree within 5 calendar years (in some areas an earlier deadline is established). Petitions for extension of this time limit must be submitted before expiration of the 5-year time limit. Violation of this time limit through failure to obtain Graduate School approval of extension may necessitate retaking the oral preliminary examination.

2. Register continuously and pay fees during the academic year (fall, winter, spring) until the Ph.D. is awarded. (These tuition payments stop with the quarter in which requirements are completed provided that the degree is conferred at the close of the following quarter.) Failure to register continuously will automatically terminate candidacy for the doctorate. To reinstate candidacy, the student may be required to retake the preliminary oral examination and to pay fees past due. Course registration for the first or second summer term (or both) may be made in lieu of the respective fall or winter quarters (or both) immediately following, and will fulfill the continuous registration requirement. However, students who hold University appointments which require registration in the Graduate School in the academic year must be registered in the Graduate School during the period of appointment.

   Note: The student must have completed the preliminary examination prior to the opening of a quarter in which he becomes eligible for the $20 fee.

Registration by Mail—The student who has been admitted to candidacy for the Ph.D. degree (for definition of candidacy see above) and is not registering for course work may register by mail. Registration forms for this purpose

will be mailed to the candidate prior to the opening of each academic quarter. He must return his registration form and check or money order for the appropriate amount to the Office of Admissions and Records, Morrill Hall, University of Minnesota, Minneapolis, Minnesota 55455.

Thesis Title Form—At the time of submission of the doctoral program, or not less than 5 months before the scheduling of the final oral examination, the student shall file with his adviser's approval the title of his doctoral dissertation. The thesis title form is obtained in the Graduate School office. The following group committees and their component major fields require that the thesis title form be accompanied by a typewritten statement, some 250 words in length, describing the research to be undertaken and the methods to be used in carrying it out: Agricultural Sciences; Biological Sciences; Education; Genetics; Language, Literature, and Art; and Physical Sciences.

Language Requirements

The following regulations are effective for all Ph.D. candidates. In general, reading knowledge of two foreign languages is required. Where it is so stipulated, however, the requirement may be met with reading knowledge of one foreign language and the option of a *collateral field of knowledge* or a *research technique.*

Two-Language Option—The language requirement can be satisfied either

(1) by passing the proficiency examinations or

(2) by presenting to the appropriate language department certification of a grade of A in the third quarter of a language or a grade of B in the fourth quarter of a language, assuming (a) that the course work was completed at the University of Minnesota; (b) that the course work was completed no longer than 5 years prior to the time the student applies for language certification; and (c) that any language department at the University of Minnesota has the right to specify minimal course requirements in excess of those mentioned above. **Note:** No course taken in the Extension Division for credit or in Correspondence Study for credit may be used in lieu of the proficiency examination or

(3) by successful completion of the examination at the end of a course established in the Extension Division (by the Departments of German, French, Italian, Portuguese, Russian, and Spanish) to aid students in meeting the language requirement or

(4) the French and German language requirements can be satisfied by passing at the appropriate level a special course offered through Correspondence Study.

The Ph.D. candidate shall submit the language declaration form no later than the time he submits his doctoral program.

The foreign languages selected for fulfilling this requirement should be relevant to the field of scholarly work of the candidate. The burden of proof of the relevance of proposed languages rests upon the candidate and his major adviser. In no case may English be submitted as a foreign language. The foreign

language requirement must be completed before the student is admitted to the preliminary examinations for the Ph.D.

Repetition of any foreign language examination is considered a special examination for which a fee of $5 is charged.

Transfer of Language Certificates—The Graduate School permits transfer of language certificates from institutions whose credits are regularly accepted by the Graduate School and whose language tests are administered in the same way as they are by the language departments of the University of Minnesota. Language certificates will not be accepted from institutions where the examinations are administered by the candidate's major department. Language certificates more than 3 years old when the student enters this Graduate School cannot be transferred.

Where certification at some other institution is not possible and where it would work a hardship on the candidate to come to Minneapolis for an examination, the language departments will send written examinations to be taken wherever the candidate may be, provided proper arrangements for proctoring can be made.

Language Examinations—Examinations to meet the language requirement of the Graduate School, unless otherwise arranged with the language departments, shall be held on the second Thursday of each quarter and on the second Thursday of each term of the Summer Session.

A repetition of the language examination is considered a special examination for which a fee of $5 is charged.

Research Technique Option—A special research technique is defined as not less than 9 credits in approved Upper Division or graduate courses, completed with a grade not lower than C. The burden of proof of the significance or relevance of the proposed research technique rests upon the candidate and his major adviser. The group committee under whose jurisdiction the major field falls shall review the recommendations of the major adviser and in turn recommend action to the dean of the Graduate School. In no case may the special research technique subject be one that has regularly or traditionally been included in the major or minor fields of study of similar candidates in the past. The special research technique subject should represent the acquisition of any special skill that will effectively contribute to the research proficiency of the candidate.

Course credits presented to fulfill the requirements of a special research technique shall be recorded on the student's permanent grade record. Any group committee may require a standard of performance higher than the minimum standard of C after appropriate consultation with the departments within its area. Course credits which are used as part of the major or minor may not be reused as a research technique. The special research technique requirements may be met by special proficiency examinations where such examinations are feasible and practical. This requirement must be met before admission to the preliminary examination.

To meet the requirements of a special research technique, credit earned or proficiency demonstrated in other approved institutions may be transferred to the University of Minnesota record if these have been completed within a 3-year period immediately prior to entering this Graduate School.

Collateral Field Option—A collateral field of knowledge is defined as not less than 15 credits of work in courses numbered 100 or above, completed with a grade not lower than C. For this purpose a maximum of 6 of the 15 credits may be earned through the joint registration program within the Extension Division, provided that they do not exceed the limit imposed for such work in a graduate program.

The collateral field of knowledge is expected to broaden the candidate's scholarly and scientific background by permitting exploration of knowledge in a field related to the major and minor. The collateral field of knowledge may include in this sense any work now available or to be developed in the preparation for college teaching, including supervised instruction at the college level.

The burden of proof of the significance or relevance of the collateral field rests upon the candidate and his major adviser. The group committee under whose jurisdiction the major field falls shall review the recommendations of the major adviser and in turn recommend action to the dean of the Graduate School. In no case may the collateral field of knowledge be one that has regularly or traditionally been included in the major or minor fields of study of similar candidates in the past.

Where a collateral field of knowledge is offered in place of one foreign language, this collateral field must be completed before the student is admitted to the final oral examination for the Ph.D., and the work to be presented in meeting this requirement shall be entered on the student's doctoral program. Completion may be in terms of earned course credits, or of validated transfer of credits from another institution, or of special proficiency examinations where feasible and practical.

The group committee may include the collateral field of knowledge in the final oral examination of the candidate by the appointment of a representative of this field to the oral examination committee.

Major Work

The major work must be in a field for which the candidate has had adequate preparation, as determined by the graduate faculty in the field concerned, in his undergraduate study and in any previous graduate work. No work offered for the Bachelor's degree may be included in the doctoral program.

While working for the Doctor's degree, normally a student should spend at least two-thirds of his time on the major subject, including work on the thesis.

Admission to the Graduate School involves a specified major field. Any subsequent proposal for a change in major necessitates a formal request to the Graduate School.

Minor Work

The minor work must be in a field in which the student is prepared to pursue courses included in the group numbered 100 or above.

The minor must be in a field the work of which can be logically related to that of the major.

In exceptional cases, the dean and the group committee may allow the minor subject to be taken in the same department as that of the major.

It is also possible to offer a minor divided between two fields which relate logically to the major. This requires recommendation by a member of the graduate faculty of each of the two minor fields.

Not less than one-sixth of the total work shall be devoted to the minor subject, which must be completed before admission to the preliminary examination.

Supporting Program of Study

With the approval of his major adviser and the appropriate group committee, a student may include, in place of the minor, a *supporting program* of study in his over-all doctoral program. The traditional minor will continue to be available at the option either of the student or of his adviser.

This supporting program, like the minor, must include not less than one-sixth of the total work in the doctoral program in courses numbered 100 and above and must be completed before admission to the preliminary examinations. It must be a coherent pattern of studies, possibly embracing several disciplines, but clearly forming a purposeful part of the doctoral program with the same type of supporting relation to the major field as the traditional minor. The student's major will, of course, be the core that holds the entire program together.

A student electing to use the supporting program option may be expected to take written preliminary examinations in the fields included in his supporting program, but will not be expected to have competency in each of the fields in his supporting program comparable to that of a person with a traditional minor in the field concerned.

This type of individually tailored program will necessitate careful planning by the student in co-operation with faculty advisers. It is therefore essential that the Ph.D. program be submitted to the Graduate School office as soon as possible after completion of 1 academic year of course work to facilitate group committee action and approval before a student commits himself to work on a supporting program.

A student who wishes to use the supporting program should consult with his major adviser and at least one other full member of the graduate faculty concerning the coherency of his doctoral program. A student's completed Ph.D. program must have the approval of the major adviser and, with regard to the supporting program, the approval of one other full member of the graduate faculty outside the major field.

Examinations

Written Examination—A written examination in the major subject shall be given by the graduate faculty in the major field prior either to the preliminary or to the final examination or to both, as the graduate faculty may decide. This examination shall cover all the work done in the major, and *may include any work fundamental thereto*. The passing or failing of this written examination shall be reported by the major adviser to the Graduate School

office on forms which students will obtain in that office. In case of failure, the candidate will normally be allowed only one opportunity to retake the failed examination; this re-examination will be permitted not earlier than the following academic quarter.

Preliminary Examination—At least 1 full academic quarter before the degree is conferred, and only after completion of the work in the minor field, or supporting program of study, the foreign language requirements or their research substitutes, and such preliminary written examinations as are required in the major field, a preliminary oral examination of the student shall be given by a committee appointed by the dean of the Graduate School, upon recommendation of the appropriate group committee. The student's adviser will be the chairman of this examining committee. The group committees may recommend the appointment of different examiners for the preliminary oral examination and for the final oral examination if in their judgment such a recommendation seems appropriate. The group committees may also recommend the inclusion on both the preliminary and final oral examining committees of a member of the graduate faculty outside the major and minor fields of the student. Ordinarily the examining committees for both the preliminary and final oral examinations shall include a minimum of five members, three from the field of the major and two from the field of the minor or of the supporting program, although the group committees may recommend the appointment of additional members if this seems desirable in given cases.

The preliminary oral examination shall cover both the major and minor fields or supporting program and may include any work fundamental thereto, except the thesis. Only after passing the preliminary oral examination may the student be considered a candidate for the Doctor's degree.

The outcome of the preliminary oral examination will be recorded in one of three possible ways: examination passed, examination failed, examination passed with reservations. The voting proportions necessary for one of these decisions are as follows: in the case of a five-member examining committee, a favorable verdict for passing a candidate will consist of either a unanimous vote or a vote of 4-1; if the committee consists of six members, a unanimous vote or a vote of 5-1 or 4-2 will pass the candidate; and if the committee consists of seven members, a unanimous vote or a vote of 6-1 or 5-2 will pass the candidate. Unless the candidate obtains favorable committee votes in these proportions, the outcome is failure, except that, on the basis of the same proportions in the voting, the verdict may be passed with reservations.

In the case of an examination reported as passed with reservations, these reservations may involve: additional preparation and study followed by re-examination; the preparation of a special paper or written examination in a stated field; or other special conditions deemed appropriate by the examining committee.

The chairman and the examining committee will report the results of the preliminary oral examination to the Graduate School office, stating clearly, in the case of passing with reservations, what additional requirements must be met by the candidate prior to re-examination or prior to the reporting of satisfactory performance, and when such re-examination shall take place.

Students failing the preliminary oral examination (1) *may*, upon recommendation of the examining committee, be allowed to retake the preliminary

oral examination, or (2) may be excluded from further candidacy for the degree. In no case may the re-examination take place until at least 1 full academic quarter has passed. No more than two preliminary examinations are allowed, and failure to receive the appropriate passing vote in the second preliminary oral examination terminates candidacy for the Ph.D.

Preliminary oral examinations will not be scheduled during the period of final oral examinations for the June commencement—normally from about April 8 to May 6—or from the beginning of the second term of Summer Session to the opening of the fall quarter. Preliminary oral examinations must be scheduled *1 week in advance* in the office of the Graduate School by the prospective candidate or his adviser.

Final Oral Examination—After preliminary written and oral examinations, after final written examinations, when required, and after certification that the thesis is ready for defense, and not less than 5 *weeks* before graduation, the final oral examination shall be given. Ordinarily this examination shall be conducted by a committee consisting of the adviser, the two other members of the thesis review committee, and at least two additional members of the graduate faculty, appointed by the dean upon recommendation of the appropriate group committee. This examination covers the thesis and the field of the candidate's special study and shall not exceed 3 hours. The final oral examination must be scheduled *at least 1 week in advance* in the office of the Graduate School, and cannot be scheduled until 30 days after the thesis is registered in the Graduate School office.

The date of the final oral examination shall be publicly announced, and any member of the graduate faculty may attend. Upon completion of the examination, a formal vote of the committee shall be taken. To be recommended for the award of the doctoral degree, the candidate must receive either a unanimous vote or a vote showing not more than one dissenting member of the total final examining committee. The chairman of the examining committee will then report the result of the vote to the Graduate School office on the appropriate form.

The final oral examination may not be scheduled during the quarter in which the preliminary oral examination was passed.

Doctor's Thesis

The thesis, for which accumulation of material may well be started by the middle of the second year, must show originality and power of independent investigation and embody results of research that form a real contribution to knowledge as well as exhibit mastery of the literature of the subject and familiarity with the sources. The matter must be presented with a fair degree of literary skill.

No material that has been published prior to its approval by the thesis committee may be used to meet the thesis requirement. Candidates contemplating publication of any material that they expect to present for a thesis should therefore arrange through the Graduate School office to obtain such approval.

The thesis** must be typewritten in quadruplicate (in some departments five copies are required) to facilitate reading by the thesis committee. Multigraph, multilith, and xerox methods of reproduction may be accepted, provided that 16- or 20-pound, rag content bond is used. The thesis must be registered in the Graduate School office and copies distributed to the thesis committee *not later than 8 weeks* before the commencement at which the candidate expects to receive the degree. Following the registration of the thesis (a clean and complete draft) a 30-day period must elapse before the final oral examination may be scheduled.

The thesis must be read by a committee of not less than three members, appointed by the dean of the Graduate School upon recommendation of the appropriate group committee. As a rule, the student's major adviser will be chairman of this committee, and the field of the minor or the supporting program of study will be represented by at least one committee member. This committee must be unanimous in certifying that the thesis is ready for defense before the final oral examination can be held. The results of the review of the thesis shall be reported to the Graduate School office on an appropriate form available in that office.

When he submits his *final oral examination report,* the candidate will sign in duplicate a *Memorandum of Agreement* with University Microfilms, Ann Arbor, Michigan, under which the ribbon copy of the thesis will be microfilmed before being permanently filed in the University of Minnesota Library. He will then pay his microfilm fee of $25. If he wishes his thesis to be copyrighted he will pay an additional $7 plus the cost of two positive microfilm copies of his thesis which will be deposited in the Library of Congress.

Each candidate for the Doctor's degree shall submit with his final oral examination report two copies of an abstract of 600 words or less, approved by his adviser, embodying the principal findings of the research. Such abstracts will be published in *Dissertation Abstracts,* which announces the availability of the thesis for distribution.

Two copies of the thesis on 16-pound or 20-pound bond paper are to be bound and deposited in the Graduate School office.

Release Card—When he deposits the bound copies of his thesis at the Graduate School office, the student will sign a release card permitting immediate circulation of his thesis. For valid reasons and with his adviser's endorsement, he may request, on the same form that his thesis be withheld from circulation for 6 months or at most a year.

Publication of Theses—Publication by microfilm normally does not preclude publication by other methods later, and it is hoped that attempts at publication in the usual way will not be relaxed.

Reports—Special forms are provided for signed reports on the written examination in the major, the preliminary oral examination, the review of the thesis, and the final oral examination. *All these must be filed with the Graduate*

** Instructions for typing and registration of the thesis may be obtained in the Graduate School office. Before having his thesis typed, the student should also read the Memorandum of University Microfilms on errors commonly found in theses submitted for microfilming. This may be obtained from the Graduate School office.

School office: the report on the written examination in the major before the preliminary oral examination can be scheduled, the thesis review report at the time the final oral examination is scheduled, and the final oral report form at least 5 *weeks* before graduation.

Office of Scientific Personnel Survey Form—Before the student's name can be included on the degree list, he is required to fill out a survey form for the Office of Scientific Personnel of the National Research Council. The completed form is submitted to the Graduate School office.

SUMMARY OF REQUIREMENTS FOR THE DOCTOR'S DEGREE

Requirements	*Under the Direction of*	*Date*
Initial registration	Adviser and dean of Graduate School	
Doctoral program and language plan	Adviser, minor faculty or supporting program faculty, appropriate graduate group committee, and dean of Graduate School	After first year or at least 5 months before preliminary oral examination
Completion of minor or supporting program	Course instructors	Before admission to preliminary examination
Language certification or research technique	Adviser, language departments, and dean of Graduate School	Before admission to preliminary examination
Written examinations	Graduate faculty of major and minor or supporting program fields	Before preliminary oral or before final oral examination or both
Preliminary examination, oral	Committee	At least 1 academic quarter before degree is to be conferred
Completion of collateral field	Course instructors	Before admission to final oral examination
Thesis title and plan if required	Adviser, group committee, and dean of Graduate School	When doctoral program is submitted or at least 5 months before final oral examination
Registering of completed thesis	Graduate School office	8 weeks before graduation
Certification of thesis	Thesis committee	Before admission to final oral examination
Final oral examination	Committee	Not later than 5 weeks before commencement in which student takes his degree
2 bound copies, abstract of thesis, and payment of $25 for microfilming thesis	Graduate School office	Not later than 5 weeks before commencement in which student takes his degree
Release card	Graduate School office	Not later than 5 weeks before commencement in which student takes his degree
Office of Scientific Personnel Survey Form	Graduate School office	Not later than 5 weeks before commencement in which student takes his degree
Graduation fee	Office of Admissions and Records	Not later than 5 weeks before commencement in which student takes his degree

MAJOR FIELDS FOR THE MASTER'S AND PH.D. DEGREES

Fields listed as majors may be used as minors, but all combinations are not acceptable.

MASTER'S DEGREE	PH.D. DEGREE
Aeronautical Engineering	Aeronautical Engineering
Agricultural Biochemistry	Agricultural Biochemistry
Agricultural Economics	Agricultural Economics
Agricultural Education	
Agricultural Engineering	Agricultural Engineering
Agricultural Plant Physiology	Agricultural Plant Physiology
Agronomy	Agronomy
American Legal Institutions	
American Studies	American Studies
Analytical Chemistry	Analytical Chemistry
Anatomy	Anatomy
Anesthesiology	
Animal Husbandry	Animal Husbandry
Anthropology	Anthropology
Architecture	
Area Studies	
Art	Art (History and Criticism)
Art Education	
Astronomy	
Biochemistry	Biochemistry
	Biology
Biometry	Biometry
Biophysics	Biophysics
Botany	Botany
Business Administration	Business Administration
Chemical Engineering	Chemical Engineering
	Chemical Physics
Child Psychology	Child Psychology
Chinese	
Civil Engineering	Civil Engineering
Classical Area Studies	Classical Area Studies
Classics	Classics
Comparative Literature	Comparative Literature
	Control Sciences
Curriculum and Instruction	
Dairy Husbandry	Dairy Husbandry
Dairy Industries	Dairy Industries
Dentistry	
Dermatology	Dermatology
Economics	Economics
Education	Education
Educational Administration	Educational Administration
Educational Psychology	Educational Psychology
Electrical Engineering	Electrical Engineering
English	English
Entomology	Entomology
Environmental Health	Environmental Health
Epidemiology	Epidemiology
Fine Arts	
Fisheries and Wildlife	Fisheries and Wildlife
Fluid Mechanics	Fluid Mechanics
Forestry	Forestry
French	French
General Geology	General Geology
Genetics	Genetics

MASTER'S DEGREE	PH.D. DEGREE
Geography	Geography
Geophysics	
German	German
Greek	Greek
History	History
History and Philosophy of Education	
Home Economics	Home Economics
Home Economics Education	
Horticulture	Horticulture
	Hospital Administration
Hospital Pharmacy	
Hydrogeology	Hydrogeology
Industrial Education	
Industrial Engineering	Industrial Engineering
Industrial Relations	Industrial Relations
Inorganic Chemistry	Inorganic Chemistry
International Relations	International Relations
Japanese	
Journalism	Journalism
Latin	Latin
Library Science	
Linguistics and Comparative Philology	Linguistics and Comparative Philology
Mathematics	Mathematics
Mechanical Engineering	Mechanical Engineering
Mechanics and Materials	Mechanics and Materials
Medical-Surgical Nursing	
Medical Technology	
Medicine (Internal)	Medicine (Internal)
Metallurgical Engineering	Metallurgical Engineering
Microbiology	Microbiology
Mineral Engineering	Mineral Engineering
Mineralogy and Petrology	Mineralogy and Petrology
Museology	
Music	Music
Music Education	
Neurology	Neurology
Neurosurgery	Neurosurgery
Nutrition	Nutrition
Obstetrics and Gynecology	Obstetrics and Gynecology
Ophthalmology	
Organic Chemistry	Organic Chemistry
Orthopedic Surgery	Orthopedic Surgery
Otolaryngology	Otolaryngology
Pathology	Pathology
Pediatrics	Pediatrics
Pharmaceutical Chemistry	Pharmaceutical Chemistry
Pharmaceutical Technology	Pharmaceutical Technology
Pharmacognosy	Pharmacognosy
Pharmacology	Pharmacology
Philosophy	Philosophy
Physical Chemistry	Physical Chemistry
Physical Education	
Physical Medicine and Rehabilitation	Physical Medicine and Rehabilitation
Physical Therapy	
Physics	Physics
Physiological Chemistry	Physiological Chemistry
Physiological Hygiene	Physiological Hygiene
Physiology	Physiology
Plant Pathology	Plant Pathology
Plastic Surgery	
Political Science	Political Science
Poultry Science	Poultry Science
Proctology	

MASTER'S DEGREE	PH.D. DEGREE
Psychiatric Nursing	
Psychiatry	Psychiatry
Psychology	Psychology
Public Administration	
Public Health	
Radiology	Radiology
Scandinavian	Scandinavian
Social Work	Social Work
Sociology	Sociology
Soil Science	Soil Science
Spanish	Spanish
Speech and Theatre Arts	Speech and Theatre Arts
Speech Science, Pathology, and Audiology	Speech Science, Pathology, and Audiology
Statistics	Statistics
Surgery	Surgery
Theatre Arts	
Urology	Urology
Veterinary Anatomy	Veterinary Anatomy
Veterinary Bacteriology	Veterinary Bacteriology
Veterinary Medicine	Veterinary Medicine
Veterinary Obstetrics and Gynecology	Veterinary Obstetrics and Gynecology
Veterinary Parasitology	Veterinary Parasitology
Veterinary Pathology	Veterinary Pathology
Veterinary Physiology and Pharmacology	Veterinary Physiology and Pharmacology
Veterinary Surgery and Radiology	Veterinary Surgery and Radiology
Zoology	Zoology

GRADUATE WORK IN THE SUMMER SESSION

Considerable graduate work specifically of interest to teachers is offered in the Summer Session. Students interested in graduate summer study for other purposes will find relatively limited offerings in a wide range of fields. Announcement of these courses may be found in the *Bulletin of the Summer Session*. Graduate work is also offered through federally supported institutes, the Biology Session at Lake Itasca Forestry and Biological Station, and in the Summer Session at the University of Minnesota, Duluth.

Master's Degree—Course work for the Master's degree, *Plan A*, may be completed in 4 summer terms of 5 weeks each. The student may register for thesis and carry *in absentia* thesis work to complete the equivalent of 3 quarters. Requirements for *Plan B* may be completed in 6 summer terms of 5 weeks each. All work for the Master's degree must be completed within 7 years after initiation of the degree program.

COMMITTEE ON INSTITUTIONAL COOPERATION TRAVELING SCHOLAR PROGRAM

The University of Minnesota is a participant in the Traveling Scholar program for graduate students enrolled in CIC (Committee on Institutional Cooperation) institutions. The eleven participating universities are the members of the "Big Ten" and the University of Chicago.

This program enables a graduate student to travel to another of the member institutions for 1 or 2 quarters (1 semester) of study to take advantage of special resources available on another campus but not available on his

own, including course offerings, research opportunities, unique laboratories and library collections, etc.

Graduate students who desire graduate course offerings not available on the University of Minnesota campus should confer first with the major department and their major advisers concerning which of the 10 other co-operating institutions to select for program enrichment and diversification. Information regarding the procedure to be followed in seeking admission to another CIC institution is available at the Graduate School office.

A generous grant from the Ford Foundation has made possible also a series of Far Eastern Language institutes under the auspices of the CIC Traveling Scholar program. The institute is held on a different campus each summer.

FINANCIAL AIDS

Many of the graduate students at the University of Minnesota find it necessary to finance their education, in part at least, by funds secured either through fellowships or some form of part-time employment. The Graduate School is deeply interested in calling the attention of such students to all possible sources of financial assistance. In general, opportunities may be found through teaching and research assistantships, service and nonservice fellowships, other part-time employment both on and off the campus, and loans.

The following announcement does not include fellowships and teaching and research assistantships open to students in the clinical branches of medicine. For information on such opportunities students should consult the *Bulletin of Graduate Programs in Medicine, Dentistry, and Pharmacy.*

Tuition for University Staff—Holders of academic appointments involving one-fourth of full-time service or more and holders of civil service appointments involving three-fourths of full-time service to the University pay tuition at the resident rate. All others pay tuition according to their status as residents or nonresidents. These appointments serve the double purpose of financial aid to students and of providing faculty with qualified persons to perform needed services.

Appointments Requiring Service

Note—Students must be enrolled in or approved for admission to the Graduate School to hold one of these appointments. After the opening of the academic year the holder must be registered in the Graduate School during each quarter that he holds an appointment. For students holding such appointments during summer term, registration in the Graduate School is not obligatory.

Assistants, Medical Fellows, and Teaching Associates—Nearly 2,200 such appointments are offered to graduate students through the various colleges, divisions, and departments of the University of Minnesota. Stipends vary:

Teaching assistants—from $1,161 to $3,726 for one-fourth to three-fourths of full-time service to $3,096 for two-thirds of full-time service for the academic year or half of full-time service for the calendar year.

Research assistants—from $1,161 to $3,483 for one-fourth to three-fourths of full-time service for the academic year to $3,096 for two-thirds of full-time service for the academic year or for half-time service for the 12-month period. Some research assistantships on the St. Paul Campus also involve full-time service during the summer months with additional compensation for that period.

Teaching associates—A considerable number of these appointments are available with stipend varying from $1,323 to $4,286 for one-fourth to three-fourths of full-time service.

All of these appointments serve the double purpose of financial aid to students and of providing faculty with qualified persons to perform needed services. Medical fellowships at Minneapolis are full-time appointments at $3,150 with fees and tuition paid.

Tuition—Holders of academic appointments involving one-fourth of full-time service or more and holders of civil service appointments involving three-fourths of full-time service to the University pay tuition at the resident rate. All others pay tuition according to their status as residents or nonresidents.

Application Deadline—Applications must be received in the Graduate School office by each February 15 for appointments covering the ensuing academic year, but applications received at other times will be considered for any available vacancies. Application blanks and further information may be obtained either from the head of the department in question or from the Graduate School office, 316 Johnston Hall, University of Minnesota, Minneapolis, Minn. 55455, **but all application blanks should be returned to the head of the department appointing the assistant.**

Administrative and Clinical Fellowships (not rigidly restricted as to major field of study) are available in the offices of the Graduate School, the Institute of Agriculture, the School of Home Economics, the School of Journalism, the Departments of Agricultural Engineering, Biostatistics, Political Science, Radio and Television, and Speech, Communication, and Theatre Arts, the Audio-Visual Education Service, Coffman Memorial Union, the Dean of Admissions and Records, the Bureau of Student Loans and Scholarships, the Foreign Student Adviser's Office, and the Dean of Students.

Residence Counselorships—One hundred and forty-six residence counselorships (which require a minimum of 20 hours of work per week) are available to men and women in the University residence halls and fraternities. Residence counselors are responsible for making residence living an educational experience for their students. They become personally acquainted with each student in their residence units and stimulate group activities and student participation in intellectual, cultural, social, and athletic activities and programs. **Remuneration** for a minimum of 20 hours of work a week in the fraternities is room and board. **In the residence halls,** residence counselorships which require 30 hours of work a week provide room and board and a stipend of $90 a quarter for new counselors and $100 a quarter for counselors who are reappointed. Residence hall counselors who hold the baccalaureate degree and are out-of-state students pay tuition fees at the resident rate. All other resi-

dence counselors pay tuition fees according to their status as residents or non-residents. Residence counselors are required to participate in regularly scheduled training programs. Application blanks may be obtained from the Co-ordinator of the Residence Counseling Program, Office of the Dean of Students, 8 Temporary North of Mines, University of Minnesota, Minneapolis, Minn. 55455.

Fellowships and Scholarships

Fellowships Unrestricted as to Field

APPLICATION DEADLINE—Applications must be received in the Graduate School office by each February 15 unless otherwise stipulated.

Foreign student tuition scholarships (75) open in any department or college are offered to qualified foreign graduate and undergraduate students. Applications for the academic year should be sent by **April 15** to the Office of the Foreign Student Adviser, 717 East River Road, Minneapolis, Minn. 55455.

***Class of 1890 Fellowship.** Whenever sufficient funds have accumulated, this fellowship of approximately $250 is open to a graduate student in the arts and science fields or the engineering fields. Offered 1966-67.

Minneapolis Foundation—Frances E. Andrews Fund, up to $750 to graduate students for the purpose of carrying on research abroad.

***Minneapolis Woman's Club Fellowship** at $1,800 available in alternate years to a woman student meeting scholarship and leadership qualifications. Offered 1966-67.

Peace Corps Tuition Fellowships (10) plus, when funds are available, stipend of $350. Applicants must (a) have successfully completed overseas duty with the Peace Corps, (b) have earned a baccalaureate degree or completed Peace Corps training at the University of Minnesota, and (c) be planning careers in government overseas service or in college teaching. Apply at 307 Johnston Hall, University of Minnesota, Minneapolis, Minn. 55455.

***Shevlin Fellowship** at $1,500, offered to a student in the College of Agriculture, Forestry, and Home Economics, the College of Liberal Arts, the School of Chemistry, or the Medical School. Application must be made through the department concerned.

Torske Klubben Fellowships (2) usually at $1,500 offered to Norwegian nationals for study in the United States.

University Alumni Graduate Fellowships (2-4) at $2,000 for students at the Ph.D. thesis stage in any area of graduate study. Agency pays tuition. Application must be made through departments.

Graduate School Doctoral Fellowships (3-6) available at $2,000 ($2,500 if holder has minor dependents) for students well advanced in their graduate studies, preferably in their doctoral thesis writing year. Agency pays tuition. Application must be made through departments.

Graduate School Special Grants. As funds are available the dean of the Graduate School may make awards up to $500 for expenses directly connected with the production of the Ph.D. thesis (travel, microfilming, recording tapes, questionnaire printing and mailing, etc.). Final typing and binding costs cannot be covered.

Graduate School Tuition Scholarships and Graduate School Summer Tuition Scholarships. A limited number of these (usable in academic year or summer term) are offered by the dean of the Graduate School.

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* The applicant, if he is a citizen of the United States and can supply evidence of need, may apply for a concurrent tuition fellowship.

National Foundations—Fellowships offered by national foundations such as the Danforth Graduate Fellowships, National Institutes of Health Predoctoral Fellowships, National Science Foundation programs (Summer Fellowships, and Traineeships), National Aeronautics and Space Administration Traineeships, and the Woodrow Wilson National Fellowships, and in the programs under the National Defense Education Act, Title IV and Title VI, are available to graduate students. For many of these, applications are due before November 1 for the next academic year. Information concerning these and other opportunities may be received from the Graduate Fellowship Office, 307 Johnston Hall, University of Minnesota.

Tozer Foundation Fellowships (20-25 with a maximum of $500) designed to help defray expenses connected with the preparation of doctoral theses, are awarded to United States students (preferably Minnesota students) by the Bureau of Student Loans and Scholarships, 104 Wesbrook Hall, University of Minnesota.

Committee on Institutional Cooperation Traveling Scholar Program—The University of Minnesota is one of eleven institutions (the Universities of Chicago, Illinois, Indiana, Iowa, Michigan, Michigan State, Minnesota, Northwestern, Ohio State, Purdue, Wisconsin) participating in the program. A graduate student at the University of Minnesota may make use of special resources not available at Minnesota but present at one of the other ten participating institutions. If a graduate student is granted CIC Traveling Scholar privileges, he registers, pays fees, and has his grades recorded at the University of Minnesota while attending another university. Such visits are limited to two quarters or one semester, and all arrangements must be completed at least one quarter before a student's departure for another campus. For details on this program write or call the Graduate School, 321 Johnston Hall, University of Minnesota, Minneapolis, Minn. 55455.

Fellowships Restricted as to Field

APPLICATION DEADLINE—Applications are due in the office of the department concerned by February 15 unless otherwise stipulated.

AGRICULTURAL SCIENCE FIELDS

***Caleb Dorr Research Fellowships** (3) at $500 in Agriculture.

Animal Husbandry

United States Public Health Service Graduate Traineeships (2-3) in Nutrition at $2,400 to $2,800. Agency pays fees. Application deadline April 1.

Dairy Husbandry and Dairy Industries

John Brandt Memorial Foundation Fellowship at $2,400 in Dairy Husbandry and Dairy Industries.

United States Public Health Service Graduate Traineeships (2-3) in Nutrition at $2,400 to $2,800. Agency pays fees. Application deadline April 1.

Entomology, Fisheries, and Wildlife

Lloyd E. Johnson Fellowship at $2,500 for a student in the field of Fisheries and Wildlife under Dr. Lloyd Smith, Jr. Application deadline April 1.

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* The applicant, if he is a citizen of the United States and can supply evidence of need, may apply for a concurrent tuition fellowship.

Forestry

Lake States Forest Experiment Station Assistantship at $3,000 for work in Forest Products in the School of Forestry. Application deadline April 1.

Mando Graduate Fellowship at $1,500 for work in Forest Management in the School of Forestry. Application deadline April 1.

Northwest Paper Foundation Fellowship at $2,880 for work in Forest Management in the School of Forestry. Application deadline April 1.

United States Forest Products Laboratory Assistantship at $3,200 for work in Forest Products in the School of Forestry. Application deadline April 1.

Home Economics

Electrical Women's Round Table, Julia Kiene Fellowship at $1,000 for a student interested in Household Equipment or business-related areas of Home Economics. Application deadline March.

General Foods Fund Fellowships (2) for full-time study in any major Home Economics area: One 1-year fellowship at $2,000 for study for Master's degree; one 1-year fellowship at $3,000 for study for Ph.D. degree.

United States Public Health Service Traineeships (2-3) in Nutrition at $2,400 to $2,800. Agency pays fees.

Poultry Science

United States Public Health Service Graduate Traineeships (2-3) at $2,400 to $2,800 for students interested in Nutrition. Agency pays fees. Application deadline April 1.

Soil Science

Texaco Fellowship at $3,000 in Soil Science. Agency pays fees.

BIOLOGICAL SCIENCES

Biochemistry (St. Paul Campus)

Procter and Gamble Fellowship in Biochemistry at $3,000. Agency pays fees. Application deadline April 15.

United States Public Health Service Predoctoral Trainee Fellowships (8) in Biochemistry at $3,000 on calendar year basis. Agency pays fees. Application deadline April 15.

United States Public Health Service Postdoctoral Trainee Fellowships (3) in Biochemistry at the basic rate of $5,500 on calendar year basis. Agency pays fees. Application deadline July 1.

Botany

***Alexander P. Anderson and Lydia Anderson Summer Fellowships** (5) at $350 each in Botanical and Zoological Science. Open only to graduates of the University of Minnesota. Application deadline March 15.

***Charles J. Brand, Class of 1902, Fellowship** at $2,200, preferably for a student in his final year of work for the Ph.D. in Botany. Offered 1966-67.

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* The applicant, if he is a citizen of the United States and can supply evidence of need, may apply for a concurrent tuition fellowship.

Caroline M. Crosby Memorial Fellowships (3-5) in Botany provide tuition, room and board, travel, and miscellaneous expenses up to $400 to enable a student to take instruction at the University of Minnesota Lake Itasca Forestry and Biological Station or a similar biological station. Application deadline March 15.

***Conway MacMillan Memorial Research Fellowship** at $1,200 in Botany.

Genetics

United States Public Health Service Postdoctoral Trainee Fellowships (2) in Genetics. Stipend negotiated.

United States Public Health Service Predoctoral Trainee Fellowships (5) in Genetics at $2,400 with $500 dependency allowance.

See also under Dight Institute, page 43.

Zoology

***Alexander P. Anderson and Lydia Anderson Summer Fellowships** (5) at $350 each in Botanical and Zoological Science. Open only to graduates of the University of Minnesota. Application deadline March 15.

Charles Peter Sigerfoos Fellowship of about $150 for a graduate student in Zoology who is a prospective doctoral candidate to enable him to pursue work at a marine or tropical biological laboratory.

ARTS AND SCIENCE FIELDS

Putnam D. McMillan Fellowships (several) at up to $1,500 to enable graduate students at the University of Minnesota in any area of the Liberal Arts to study at other universities in this country or abroad. Application deadline April 15.

***Albert Howard Fellowship** at $240. Offered when funds suffice; offered 1966-67. Open only to graduates of the University of Minnesota.

William W. Stout Memorial Graduate Fellowship at $2,000 plus $500 for 1 or more minor dependents to a student in the intermediate years of his Ph.D. program. Agency pays tuition.

Thomas F. Wallace Graduate Fellowship at $2,000 in the Humanities or Social Sciences for a student in the intermediate year of preparation for the Ph.D. degree.

George A. Macpherson Fellowship at $2,000 a year to a student who will enter teaching in any of the Natural Sciences, Social Sciences, or Humanities.

Anthropology

Walter B. Cline Memorial Fellowship at $300, offered when funds have accumulated, for graduate study of languages and/or cultural history of Asia or the Moslem world. Offered 1966-67.

National Institutes of Health Training Grants (8) in Anthropology, excluding Archaeology, at $2,700 for the calendar year. Agency pays fees.

Art

Art Fellowships at $500 to $1,000 for the study of Modern American Art.

Kress Foundation Scholarships (several) at stipend varying from $500 to $1,000.

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* The applicant, if he is a citizen of the United States and can supply evidence of need, may apply for a concurrent tuition fellowship.

Business Administration

Paul F. Goldsborough, Jr., Memorial Fellowship. Available when funds permit. Application deadline April 1.

Haskins and Sells Foundation Graduate Fellowship in Accounting of $1,000 for a qualified instructor who is preparing for a career as an accounting teacher. Application deadline April 1.

Ernest Heilman Memorial Fellowship at $300 in Business Administration for a student with strong interest in accounting. Application deadline April 1.

Insurance Companies of Minnesota Fellowship at $350 in Business Administration for a student interested in insurance. Application deadline April 1.

Kaiser Aluminum and Chemical Corporation Fellowship at $2,000 in Business Administration and Marketing. Agency pays tuition. Application deadline April 1.

Minnesota Mining and Manufacturing Company Graduate Fellowship at $1,200 in Business Administration for a student interested in accounting. Application deadline April 1.

New York Life Insurance Company Fellowship at $350 in Insurance. Application deadline April 1.

Paine, Webber, Jackson, and Curtis Scholarship at $500 or more as negotiated in Business Administration for a student with strong interest and potential for success in the securities business. Application deadline April 1.

Price Waterhouse Foundation Graduate Fellowship in Accounting at $1,000 for a student who intends to enter the teaching field. Application deadline April 1.

Emmett Salisbury Sales Management Scholarship available as funds permit in Business Administration for a student with strong interest in sales management. Application deadline April 1.

Twin City Association of Purchasing Agents Fellowships, one at $500 and one at $250 in Business Administration for a student with strong interest in purchasing. Application deadline April 1.

Child Psychology

United States Public Health Service Training Stipends (12 or more) for research in Child Psychology at $2,400 to $2,800 depending on student's year of training. Agency pays tuition.

Classical Languages

John C. Hutchinson Scholarship of $300 awarded every second year to a graduate student in Classical Languages. Offered 1966-67.

Economics

H. J. Bhabha Fellowship at $2,000 for a highly qualified student from India who is interested in the Natural Sciences, the Physical Sciences, or Economics. Agency pays fees.

German

Carl Schlenker Memorial Fellowship at $800 open to an unmarried American-born student majoring in German language and literature. Preference is given to graduate students.

Humanities

Thomas F. Wallace Graduate Fellowship at $2,000 in the Humanities or Social Sciences for a student in the intermediate year of preparation for the Ph.D. degree.

Industrial Relations

Archer Daniels Midland Industrial Relations Fellowship at $400. Application deadline December 15.

Journalism

Carroll Binder Memorial Award of approximately $400 for a graduate or undergraduate student who shows promise in the reporting and/or interpreting of international news and who expects to go into newspaper work. Application deadline March 31.

Arle Haeberle Fellowship in amount depending on availability of funds for a female first-year graduate student to continue studies in Speech, Journalism, or Theatre for a career in Broadcasting.

Minneapolis Star and Tribune "World Affairs Program" Teaching Assistantship at $2,200 in Journalism. Application deadline March 1.

David Silverman Memorial Scholarship at $300 in Journalism for a student specializing in news-editorial aspects of journalism.

Stephen L. Wells Scholarship in Public Opinion at $200 for a student in Journalism who plans to work in public relations.

Library Science

John C. Hutchinson Scholarship of $250 awarded every second year to a graduate student in Library Science. Offered 1967-68.

Lura C. Hutchinson Scholarship in Library Science at $200. Offered 1966-67.

Irene Fraser Jackson Memorial Fellowship at $1,000 open to students in Library Science.

Minnesota Library Association Scholarship of $600 awarded every second year to a graduate student preparing for college or public librarianship. Offered 1966-67.

Blanche Thompson Scholarship at $500 open to school librarians.

H. W. Wilson Memorial Fellowship of $1,000 in Library Science.

Political Science

Hubert H. Humphrey Fellowship at $2,500 open to an advanced graduate major with a distinguished record in Political Science in any area of specialization within the discipline.

***Clara H. Ueland Memoral Fellowship** at $600, open to recent women graduates whose interests are in Politics and Government.

Psychology

Center for Research in Human Learning Fellowships (12 predoctoral, 3 postdoctoral, 3 special postdoctoral) at $2,100, $2,400, $2,700 for first, second, and third years of predoctoral study, $5,500 for postdoctoral study, and $8,000 for special postdoctoral study for persons interested in human learning. Dependency allowance is $500. Agency pays fees.

Clinical Psychology—Veterans Administration: Sixteen work-study stipends at from $2,700 to $4,000 for half-time psychological work under the joint training program of the University and the Veterans Administration open to students who have completed at least one year of successful graduate work in clinical psychology. Appointees pay tuition according to their status as residents or nonresidents.

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* The applicant, if he is a citizen of the United States and can supply evidence of need, may apply for a concurrent tuition fellowship.

Clinical Psychology—United States Public Health Service: Twenty-eight fellowships at from $1,800 to $3,000 for study for the Ph.D. degree in Clinical Psychology. The amount depends upon whether the student is in his first, second, third, or fourth year of graduate work when appointed. Agency pays tuition and fees.

Counseling Psychology—Veterans Administration: A number of work-study stipends at from $2,700 to $4,000 for half-time psychological work under the joint training program of the University and the Veterans Administration open to students who have completed at least one year of successful graduate work in psychology, either in the Department of Psychology or the Department of Educational Psychology. Appointees pay tuition according to their status as residents or nonresidents.

Counseling Psychology—United States Vocational Rehabilitation Administration: Thirty traineeships in Vocational Rehabilitation Counseling at from $1,800 to $3,400 for the academic year. The amount depends upon the year level of graduate work. Agency pays tuition and fees.

Counseling Psychology—Clinical fellowships (7) at $2,933 for graduate students in Counseling Psychology, Educational Psychology, Student Personnel Work, or Higher Education are available in the Student Counseling Bureau.

United States Public Health Traineeships (9-18 at predoctoral and postdoctoral levels) in Psychopharmacology at $2,400 for first-year Ph.D. candidates to $3,000; $6,000 for first-year postdoctoral study and $7,000 for second-year postdoctoral study; allowance of $500 for each dependent. Agency pays fees. Application deadline March 1.

Postdoctoral Training Program in Marriage Counseling (6 stipends) at $6,000 and $7,000. Agency pays fees. Application deadline March 1.

Public Administration

Lloyd M. Short Fellowship at $1,350 in Public Administration.

Public Administration Traineeships (10 or more) at $2,400 to $3,000 for the calendar year with state government and municipalities.

Radio and Television

McKnight Fellowship in Radio and Television at $2,200. Application deadline August 15.

Social Work

United States Children's Bureau Traineeships (8) at $2,000 (for two graduate years to earn the M.S.W. degree) for students whose career objective is work in Child Welfare. In addition there is one traineeship at $3,400 plus dependency allowance of $500 for a post-M.S.W. student working toward the Ph.D. degree. Agency pays tuition and fees. Application deadline April 1 for Ph.D. candidates, May 1 for M.S.W. candidates.

United States Vocational Administration Traineeships (10) at $1,800 (for first graduate year) and $2,000 (for second graduate year) for Social Work students whose career objective is to work in the rehabilitation field. Agency pays tuition. Application deadline May 1.

United States Public Health Service, Mental Health Act, Traineeships (26) which provide tuition plus $1,800 (for first graduate year), $2,000 (for second graduate year) for Social Work students whose career objective is to work in the Mental Health or Correctional or School Social Work (visiting teacher) fields. In addition there are traineeships at $3,600 plus payment of tuition by the agency, for qualified holders of the M.S.W. degree whose objective is the Ph.D. degree. For the latter a $500 dependency allowance is offered. Application deadline April 1 for post-M.S.W., May 1 for M.S.W.

A few stipends of about $170 per month in co-operation with the Veterans Administration for Medical and Psychiatric Social Work students.

Mrs. Archie Walker Scholarship Fund (2 stipends) for Social Group Work students. Amount based on student's needs, not to exceed $2,000. Application deadline May 1.

Sociology

National Institute of Mental Health Traineeships (10) in Anti-Social Behavior and the Sociology of Mental Health at $1,800 to $3,000, depending on year of graduate work. Dependency allowance of $500. Basic training for careers in teaching and research. Agency pays fees. Application deadline January 31.

National Institute of Mental Health Traineeships (7) in Sociological Research on the family at $1,800 to $3,000, depending upon year of graduate work. Basic training for careers in family research and teaching in a variety of occupational settings. Dependency allowance of $500. Agency pays fees. Application deadline January 15.

Speech and Theatre Arts

Oscar W. Firkins Scholarship of $600 in Theatre Arts for a former University of Minnesota student.

Arle Haeberle Fellowship in amount depending on availability of funds for a female first-year graduate student to continue studies in Speech, Journalism, or Theatre for a career in Broadcasting.

McKnight Foundation Graduate Theatre Fellowships (10-15) at $1,200 to $2,700 annually for two years in Theatre Arts. Candidate must be nominated by a director of a college theater from which his degree was received. Holders devote first academic year to graduate study and work in the University Theatre and in the second year combine studies at the University with internship at the Tyrone Guthrie Theatre. Nomination deadline December 15. Those nominated must complete special application form by January 15.

National Institutes of Health Traineeships (2) at $2,800 in Communication Sciences.

United States Office of Education Fellowships (approximately 6) at $2,000 to $2,800 with dependency allowance of $400 in Speech Pathology and Audiology. Agency pays fees. Application deadline May 1.

Sam S. Shubert Foundation Fellowship at $2,795 for a student interested in pursuing a graduate degree and in writing a full-length play.

United States Vocational Rehabilitation Administration Traineeships (16) in Speech and Hearing at $2,400 to $3,400. Agency pays fees. Application deadline May 1.

Speech and Hearing Clinic Research Assistantship in Speech Pathology at $1,800.

EDUCATION FIELDS

Agricultural Education

Minnesota Vocational Agriculture Instructors Association Fellowships (10) at $100 in Agricultural Education for men of demonstrated ability who are currently teaching Vocational Agriculture in Minnesota. Application deadline March 15.

Education

United States Office of Education Fellowships for the Training of Teachers of the Deaf, Visually Handicapped, Mentally Retarded, Physically Handicapped, Emotionally Disturbed (33) at $2,000 to $2,800, depending on extent of graduate study. Agency pays fees and $400 dependency allowance.

United States Public Health Service, National Institute of Mental Health Fellowships for Teachers of Emotionally Disturbed and Socially Maladjusted Children (12) at $2,000. Agency pays fees.

United States Public Health Service Traineeships in School Psychology (10) at from $1,800 to $3,000. Agency pays tuition.

ENGINEERING AND PHYSICAL SCIENCE FIELDS

H. J. Bhabha Fellowship at $2,000 for a highly qualified student from India who is interested in the Natural Sciences, the Physical Sciences, or Economics. Agency pays fees.

Ford Forgivable Loan Program. A number of loans of up to $10,000 over a three-year period based on the student's needs are available for engineering doctoral study. Loan may be forgiven if the student elects to teach in the United States or Canada. Applications due November 1 and May 1 of each year.

Humble Oil Education Foundation Fellowship at $2,500 for a student in a Physical or Engineering Science.

George A. Macpherson Fellowship at $2,000 a year to a student who will enter teaching in any of the Natural Sciences, Social Sciences, or Humanities.

Walter G. Seeger Fellowship in Engineering at $2,000 in Chemical, Electrical, and Mechanical Engineering.

Aeronautical Engineering

U.S. Rubber Company Foundation Grant-in-Aid at $2,400 for a student in a physical or engineering science.

Architecture

The American Institute of Architects and The American Institute of Architects Foundation, Inc., Scholarship Program (normally 3 stipends) in varying amount in Architecture. Application deadline late October.

Rollin B. Child Education Fund—a varying number of stipends in varying amount in Architecture. Application deadline October 15.

Minnesota Lathing and Plastering Scholarships (a few) in varying amount in Architecture. Application deadline October 15.

Minnesota Society of Architects Scholarship Fund, a varying number of stipends in varying amount. Application deadline October 15.

Chemical Engineering

John P. Fridley Fellowships (2) at $2,000 with dependency allowance of $500 in Chemical Engineering. Agency pays fees.

Minnesota Mining and Manufacturing Company Fellowship at $2,000 for research in Chemical Engineering. Agency pays fees.

Procter and Gamble Fellowship at $2,000 for research in Chemical Engineering. Agency pays fees.

Shell Fellowship in Chemical Engineering at $2,000. Agency pays fees.

Chemistry

Archer Daniels Midland Company Fellowship at $2,700 in Organic Chemistry. Agency pays fees.

Dow Chemical Company Fellowship at $2,000 in Chemistry. Agency pays fees.

Du Pont Postgraduate Teaching Assistant Award at $1,200 in Chemistry. Agency pays fees exclusive of laboratory fees, in the amount normally charged to a teaching assistant of equivalent status.

Du Pont Summer Fellowships (25) at variable stipend in Chemistry.

Eastman Kodak Company Scientific Award of $1,000 in Chemistry.

Esso Research and Engineering Company Fellowship in Chemistry at $1,800 for recipient, single or married without children; $2,400 if married with one or more children. Agency pays fees.

Ethyl Corporation Fellowship at $2,500. Agency pays fees.

Minnesota Mining and Manufacturing Company Fellowships at $2,200 for research in Chemistry. Agency pays fees.

Monsanto Company Summer Research Fellowships (27) at varying stipend.

Procter and Gamble Summer Fellowships in Chemistry at varying amount.

Sinclair Fellowship at $2,000 in Organic Chemistry, under Professor W. E. Parham. Agency pays fees.

Socony Mobil Company Summer Fellowships (10) at varying stipend.

Sun Oil Company Summer Fellowships (6) at varying stipend.

Union Carbide and Carbon Chemicals Corporation Fellowship in Organic Chemistry at $1,800 ($2,100 if student is married) under Professor C. F. Koelsch. Agency pays fees.

Civil Engineering

United States Public Health Service Traineeships for graduate study in Sanitary and Water Resources Engineering (2 at $250 per month for first year; 2 at $333 and $400 for second and third years). Agency pays tuition and fees. Application deadline April 1.

Electrical Engineering

Collins Radio Company Fellowship at $1,500 to be awarded in the field of Electrical Engineering.

Control Data Corporation Fellowship in Electrical Engineering at $3,200 for the holder of the Master's degree who is proceeding to the Ph.D. with emphasis on electronic data processing. Agency pays fees.

Mayo Engineering Graduate Fellowships (2) in Electrical Engineering at $500 offered to graduate students interested in medical instrumentation and allied pursuits.

Mayo Engineering Graduate Fellowship open to a major in Electrical Engineering who has completed the course requirements for the M.S. degree. Residence will be Rochester, Minnesota, for thesis work in the Engineering Division of the Mayo Graduate School of Medicine. May be held for a maximum of two years. Stipend commensurate with current salaries for graduates in electrical engineering.

Fluid Mechanics

Graduate School Fluid Mechanics Fellowship at $2,400 for an outstanding candidate in Fluid Mechanics. Application deadline April 15.

Geology and Geophysics

American Iron and Steel Institute Fellowship at $3,600 for a student in Geology or Geophysics with special interest in crystallography and crystal physics. Agency pays tuition.

***Thomas F. Andrews Fellowship** at approximately $500 to $1,000 in Geology, available at intervals of two or three years. Application deadline April 15.

Jersey Production Research Fellowship at $3,000 in Geology for a student with strong preparation in physical chemistry. Application deadline April 15.

Edmund J. Longyear Memorial Fund Fellowship in Mineral Engineering, Metallurgical Engineering, Geology, or Geophysics at a variable amount depending on circumstances. Application deadline April 15.

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* The applicant, if he is a citizen of the United States and can supply evidence of need, may apply for a concurrent tuition fellowship.

Reserve Mining Company Fellowship at $3,000 for twelve months of study in Geology, Metallurgical Engineering, or Mineral Engineering. Application deadline April 15.

United States Steel Foundation, Inc., Fellowship at $2,400 annually for two years ($3,000 annually if student is married at time of designation) in Mineral Engineering, Metallurgical Engineering, or Geology. Application deadline April 15.

Mechanical and Industrial Engineering

Minnesota Mining and Manufacturing Company Fellowship at $2,000 to $2,700 in Mechanical Engineering.

Metallurgical Engineering and Mineral Engineering

American Iron and Steel Institute Fellowship at $3,000 in Metallurgical Engineering. Application deadline April 15.

Atomic Energy Commission Research Assistantships (5) at $3,500 in Metallurgy. Application deadline April 15.

Edmund J. Longyear Memorial Fund Fellowship in Metallurgical Engineering, Mineral Engineering, Geology, or Geophysics at $500. Application deadline April 15.

Mines Experiment Station Research Assistantship at up to $3,000 for the calendar year in Metallurgical Engineering. Application deadline April 15.

Mines Experiment Station Research Assistantships at up to $3,000 for the calendar year in Mineral Engineering. Application deadline April 15.

National Steel Corporation Fellowship at up to $3,600 in Metallurgical Engineering under Professor Gust Bitsianes. Application deadline April 15.

Office of Naval Research Research Assistantships (6) at $3,500 in Metallurgical Engineering. Application deadline April 15.

Reserve Mining Company Fellowship at $3,000 for the calendar year in Metallurgical Engineering, Mineral Engineering, Geology, or Physics. Offered 1967-69.

United States Bureau of Mines Fellowships (2) in Mineral Economics at up to $4,000 plus travel and expenses annually for two years. Open to male United States citizens desiring doctoral degree. Application deadline April 15.

United States Bureau of Mines Fellowship at up to $3,000 in Mineral Engineering under Professor E. P. Pfleider. Application deadline April 15.

United States Bureau of Mines Fellowships (2) at $3,000 in Metallurgical Engineering under Professor S. R. B. Cooke. Application deadline April 15.

United States Steel Foundation, Inc., Fellowship in Mineral Engineering, Geology, or Metallurgical Engineering at $2,400 annually for two years ($3,000 annually if student is married at time of designation) plus $600 for supplies. Application deadline April 15.

MEDICAL AND HEALTH SCIENCE FIELDS

Anatomy

National Institutes of Health Training Grants (about 16) at $2,400 to $2,800 for study in Anatomical Sciences. Dependency allowance of $500. Agency pays tuition. Application deadline February 7.

Biochemistry (Minneapolis Campus)

National Institutes of Health Training Grants (4) at $2,400 for study in Biochemistry. Dependency allowance $400. Agency pays tuition. Application deadline April 1.

Biometry

United States Public Health Service Traineeships in Biostatistics at $2,100 (beginning), $2,600 (intermediate), $2,800 (terminal) with $500 allowance per dependent per year. Agency pays tuition and fees.

Microbiology

United States Public Health Service Postdoctoral Fellowships (4) at $5,500 with dependency allowance of $500.

United States Public Health Service Predoctoral Fellowships (30) at $2,400 with dependency allowance of $500 in Microbiology.

Pharmacology

Upjohn Company Fellowship at varying stipend for study in Pharmacology, Pharmaceutical Chemistry, Pharmaceutical Technology, or Pharmacognosy.

Physiology

National Institutes of Health Training Grants (about 25) at $2,400 for first year, $2,600 for second year, and $2,800 for terminal year (with dependency allowance of $500 for dependent spouse and each dependent child) for qualified applicants. Agency pays fees. Application deadline February 1.

Dight Institute

United States Public Health Service Traineeships (5) at from $2,400 to $2,800 with dependency allowance at $500 in Human Genetics are available to graduate students in the Genetics area and Zoology. Agency pays fees.

College of Pharmacy

American Foundation for Pharmaceutical Education Graduate Fellowships at $1,800 maximum ($2,400 for married students). Agency pays fees. Application deadline March 15.

Samuel W. Melendy Memorial Fellowships at no more than $1,800. Major study must be under direction of a member of the faculty of the College of Pharmacy, and full time must be devoted to graduate study and research.

Upjohn Company Fellowship at varying stipend for study in Pharmaceutical Chemistry, Pharmaceutical Technology, Pharmacognosy, or Pharmacology.

School of Public Health

United States Public Health Service Traineeships in Environmental Biology (6 or more) at $3,000 to $6,000 with dependency allowance of $360. Agency pays fees. Application deadline April 1.

United States Public Health Service Traineeships in Air Pollution Control (4 or more) at $3,000 to $4,800 with dependency allowance of $360. Agency pays fees. Application deadline April 1.

United States Public Health Service Traineeships in Public Health (25 or more) at $3,000 to $4,800 with dependency allowance of $360. Agency pays fees. Application deadline April 1.

United States Children's Bureau Graduate Traineeships in Maternal and Child Health at $4,800 plus dependency allowance up to $2,880. Agency pays fees. Application deadline September 15.

United States Public Health Service Traineeships in Biostatistics ranging from $1,000 to $4,500, depending upon need and qualifications of students. Renewable. Agency pays fees and $360 dependency allowance. Application deadline September 15.

United States Public Health Service Traineeships in Epidemiology at $3,000 to $5,400 per year, plus allowance of $360 per year per dependent. Renewable with annual 10 per cent increase in base stipend. Agency pays tuition. Application deadline September 15.

United States Public Health Service, Mental Health Institute, Traineeships (6) for graduate study in Mental Health. Open to public health nurses, at $2,400 for first year, $3,000 for second year. Agency pays tuition. Application deadline September 15.

United States Public Health Service Traineeships for graduate study in Public Health at $250 to $400 per month plus dependency allowance and payment of tuition. Open to public health personnel.

United States Public Health Service Professional Nurse Traineeship Program (Division of Nursing) (30 or more stipends) in Public Health Nursing at $3,000 plus $360 dependency allowance and tuition. Open to graduate students who are graduate nurses preparing for leadership positions.

United States Public Health Service Traineeships (5 or more) in Radiological Health at $250 to $400 per month plus dependency allowance. Renewable. Agency pays tuition. Application deadline September 15.

United States Public Health Service Special Purpose Traineeships (10 or more) for graduate study in Air Pollution, Hospital Engineering, and Accident Prevention. Agency pays tuition, stipend, and dependency allowance of $360 per dependent. Application deadline April 1.

College of Veterinary Medicine

Graduate fellowships are offered in all departments of the College of Veterinary Medicine. Since the duration of support and stipend amounts vary, inquiries should be addressed to the specific department in which a fellowship is desired.

United States Public Health Service Training Grants (11) at $6,667 for students holding their professional degrees for graduate study in the Departments of Veterinary Anatomy, Veterinary Pathology and Parasitology, Veterinary Bacteriology, and Veterinary Physiology and Pharmacology.

Council of Graduate Schools in the United States

Resolution Regarding Scholars, Fellows, Trainees, and Graduate Assistants

In every case in which a graduate scholarship, fellowship, traineeship or graduate assistantship for the next academic year is offered to an actual or prospective graduate student, the student, if he indicates his acceptance before April 15, will have complete freedom through April 15 to submit in writing a resignation of his appointment in order to accept another scholarship, fellowship, traineeship, or graduate assistantship. However, an acceptance given or left in force after April 15 commits him not to accept another appointment without first obtaining formal release for the purpose.

It is further agreed by the institutions and organizations subscribing to the above Resolution that a copy of this Resolution should accompany every scholarship, fellowship, traineeship, and assistantship offer sent to a first-year graduate student before April 15.

Abilene Christian College
Adelphi University
Alfred University
American University
Arizona State University
Atlanta University
Atomic Energy Commission
Auburn University

Ball State Teachers College
Barry College
Baylor University
Boston College
Boston University
Bowling Green State University
Bradley University
Brandeis University
Brigham Young University
Brown University
Bryn Mawr College
Bucknell University

California Institute of Technology
Canisius College
Carnegie Institute of Technology
Case Institute of Technology
Catholic University of America
Central Michigan University
City University of New York
Claremont Graduate School and University Center
Clark University
Clarkson College of Technology
Clemson College
Colgate University
College of Saint Rose
Colorado State University
Columbia University
Cornell University
Creighton University

Danforth Foundation
Dartmouth College
DePaul University
Drake University
Drexel Institute of Technology
Duke University
Duquesne University

East Tennessee State University
Emory University

Florida State University
Fordham University
Fort Hays Kansas State College
George Peabody College for Teachers
George Washington University
Georgetown University
Georgia Institute of Technology
Gonzaga University

Harvard University
Hofstra University

Illinois Institute of Technology
Illinois State University at Normal
Immaculate Heart College
Indiana State College
Indiana University
Iowa State University

Jefferson Medical College of Philadelphia
John Carroll University
Johns Hopkins University

Kansas State College of Pittsburg
Kansas State University
Kent State University

Lehigh University
Long Island University
Louisiana Polytechnic Institute
Louisiana State University
Loyola University (Chicago)
Loyola University (Los Angeles)

Marquette University
Massachusetts Institute of Technology
McGill University
Medical College of Virginia
Miami University (Ohio)
Michigan State University
Mississippi College
Mississippi State University
Montana State College
Montana State University

National Aeronautics and Space Administration
New Mexico State University
New School for Social Research
New York University
Newark College of Engineering
Niagara University
North Carolina College at Durham
North Carolina State College of the University of North Carolina at Raleigh
North Dakota State University
North Texas State University
Northeastern University
Northwestern State College of Louisiana
Northwestern University

Ohio State University
Ohio University
Oklahoma State University
Oregon State University

Pennsylvania State University
Pepperdine College
Polytechnic Institute of Brooklyn
Princeton University
Purdue University

Rensselaer Polytechnic Institute
Rice University
Rivier College
The Rockefeller Institute
Roosevelt University
Rutgers, The State University

Saint John's University
Saint Louis University
Saint Mary's University of San Antonio
Sam Houston State Teachers College
San Diego State College
San Francisco College for Women
San Francisco State College
Seattle University
Seton Hall University

Siena College
South Dakota State College
Southern Illinois University
Southern Methodist University
Stanford University
State University of Iowa
State University of New York at Albany
State University of New York at Buffalo
Stephen F. Austin State College
Stevens Institute of Technology
Syracuse University

Temple University
Texas A & M University
Texas Christian University
Texas Southern University
Texas Technological College
Texas Woman's University
Trinity College
Trinity University
Tufts University
Tulane University
Tuskegee Institute

University of Alabama
University of Alaska
University of Arizona
University of Arkansas
University of California, Berkeley
University of California, Davis
University of California, Los Angeles
University of California, Riverside
University of California, San Diego
University of California, Santa Barbara
University of Chicago
University of Cincinnati
University of Colorado
University of Connecticut
University of Delaware
University of Denver
University of Detroit
University of Florida
University of Georgia
University of Hawaii
University of Houston
University of Idaho
University of Illinois
University of Kansas
University of Kentucky
University of Louisville
University of Maine
University of Maryland
University of Massachusetts
University of Miami
University of Michigan
University of Minnesota
University of Mississippi
University of Missouri
University of Nebraska
University of Nevada
University of New Hampshire
University of New Mexico
University of North Carolina at Chapel Hill
University of Notre Dame
University of Oklahoma
University of Omaha
University of Oregon
University of the Pacific
University of Pennsylvania
University of Pittsburgh
University of Rhode Island
University of Rochester
University of San Francisco
University of Santa Clara
University of Scranton
University of South Carolina
University of South Dakota
University of Southern California
University of Southern Mississippi
University of Tennessee
University of Texas
University of Toledo
University of Toronto
University of Tulsa
University of Utah
University of Vermont
University of Virginia
University of Washington
University of Wichita
University of Wisconsin
University of Wyoming
Utah State University

Vanderbilt University
Villanova University
Virginia Polytechnic Institute

Washington State University
Washington University
Wayne State University
West Virginia University
Western Michigan University
Western Reserve University
Woodrow Wilson National Fellowship Foundation

Xavier University

Yale University
Yeshiva University

Honorary Fellowships

Professors or other eminent scholars who desire temporarily the privileges of the library, research facilities, and seminars in the University, and who are not candidates for a degree, may upon recommendation of the dean of the

Graduate School and the approval of the president of the University be appointed honorary fellows without stipend.

Honorary fellows shall not be required to pay any fees except to cover the cost of unusually expensive supplies or equipment.

Possibilities for Employment

The Employment Bureau of the University, 4 Wulling Hall, maintains a file of available jobs on the Minneapolis Campus and in the Twin Cities. Further information may be found in the *Bulletin of General Information.*

Students in the Graduate School may also find it profitable to explore through other channels the possibility of part-time employment in the Twin Cities area in business, professional, or other fields.

Note to Wives—There are many campus employment opportunities open to wives of graduate students. Applicants should communicate *at once* with the Civil Service Employment Bureau, Room 4, Morrill Hall, University of Minnesota, Minneapolis, Minnesota 55455.

Services of the Bureau of Student Loans and Scholarships

The University has funds available for personal loans to graduate students who have satisfactorily completed 2 quarters in residence. This eligibility requirement may be waived in cases of emergency. No security is required other than the student's integrity and his ability to do graduate work. A student may borrow up to $750 during any 1 year or a maximum of $1,500. All applications should be made to the Bureau of Student Loans and Scholarships, 104 Wesbrook Hall, University of Minnesota, Minneapolis, Minnesota 55455.

If a student wishes assistance in planning his finances during residence in the Graduate School and in working out a program of part-time employment and supplementary financial aid, the counselors in the bureau will be glad to help by personal interview or by correspondence.

Graduate students may be eligible for loan assistance under the National Defense Student Loan Program; inquiries concerning this program should be directed to the Bureau of Student Loans and Scholarships.

Services for Students from Abroad

Counseling and advisory services are provided for students from other countries by the adviser to foreign students. Assistance is given in meeting English language requirements; orientation to federal, state, and local regulations; and other problems, educational, social, and financial in nature. All foreign students are invited to address inquiries concerning these matters to the Office of Adviser to Foreign Students, 717 East River Road, University of Minnesota, Minneapolis, Minnesota 55455.

Placement of Graduate Students

Aid and counsel to graduate students who wish college, university, or other positions may be had from advisers and departments, the dean of the Graduate

School, and the deans of various colleges of the University and through the *Bureau of Recommendations,* which receives reports of vacancies for college teaching in all fields as well as in counseling, administration, and research. For further information, students may address the Director, Bureau of Recommendations, 102 Burton Hall, University of Minnesota, Minneapolis, Minnesota 55455.

HOUSING FACILITIES

Most out-of-town students live either in University-maintained residence halls, in private housing, or in fraternities or sororities. Student residences are inspected regularly to assure safe and healthful quarters as well as good study conditions.

Information concerning residence halls may be obtained from the Director of Housing, 100 Wesbrook Hall, University of Minnesota, Minneapolis, Minnesota 55455. This information as well as information about private housing and fraternities or sororities may also be obtained from the Student Housing Bureau, 209 Eddy Hall, Minneapolis, Minnesota 55455, or 101 Coffey Hall, St. Paul, Minnesota 55101.

University Residence Halls—Living in a residence hall has many advantages** for the student. The halls, located close to class buildings and to the student unions, offer comfortable living with well-planned, healthful meals, served under the direction of a trained dietitian. Opportunities for counseling, health supervision, student government, social and athletic programs are provided. All residence halls are modern, fireproof brick buildings, constructed in accordance with the highest safety standards. The 1966-67 rates for board and room will be $265 to $320 per quarter, payable in monthly installments.

Application should be made early for accommodations in University residence halls. *Final acceptance by the University is not necessary before applying.* Cancellation may be made with a $10 penalty if the residence hall is notified by July 1. Cancellation after July 1 involves forfeit of the entire $25 deposit.

Minneapolis Campus—*Sanford Hall,* accommodating 510 women, is located on University Avenue S.E. near the northwest entrance to the campus.

Comstock Hall accommodates 540 women in large double and single rooms (no double-deck beds). It is situated along the Mississippi River close to the center of University life.

Pioneer Court accommodates 271 women. It is located on the southern edge of the campus near the East River Road.

Pioneer, Centennial, Territorial, and *Frontier Halls* for men are located in a quadrangle on the southern edge of the campus near the East River Road. These halls accommodate 2,360 men. Special areas for graduate students are available. Many residents can earn part of their board and room by work in

** For information about residence counselorships in these units, see page 31.

the halls. For additional information, contact the Director of Housing, 100 Wesbrook Hall, University of Minnesota, Minneapolis, Minnesota 55455.

St. Paul Campus—*Bailey Hall* is a new attractive residence hall with a wing for 156 men and another wing for 152 women in double rooms. Meals for residents of this hall are served in the new cafeteria connected by tunnel.

Other accommodations may be available in *Brewster, Meredith, Dexter,* and *North Halls.*

University Housing for Married Students—*Commonwealth Terrace,* new permanent apartments for married students located on the St. Paul Campus, provides housing for 362 families in 1- and 2-bedroom units. Present rates are $70 and $80 per month unfurnished except for stove and refrigerator, including utilities. Priority is given to Minnesota residents with children.

Thatcher Hall, for married graduate students only, is located at the edge of the St. Paul Campus. The building contains efficiency and one-bedroom apartments at $62.50 and $70 per month furnished.

The demand for family housing is great, and an early application is advisable. Applications for any of the locations should be sent to Married Student Housing Office, 1295 Gibbs Ave., St. Paul, Minnesota 55108.

Off-Campus Housing—Rooms or apartments in privately operated residences** must be engaged "on the spot"—no reservations can be made before arrival on campus. Lists of vacancies in approved places of residence may be obtained from the Student Housing Bureau. Single students under 21 years of age must have approval of the Student Housing Bureau to live in an apartment. Vacancies in reasonably priced apartments or housekeeping facilities for married students are limited, but the Student Housing Bureau assists students in locating such units. For additional information regarding off-campus housing facilities, write to the Student Housing Bureau, 209 Eddy Hall, University of Minnesota, Minneapolis, Minnesota 55455.

AIR FORCE ROTC PROGRAM

Students in the Graduate School may pursue the Two-year Air Force ROTC program. To be eligible, applicants must have 6 quarters of academic work remaining, after successful completion of a required 6-week summer encampment. Students successfully completing the entire program earn their Commissions in 2 years. Applications are accepted each Winter quarter. No graduate credit may be earned.

** For information about residence counselorships in these units, see page 31.

Fields of Instruction

Symbols and Explanations

A course sequence separated by hyphens (121-122-123) must be taken *in the order listed* unless it is specifically stated that a student may enter any quarter.

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

A prerequisite reading "5 cr" means 5 credits earned in courses offered by the same department as that offering the course being described.

Symbols—The following symbols are used throughout this bulletin and will carry no page footnotes:

* Courses through which it is possible for graduate students to prepare Plan B papers.

† To receive credit, all courses listed before dagger must be completed.

§ No credit is given if credit has been received for equivalent course listed after section mark.

¶ Means "concurrent registration in."

♯ A sharp sign means "consent of instructor."

△ A triangle means "consent of the division, department, or school offering course."

x After a course number, means "course is offered more than 1 quarter."

f,w,s,su Following a course number indicate fall, winter, spring, or summer quarters.

Courses numbered from 100 to 199, which are taught by members of the graduate faculty, are open to both graduate and undergraduate students except in the School of Dentistry and a few departments of the Medical School. Those numbered 200 or above are for graduate students only.

Students should consult the *Class Schedule* for each quarter and special college and departmental statements to learn the hour and place of specific courses.

AERONAUTICAL ENGINEERING

Professor

Abraham S. Berman
Lawrence E. Goodman
Helmut G. Heinrich
William C. Meecham
Robert Plunkett
Patarasp R. Sethna, *chairman*

Associate Professor

Allan A. Blatherwick
Walter T. Graves
Chih-Chun Hsiao
Daniel D. Joseph
Thomas S. Lundgren
Eugene Stolarik
William H. Warner

Assistant Professor

Gordon S. Beavers
Lawrence L. Lee
Theodore A. Wilson

Students who wish to major in this area should consult the chairman of the departmental graduate committee, 107 Aeronautical Engineering Building.

Prerequisites—For major work, adequate preparation in fundamental engineering sciences (mathematics, physics, mechanics, and chemistry) and the general admission requirements. For minor work, course prerequisites govern.

Language Requirement—For Master's degree, none. For the Ph.D. degree, two foreign languages chosen from French, German, Italian, and Russian.

Master's Degree—Offered under both Plan A and Plan B. The Plan B paper requirements may be met in connection with any course accepted for graduate credit, seminar, or independent work under faculty supervision, subject to the prior approval of the student's adviser and of the faculty member supervising the preparation of the paper.

Doctor's Degree—Program to be developed in consultation with adviser.

100A. Kinematics and Dynamics of Fluid Flow. Kinematics of fluid field including continuity equation, vorticity, circulation, velocity potential, source, and doublet. Application of Gauss's and Stokes's theorem to fluid flow. Flow about cylinder. Potential flow in two and three dimensions. Dynamics, Euler's equation, Bernoulli's equation. Aerostatics. (4 cr; prereq Math 33 or ¶Math 33)

101A. Incompressible Boundary Layer Theory. Curvilinear co-ordinate systems, cylindrical and spherical. Viscous incompressible flow. Thin airfoil theory. Stress and strain rate. Navier-Stokes's equation. Boundary layer equation and Blasius solution. Von Karman momentum integral. Pohlhausen method. Turbulent boundary layer. (4 cr; prereq 100A)

102A. Shock Waves and Compressible Fluid Flow. Basic concepts of thermodynamics. One-dimensional steady isentropic flow. Laval nozzle. Normal and oblique shock waves and reflections. Prandtl-Meyer flow. Supersonic thin airfoil theory. (4 cr; prereq 100A)

104. Incompressible Potential Flow. Irrotational incompressible flow in two dimensions by complex variable methods. Airfoil theory. Three-dimensional potential flow by superposition methods. (3 cr; prereq 100A)

106. Aerodynamics of Lifting Surfaces. Thin airfoil theory, finite wing, aspect ratio, planform and lift distribution, polar diagram of airplanes, dimensional analysis and dynamic similarity. (3 cr; prereq 100A or equiv)

107. Performance of Aircraft. Analysis of speed, take off, landing, range, and endurance characteristics of propeller and jet propelled aircraft. Vtol and Stol vehicles. (3 cr; prereq 100A or equiv)

108. Stability and Control of Aerospace Vehicles. Longitudinal stability and control, power effects, lateral stability and maneuvering flight, introduction to dynamic stability, steady state aeroelasticity, tail and aileron efficiency, wing divergence and aileron reversal, longitudinal stability. Rigid and elastic vehicles. (3 cr; prereq 100A or equiv)

109. Performance of Ballistic and Space Vehicles. Equation of motion, control and thrust, burnout velocity of single and multistage missiles, ballistic trajectories with and without drag, simplified vertical, orbital, escape and re-entry trajectories. (3 cr; prereq 100A, MM 36)

110. Compressible Viscous Flow. Navier-Stokes's equation of compressible viscous fluid. Energy equation. Boundary layer equations. Karman-Tsien solution. Momentum and energy relations. Turbulent boundary layer. Shock wave and boundary layer interaction. (3 cr; prereq 102A)

111. Intermediate Inviscid Flow. Theory of two-dimensional line vortices. Application of the theory in aerodynamics, wake phenomena. Introduction to the inviscid theory of gravity and instability waves. (3 cr; prereq Math 174 or Aero 104 or Hydro 188 or ‡)

115. Aerospace Structures I. Aerospace vehicle load factors and structural design. Deformation analysis of multi-cell torsion box structures. Introduction to fuselage stress analysis; moment distribution, energy methods. (3 cr; prereq MM 37)

116. Aerospace Structures II. Pressurized vehicles. Application of matrix methods to deformation analysis of aerospace structures. Minimum weight design. (3 cr; prereq 115)

130. Design Methods for Aerospace Systems. Organization of engineering design efforts, establishment and application of criteria for judging designs. Parametric, feasibility, and systems studies. (3 cr; prereq ‡)

131. Aerospace Systems Design. Preliminary design synthesis of a selected system. Planning and scheduling. (4 cr; prereq 130 and ‡)

144. Aeromechanics Laboratory I. Basic experimental techniques of solid and fluid mechanics. Fundamental methods of measurement. Introduction to the properties of solids and fluids. Simple experiments involving the principles of solid and fluid mechanics. Introduction to error analysis, with simple applications. (3 cr, §MM 142; prereq 100A, MM 37)

145-146-147. Aeromechanics Laboratory II-III-IV. Experiments in fluid and solid mechanics. Static and dynamic pressure, forces on wind tunnel models, shock wave patterns. Model analysis. Boundary layer measurements, lift and drag determination, flow visualization. Rheological and strength properties of materials and structures. Verification of equations of solid and fluid mechanics. Use of computers. (2 cr per qtr; prereq 144, ¶Engl 85A-B-C)

148. Experimental Supersonics and Hypersonics. Wind tunnel techniques and instrumentation. Flow and model studies. (3 cr; prereq 147)

150. Aeroelasticity I. Static aeroelastic phenomena, closed form and approximate solutions for torsional divergence and aileron reversal. Simple harmonic and arbitrary motion for irrotational incompressible and compressible flow. The gust and flutter problems. (3 cr; prereq 102A and MM 193)

159. Aerodynamic Deceleration I. Aerodynamics of subsonic and supersonic retardation devices. Wake and interference effects. Trajectory calculations, re-entry problems and recovery systems. (3 cr; prereq 100A, MM 36)

160. Aerodynamic Deceleration II. Review of opening shock theories; mass balance method. Stress analysis, dynamic stability, wake analysis, air resistance of two-body systems, re-entry trajectories. (3 cr; prereq 159)

170. Turbulence and Atmospheric Fluid Dynamics I. Molecular agitation and turbulence. Introduction to the statistical theory of turbulence. Eulerian and Lagrangian correlations. Spectral distribution of turbulent energy. Karman-Howarth equation. (3 cr; prereq 100A)

174. Statistical Processes in Biology. Review of thermodynamics. Introduction of the Boltzmann-Ehrenfest model. Analysis of dynamics of the model with application to development and maintenance of structure in biological systems. (3 cr; prereq ME 30A or equiv)

175. Random Processes. Probability densities, averages, correlations, power spectra; interrelations. White noise, Gaussian processes. Random walk problems. Wiener-Hermite functionals for nonlinear processes. Examples for discrete systems and fluid systems. (3 cr; prereq Math 149 or equiv or ‡)

177. Introduction to Acoustic Propagation. Derivation of acoustic equations. General properties of propagating fields. Sound problems in the ocean and the atmosphere. (3 cr; prereq Math 147 or ‡)

180. Introduction to Astrodynamics. Co-ordinate systems and dynamical equations of celestial mechanics; orbit determination for artificial satellites, perturbation theory; special topics. (3 cr; prereq MM 36)

183. One-Dimensional Gas Dynamics. Properties of normal shocks. Flows through nozzles. One-dimensional channel flow with friction and energy addition. Continuous unsteady one-dimensional flows of perfect fluids. Flows in wind tunnels and diffusers. Shock tube flows. (3 cr; prereq 102A)

184. Introduction to Hypersonic Flows. Two-dimensional flow by method of weak waves. Characteristic nets. General hypersonic flow theory. Hypersonic flows past slender bodies with sharp leading edges. Effects of slight leading edge blunting. Two-dimensional supersonic airfoil theory. Resistance and drag. Similarity laws for flows past slender bodies. (3 cr; prereq 102A)

185. Rarefied Gas Dynamics. Elements of kinetic theory. Velocity distribution function. Surface interactions. Free molecular flow. Slip flow. Application to low density aerodynamics. (3 cr; prereq 102A or ‡) Lundgren

190. Introduction to Magnetohydrodynamics. Fundamental equations and concepts of magnetohydrodynamics. Transport of magnetic field; magnetohydrodynamic channel flow. Alfven waves. (3 cr; prereq 102A, Math 147 or ‡)

193, 194, 195. Problems in Fluid Mechanics. Investigation of analytical and experimental problems approved by faculty member. (0-3 cr; prereq ‡; faculty sponsor required before regis)

201. Foundations of Fluid Mechanics. Kinematics of deformable media. Thermodynamics of compressible fluids. Derivation of integral and differential forms of the conservation laws. Entropy production. Linear laws. Perfect fluids. Vorticity theorems. (3 cr; prereq 102A and ¶Math 149 or ‡) Joseph, Lundgren, Meecham

202. Finite Waves in Compressible Fluids. Shocks, expansion waves. Shock polar diagram. Method of characteristics in one-dimensional unsteady flow and two-dimensional steady flow. (3 cr; prereq 201 or ‡) Joseph, Lundgren, Meecham

203. Linearized Compressible Flow. Acoustic equations. Wave propagation. Superposition of source solutions. Subsonic and supersonic sources. Finite thin wing theory. (3 cr; prereq 201 or ‡) Joseph, Lundgren, Meecham

205. Incompressible Boundary Layer Theory. Review of basic equations. Blasius solution for flat plate; boundary layer on blunt bodies, strips. Jet from slit and circular orifice. (3 cr; prereq Math 149, ¶201 or equiv or ‡) Meecham, Lundgren

206. Compressible Boundary Layer Theory. Viscosity dependence on temperature. Boundary layer assumptions for compressible flow. Solutions for Prandtl number equal one; isothermal and adiabatic flat plate. Convective flow. Compressible effects. (3 cr; prereq Math 149, ¶201 or equiv or ‡) Meecham, Lundgren

207. Instability of Flow of Viscous Fluids. The stability of parallel flow and flow over curved surfaces discussed and applied to boundary layers. Demonstration of use of boundary layer (singular perturbation) techniques to determine stability characteristics of general parallel flows. Stability characteristics of various viscous flows are classified and physical mechanisms which lead to instability discussed. (3 cr; prereq 201 or ‡) Joseph

208. Nonlinear Theories of Hydrodynamic Stability. Methods of energy, modal evolution, and parametric expansions applied to problems of stability of hydrodynamic systems to finite amplitude disturbances. Application to thermoconvective systems. (3 cr; prereq 207 or ‡) Joseph

216. Theory of Turbulence. Correlation tensors. Karman-Howarth equations. Major theories of turbulence: Heisenberg, Chandrasekhar, Kolmogoroff; similarity results. (3 cr; prereq 175, Math 149 or equiv or ‡) Meecham

217. Applications of Turbulence Theory. Magnetofluiddynamic turbulence, characteristics of correlations. Lighthill theory of sound and turbulence. Turbulence-produced sound; sound scattered by turbulence. Turbulent boundary layer noise. (3 cr; prereq 216 or equiv or ‡) Meecham

230-231-232. Transonic and Hypersonic Flow. Transonic similarity rules. Curved shocks, ionization effects, chemical reaction. (3 cr per qtr; prereq 203 and Math 173-174-175 or ¶Math 173-174-175)

240. Perturbation Methods in Fluid Mechanics. The method of matched asymptotic expansions presented through simple examples and applied to viscous flows at high and low Reynolds numbers, lifting wings, hypersonic flow, acoustics, and other problems in fluid mechanics. (3 cr; prereq 202 or ‡)

250-251-252. Magnetofluiddynamics. (3 cr per qtr; prereq 203 or Phys 104 or Math 234 or ‡)

297, 298, 299. Seminar: Fluid Mechanics. (0-1 cr per qtr)

AGRICULTURAL ECONOMICS

Professor

Sherwood O. Berg
John Blackmore
Marguerite C. Burk
Willard W. Cochrane
Reynold P. Dahl
Selmer A. Engene, *director of graduate study*
Darrel F. Fienup
Clifford C. Hildreth
Harald R. Jensen
E. Fred Koller
Elmer W. Learn
Truman R. Nodland
Philip M. Raup
Vernon W. Ruttan, *head*
Raymond D. Vlasin

Associate Professor
W. Keith Bryant
Francis J. Smith, Jr.
Arley D. Waldo

Assistant Professor
Dale C. Dahl
James P. Houck, Jr.

Prerequisites—For major work, 18 quarter credits in courses acceptable to the student's adviser. Further courses may be required if the adviser thinks necessary. For minor work, 9 quarter credits.

Major and Minor—The thesis may be in any subfield of agricultural economics (marketing, farm management, economics of agricultural production, agricultural prices, agricultural policy, farm finance, and economics). Candidates will be expected to take work in different subfields, the program depending upon the subfield of specialization. With the approval of the adviser, certain courses in general economics and business administration may be accepted as major work. The minor may be in general economics.

Language Requirement—For the Master's degree, none. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge. Routinely acceptable are French and German.

Master's Degree—Offered under both Plan A and Plan B.

Doctor's Degree—Work leading to the Ph.D. degree is offered.

Note—For courses in general economics and business administration, see the sections on business administration and economics.

101. Statistical Methods for Social Sciences. Extension of Biom 100 with emphasis on application of statistical methods to research in social sciences; multiple regression and correlation, analysis of variance and covariance, index numbers, elementary sampling procedures. (4 cr; prereq Biom 100 or equiv) Bryant

108.* Agricultural Policy. Economic problems and issues in American agriculture, including organization of the agricultural industry, tenancy, farm incomes, standards of living, taxation, and foreign agricultural programs; policies adopted by governmental, agricultural, and other agencies toward such problems. (3 cr) Waldo

109. Agribusiness. Character, extent, and economic implications of existing interrelationships between agriculture and industries which supply agriculture and which process and distribute products of agriculture. (3 cr; offered when demand warrants)

110. Economics of Agricultural Production. Principles of production economics applied to agriculture; profitable combinations of factors of production, comparative advantage, and localization of production. (3 cr; prereq 3 or 82) Engene

126.* Economics of Consumption. Factors determining consumption patterns of individuals and families; comparison and integration of contributions of economics and other social sciences in study of consumer behavior; use of consumer surveys in market studies. (3 cr; prereq 2 or ‡) Burk

127.* Economics of Food Consumption and Distribution. Trends in U.S. and foreign consumption of food by areas and population groups; market research procedures; concepts and framework for analysis of consumption and distribution problems for agriculture, food industries, and the public. (3 cr; prereq 2 or ‡) Burk

131. Market Prices. Nature of demand for farm products; supply considerations; price formulation and structure of markets; price variation and instability; dynamic analysis. (3 cr; prereq 30, Econ 65)

135. Problems in Land Resource Use. Land as a factor of production; rural and urban utilization; rents and land values; land classification; taxation; land exchange; manage-

ment of public land. (3 cr; prereq 110 or ‡; offered when demand warrants) Raup, Vlasin

140. Grain Marketing. (3 cr; prereq 40) R Dahl

141. Dairy Marketing. (3 cr; prereq 40) Koller

142. Fruit and Vegetable Marketing. (2 cr; prereq 40) R Dahl

143. Livestock and Poultry Marketing. (3 cr; prereq 40)

144.* Co-operative Organization. Development of co-operation in agriculture in United States and foreign countries. Analysis of economic problems peculiar to co-operative organization, especially of marketing agencies. (3 cr; prereq 40; offered 1966-67 and alt years) Koller

147.* Marketing Accounting. Interpretations of accounts, statement preparation, and analysis. Accounting methods and statements of agricultural marketing organizations including co-operative associations. Utilization of accounting data and statements by management. (4 cr; prereq 25 or equiv; offered 1967-68 and alt yrs) Koller

150.* Advanced Farm Finance. (3 cr; prereq 50 or equiv) R Dahl

170.* Land Economics. (3 cr; prereq 110 or ‡) Raup

172. Economics of World Agriculture. Distribution, quality, and utilization of agricultural resources; variations in population densities and characteristics; agricultural organization and structure; comparative advantage and the location of agricultural activity; national and international policies relating to agriculture; future trends and prospects. (3 cr) Raup

175. Agricultural Trade and Commercial Policy. Patterns of trade in agricultural products; trade policies and practices of export and import nations with respect to agricultural products; commodity agreements; agricultural trade policies of common market areas; potential trade developments. (3 cr; prereq Econ 65 and 66) Houck

180. Farm Accounting. Course 80 plus a special problem. (3 cr; prereq ‡) Nodland

183. Advanced Farm Planning. Special problems. (3 cr; prereq ‡) Engene

200, 201, 202.* General Seminar: Agricultural Economics. Special seminars or individual work may be arranged on subjects suited to the needs of particular groups of students. (Cr ar; offered when demand warrants) Ruttan and staff

208.* Seminar: Agricultural Price and Income Policies. What is policy; how is policy formulated and executed; relation of policy to modern thought; a critical review of past farm price and income policies, and analyses and appraisal of specific current price and income policies and policy proposals. (3 cr) Cochrane, Ruttan

211.* Economics of Agricultural Production II. Theories of choice under conditions of imperfect knowledge, i.e., under risk and uncertainty. Application of these theories to decisions in agricultural production. (3 cr; prereq Econ 165, AgEc 110 or ‡) Jensen

221.* Farm Management Research Methods. Factors shaping their evolution. (3 cr) Jensen

226.* Seminar: Farm Management. Intensive analysis of current problems. (3 cr) Jensen, Engene

235.* Methods of Price Analysis. Application of economic theory and statistical techniques to agricultural price and market research. (3 cr; prereq 101 and 131 or ‡) Bryant

240. Seminar in Law and Agricultural Marketing. Topic will be announced. Topics are drawn from government regulation, business organization, and trade practices of the food and fiber economy. (3 cr; prereq law or grad student)

241.* Seminar: Marketing. (3 cr; offered when demand warrants)

244.* Seminar: Co-operative Marketing. (3 cr; offered when demand warrants) Koller

246.* Seminar: Economics of Consumption. (3 cr; offered when demand warrants) Burk

270.* Seminar: Land Tenure. (3 cr; offered when demand warrants) Raup

278. Seminar: Agricultural and Economic Development. Theory and practice of agriculture in economic development. (3 cr; prereq 172 or Econ 103) Cochrane, Ruttan

AGRICULTURAL ENGINEERING**

Professor
Evan R. Allred
Landis L. Boyd, *head, director of graduate study*
Arnold M. Flikke
Andrew Hustrulid
Curtis L. Larson
Philip W. Manson
John Strait

Associate Professor
W. Forrest Bear
Jesse H. Pomroy
Arnold K. Solstad

Assistant Professor
M. Ray Smith

Research Fellow
Lee F. Hermsmeier

Prerequisites—For major work, adequate preparation in undergraduate subjects and in the sciences fundamental to agricultural engineering in addition to the general admission requirements. For minor work, the prerequisites to the courses to be taken and approval of the department faculty.

Major and Minor—With the approval of the adviser, courses in other fields of engineering, the physical sciences, the biological sciences, or agricultural sciences may be included in the major. For the Ph.D., the minor must be taken outside of the field of agricultural engineering. However, a supporting program of study may replace the minor.

Language Requirement—For the M.S. degree, none. For the Ph.D. degree, reading knowledge of two languages (French, German, and Russian are acceptable). Students may petition the department faculty to use another language or to substitute a research technique or collateral field of knowledge for one of the languages.

Master's Degree—Offered primarily under Plan A, but also under Plan B, if approved in advance by the department faculty. If Plan B is approved, the candidate is required to complete 45 quarter credits of course work and three written reports of the same quality but not the extent of the Master's thesis. These reports may be prepared as an additional requirement in advanced courses and seminars, or in courses which permit independent effort under faculty guidance and involve 9 credits.

Doctor's Degree—Work leading to the Ph.D. degree is offered. The general requirements of the University as listed previously in this bulletin apply.

Agricultural Engineering

Graduate Credit for Minors Only

141. Design of Agricultural Machinery. Operating principles and problems. (3 cr; prereq 91) Strait

144. Advanced Drainage and Irrigation. Evapotranspiration requirements; pump design and selection for drainage and irrigation; water quality; hydraulic design and construction of irrigation and drainage systems. (3 cr; prereq 124) Allred

147. Agricultural Structures and Animal Environment. Design of structural members and assemblies for farm structures and related equipment. Wind resistant design and fabri-

** Professional degrees in engineering are administered by the Institute of Technology.

cation. Environmental requirements of farm animals and control of environment in animal shelters. Cost estimating. (3 cr; prereq 97, 127, ME 160A)

Graduate Credit for Either Majors or Minors

160. Agricultural Engineering Instrumentation. Application of basic electrical instruments to measurement and control of temperature, relative humidity, air flow, and radiation. Dynamic response of instruments and control circuits. Physical measurements relating to soils and crops. Statistics of random errors. (3 cr; prereq EE 30A, Math 32, Phys 50) Hustrulid

161. Agriculture Machine Analysis—Advanced Design Problems. Application of principles of dynamics to design of agricultural machinery. Experimental measurement of working forces and stress. Motion analysis. (3 cr; prereq 141, MM 142) Smith

164. Advanced Soil and Water Engineering. Hydraulic design of erosion control structures: drop spillways, chutes, conduit spillways, combination with grass spillways. Benefits versus costs. Field surveys and layouts for irrigation, drainage, and erosion control. Runoff measurements. (4 cr; prereq 144, CE 61) Larson

165. Flood Control—Small Watersheds. Flood control by detention reservoirs, channel improvement. Combining detention and storage. Design principles. Evaluation of benefits and costs. Flood forecasting, zoning. Land treatment effects. Sediment yield and control. (2 cr; prereq ¶164, CE 161) Larson

167. Advanced Agricultural Structures. Design of livestock and crop production units. (3 cr; prereq 147, CE 81)

180. Radioisotope Measurements. Properties of nuclear radiation. Geiger-Muller, proportional, and scintillation detectors. Gamma ray spectrometry. Statistics of nuclear radiation measurement. Applications of radioisotope measurement in agricultural engineering. (3 cr; prereq Phys 50, Math 32) Hustrulid

181.* Problems in Agricultural Engineering: Power and Machinery. (2-4 cr; prereq ‡) Smith, Strait, Boyd

184.* Problems in Agricultural Engineering: Soil and Water. (2-4 cr; prereq ‡) Allred, Larson, Manson

187.* Problems in Agricultural Engineering: Structures and Processing. (2-4 cr; prereq ‡) Flikke, Hustrulid, Boyd

200. Seminar. Reports on current topics arnd department research. (1 cr; prereq ‡) Staff

211-212-213. Advanced Problems and Research. Research problems in agricultural engineering. (2-6 cr per qtr; prereq 181 or 184 or 187 or △) Staff

230.* Agricultural Engineering Similitude. Use of dimensional analysis to develop general equations to define phenomena. Principles of similitude. Introduction to analog methods. (3 cr; prereq Math 148 or 150) Boyd

254. Advanced Hydrology—Small Watersheds. Appraisal of techniques for estimating runoff volume and peak discharges for ungauged watersheds. Hydrograph synthesis. Composite hydrographs. Mathematical modeling of the runoff process. Frequency relationships of rainfall and runoff. (3 cr; prereq CE 161) Larson

257. Moisture and Heat Transfer. Mathematical study of the transfer of moisture and heat in agricultural crops and soils. (3 cr; prereq 127, Math 33, ME 160A) Hustrulid

Mechanized Agriculture

Graduate Credit for Non-Engineering Minors Only

114.* Special Problems in Farm Buildings. Problems based on work given in the prerequisite courses. (2-4 cr; prereq 3, 7, and 14) Flikke, Pomroy

115.* Drainage and Irrigation. Moisture deficiencies, excesses. Theory and design of tile drainage, surface drainage, and irrigation systems in humid areas. Economic feasi-

bility. Legal problems and procedures. Irrigation water supply. (3 cr; prereq 84) Allred

124.* Agricultural Machinery and Mechanical Power Management. Machinery and power management and use, and its cost as a factor in agricultural production. Lectures and special problems. (3 cr; prereq 9 cr in mechanized agriculture, incl 12) Strait, Smith

127.* Principles of Radioisotope Measurements. Theory and technique of radioisotope measurements including atomic and nuclear structure; properties of alpha, beta, and gamma rays; interaction of radiation with matter. Geiger-Muller proportional and scintillation counters. (3 cr; prereq 1 yr physics, Math T) Hustrulid

130. Instructional Methods in Farm Mechanics. Planning high school farm shops including building layouts, equipment organization, tool and supply selection, and storage methods. Administering farm mechanics programs, demonstrations, job records, and farm mechanics problems relating to the student's farming program. (3 cr; prereq 10 cr in mechanized agriculture, AgEd 91 or ¶AgEd 91) Bear, Solstad

131.* Problems and Field Studies in Advanced Farm Mechanics. Principles and practices pertaining to the implementation of instructional program in farm mechanics. (3 cr per qtr, max 9 cr; prereq 130) Bear, Solstad

134.* Soil and Water Engineering Design Procedures. Erosion control and water control structures. Field layout and studies of terraces, grass waterways, tile and surface drains, irrigation systems. (3 cr; prereq 42 or ♯, 115) Larson

174.* Problems in Soil and Water Management. Individual problems in engineering phases of soil and water management, based on work given in prerequisite courses. (2-4 cr; prereq 84, 115, 134) Allred, Larson, Manson

AGRONOMY AND PLANT GENETICS

Professor
Richard Behrens
Charles R. Burnham
Herbert W. Johnson, *head, director of graduate study*
Jean W. Lambert
Donald C. Rasmusson

Associate Professor
Robert N. Andersen
Verne E. Comstock
Laddie J. Elling
Roger A. Kleese
Gordon C. Marten
Robert G. Robinson
Alois R. Schmid
James C. Sentz
Lawrence H. Smith
Horace L. Thomas

Assistant Professor
William A. Brun
William A. Compton
Robert F. Heiner
Robert E. Stucker

Research Associate
Richard L. Cooper

Prerequisites—Sufficient credits in plant sciences must be presented to satisfy the adviser. Further courses may be required without credit at the option of the adviser.

Major and Minor—With the approval of the adviser, courses in biochemistry, botany, genetics, horticultural science, plant pathology, plant physiology, soil science, and other biological sciences may be accepted as major work. For the Ph.D. degree the student may substitute, with approval of his adviser and the appropriate group committee, a supporting program of study for the minor requirement. A minor is required for the Plan A Master's degree.

Attention of students also is directed to the field of genetics.

Language Requirement—Reading knowledge of one foreign language is advised although not required for the Master's degree. For the Ph.D. degree the requirement may be fulfilled by (a) two foreign languages or (b) one for-

eign language and the option of a special research technique or a collateral field of knowledge.

Master's Degree—Offered under both Plan A and Plan B in agronomy and genetics.

Doctor's Degree—Work leading to the Ph.D. degree is offered in agronomy and genetics.

Agronomy

121w. Grain and Oil-Seed Crops. (Same as 21) Graduate students must carry out a special problem. (4 cr; prereq 1 or ‡) Robinson

122s. Crop Grading and Identification. (Same as 22) Graduate students must do special work. (3 cr; prereq 1 or ‡) Elling

127f. Forage Crops. (Same as 27) Graduate students required to write term paper in addition to regular requirements. (4 cr; prereq 1 or ‡) Schmid

134s. Advanced Forage Crops. Principles of hay and pasture management, preservation and utilization, factors affecting nutritive value, forage mixtures, forage crops of other areas of the world. Lectures, laboratory, and field trips. (4 cr; prereq 27 or ‡) Schmid

135f. Weed Control. Survey of research and regulatory aspects of weed control. Kinds and extent of losses due to weeds. Outline of principles of cultural and chemical weed control. Specific weed control practices in agricultural production. (3 cr; prereq 1 or ‡) Behrens

201f,w,s,su.* Research in Farm Crops. Problems in physiology, production, and classification of crop plants. (Cr ar; prereq 121, 127) Staff

202f,w.* Seminar: Farm Crops. Reviews and discussions of important agronomic literature. (1 cr per qtr; prereq 9 cr in farm crops) Staff

204w. Pasture and Forage Research Techniques. Potentialities and limitations of grazing trials including the animal-plant complex and experimental designs; *in vivo* and laboratory methods for determining forage quality; determination of herbage yield and botanical composition. (3 cr; prereq Biom 100 or equiv, Agro 127 or ‡; offered 1966-67 and alt yrs) Marten

248w. Applied Statistics. Design of experiments and application of statistical methods to analysis of biological data, particularly with small samples. (3 cr; prereq Biom 100 or PubH 110) Thomas

251f,w. Special Problems in Application of Statistics. Design of experiments or interpretation of data through consultation with individual students. (Cr ar; prereq Biom 100 or equiv) Thomas

Plant Breeding

132w.* Introduction to Plant Breeding. An introductory course concerned with plant breeding methodology and general principles. (3 cr; prereq Gen 66 or equiv) Staff

233w. Principles of Plant Breeding I. Critical examination of principles involved in breeding self-pollinated crops. Population concepts, sources of genetic variability, selection schemes, host pathogen relationships, and hybrid breeding. (3 cr; prereq Gen 141, Agro 132 or equiv) Rasmusson

234s. Principles of Plant Breeding II. Critical examination of principles involved in breeding cross-pollinated crops. Population concepts, alternative selection schemes, heterosis and combining ability. (3 cr; prereq Agro 233 or ‡) Kleese

241f,w,s. Research in Plant Genetics. May be taken as major or minor work. (Cr ar) Staff

242f,w. Seminar: Plant Breeding. (1 cr per qtr) Staff

244f,su.* Laboratory Methods in Plant Breeding. Field study of plant breeding programs and techniques. (1 cr; prereq Agro 132 or ‡) Lambert

245s. Current Topics in Plant Breeding. (2 cr; prereq Agro 234 or ‡) Rasmusson

252w. Cytogenetics. Cytogenetic behavior of chromosomal changes. Experimental methods and possible applications. (4 cr; prereq Bot 118, Gen 140 or ‡) Burnham

253s. Methods in Plant Genetics. Planning and analysis of genetic experiments. Special applications. (2 cr; prereq Gen 140; offered 1966-67 and alt yrs) Burnham

255. Current Topics in Plant Genetics. (2 cr; qtr ar; prereq Gen 140 or ‡) Kleese

262w. Population and Quantitative Genetics II. (Same as Gen 262) Selection with reference to population changes in quantitative characters. Information required for predicting effects of selection and related research. (3 cr; prereq Gen 260, Biom 181 or equiv) Comstock

263s. Application of Quantitative Genetics to Plant Breeding. Use of population and quantitative genetic principles in decision making in plant breeding. (3 cr; prereq Agro 234 and 262) Staff

AMERICAN STUDIES

Professor

Robert H. Beck
Bernard R. Bowron, Jr., *chairman*
Clarke A. Chambers
David Cooperman
Charles H. Foster
George Hage
Joseph J. Kwiat
Jacob C. Levenson
David W. Noble
Johannes Riedel
Arnold M. Rose
Mulford Q. Sibley
Timothy L. Smith
Francis J. Sorauf
Robert F. Spencer
Gregory Stone
Donald R. Torbert
Dimitri T. Tselos

Associate Professor

Robert Berkhofer
Hyman Berman
Paul L. Murphy
Darrett B. Rutman
Mary C. Turpie

The Program in American Studies is not a department but an interdepartmental degree program. Consequently, the graduate faculty members of all the participating departments actually constitute the graduate faculty of American Studies.

The administrative officers of the American Studies graduate program are Bernard Bowron, chairman, and Mary Turpie, assistant chairman.

Prerequisites—An undergraduate major in one of the participating departments (history, English, philosophy, art, music, anthropology, economics, education, journalism, political science, sociology), or a major in American Studies, or other preparation acceptable to the Committee on American Studies.

American Studies as a Minor—Consult the chairman.

Language Requirement—For the Master's degree, reading knowledge of one foreign language. For the Ph.D. degree, reading knowledge of two foreign languages.

Master's Degree—Only under Plan B; 45 hours of American subjects are required, distributed in four areas: (a) history, (b) literature, (c) philosophy and fine arts, (d) social sciences. All candidates must include AmSt 200-201-202 in their program and must pass a written and an oral examination in American Studies.

Doctor's Degree—Candidates for the Doctor's degree enroll in courses on aspects of American civilization distributed in the four areas named above and in the fifth area of foreign civilization. All candidates must include AmSt 210

and 211-212-213 in their program, write an interdepartmental dissertation, and pass a series of written examinations, the preliminary oral examination, and the final oral examination.

For further details see the bulletin of the *Program in American Studies.*

200-201-202. Introduction to American Studies. Exposition of interdisciplinary methods and of the concept of American Studies; reading of classics in American civilization; extended exploration of a topic. (3 cr per qtr; prereq MA candidate) Turpie, Sibley, Kwiat

210. Seminar: Introduction to American Studies. (3 cr; prereq PhD candidate) Turpie

211-212-213. Seminar: American Studies. Problems and methods in the study of American culture. (3 cr per qtr; prereq PhD candidate) Levenson, Noble

240-241-242. Materials for the Study of American Civilization. (3 cr per qtr; prereq advanced degree candidates in American Studies or ‡) Turpie

250, 251, 252. Readings in American Civilization. Independent study of interdisciplinary aspects of American civilization under guidance of members of various departments. (Cr ar; prereq consent of program chairman) Bowron and staff

Note—For approved American courses in history, literature, philosophy, and other departments concerned, see the annually revised course list available in the American Studies office.

ANATOMY

Professor
Anna-Mary Carpenter, Ph.D., M.D.
William J. L. Felts, Ph.D.
Arnold Lazarow, M.D., Ph.D., *head*
R. Dorothy Sundberg, Ph.D., M.D.
Lemen J. Wells, Ph.D.

Associate Professor
Padmakar K. Dixit, Ph.D.
Carl B. Heggestad, M.D., Ph.D.
Morris Smithberg, Ph.D., *co-ordinator of graduate study*
Richard L. Wood, Ph.D.

Assistant Professor
W. G. Eric Bauer, Ph.D.
Arnold W. Lindall, M.D., Ph.D.
Leonard R. Murrell, Ph.D.

Lecturer
Robert J. Isaacson, D.D.S., Ph.D.
Richard Stallard, D.D.S., Ph.D.

Prerequisites—Prerequisite work for all majors or minors in the field of anatomy includes general zoology, 9 credits.

Major and Minor, for the Ph.D.—Each major in anatomy must have had or must take the basic courses in anatomy—embryology, gross anatomy, histology, and human neuroanatomy. For majors in anatomy (hematology), 165 and 166 are required. Majors in clinical subjects who desire a minor in anatomy must have had as prerequisites the courses in anatomy usually required of medical students (including 100-101, 103, 104, 107, and 111).

Language Requirement—For the Master's degree, reading knowledge of one foreign language—French, German, Italian, Spanish, or Russian. For the Ph.D. degree, either (a) two foreign languages (preferred) or (b) one foreign language and the option of a collateral field of knowledge. When two languages are offered, any combination of the languages listed above may be approved.

Master's Degree—Offered only under Plan A. (Consult department head.)

Doctor's Degree—The department provides excellent facilities for work in anatomy leading to the Ph.D. degree.

100f-101w.† Gross Human Anatomy. Dissection of the human body. (14 cr for both qtrs; prereq ‡; enrollment limited) Heggestad, Lazarow, Smithberg, Wells

103f-104s.† Human Histology. Microscopic structure, cytochemical and functional aspects of cells, tissues, and organs. (7 cr for both qtrs; enrollment limited; prereq ‡) Carpenter, Lazarow, Wood

105f. Microscopic Anatomy. Minute structure of the tissues and organs of the body including the nervous system, emphasis on teeth and digestive tract. (8 cr; prereq 108 and 109) Bauer, Dixit, Stallard

107w. Human Embryology. Development of the human body. (4 cr; enrollment limited; prereq ‡) Heggestad

108w. Gross Anatomy for Dental Students. Lectures and dissection of extremities and abdomen and pelvis. (6 cr; enrollment limited; prereq ‡) Felts, Murrell

109s. Gross Human Anatomy for Dental Students. Lectures and dissection of thorax and head and neck. (6 cr; enrollment limited; prereq ‡) Felts, Murrell

110f. Human Neuroanatomy. Gross and microscopic structure of the central nervous system; emphasis on structure related to function. Laboratory demonstrations include gross anatomy of the brain stem. (3 cr; prereq 105 or ‡) Isaacson, Lindall

111s. Human Neuroanatomy. Structure of the nervous system including the organs of special sense. (5 cr; enrollment limited; prereq 104 or Zool 150, ‡) Lindall, Smithberg

131f. Biological Electron Microscopy. (Cr and hrs ar; prereq ‡; offered 1967-68 and alt yrs) Wood

132. Experimental Study of the Fetus. (Cr and hrs ar; prereq ‡) Wells

140f, 141w, 142s. Skeletal Tissue Biology. Gross and microscopical anatomy of the skeletal tissues, their origin and development. Student presentation of literature in their particular areas of interest. (2 cr per qtr; prereq ‡) Felts

149. Experimental Neuroanatomy. Morphology of the central nervous system as determined by experimental methods. (Cr and hrs ar; prereq ‡)

153, 154, 155, 156. Advanced Anatomy. Cytochemistry, embryology, gross anatomy, hematology, histology, or neurology or experimental morphology. (Cr and hrs ar; prereq ‡) Staff

160s. Introduction to Histological and Morphologic-Histochemical Techniques. Fixation, embedding, and staining of cytological components and enzymes. (2 cr; prereq 104, ‡; offered 1966-67 and alt yrs) Carpenter

161. Experimental Cytochemistry. (Cr and hrs ar; prereq 104, MdBc 101, ‡) Lazarow

165f-166w. Hematology. Blood and blood-forming organs; blood and bone marrow from the standpoint of diagnosis and prognosis. (4 cr per qtr; prereq 103, or Zool 54 or ‡) Sundberg

167s. Seminar: Hematology. (1 cr; prereq 166) Sundberg

201, 202, 203, 204. Research in Anatomy. Cytochemistry, embryology, gross anatomy, histology, hematology, or neurology. Special facilities offered to graduate students in clinical departments for work upon problems in applied anatomy. (Cr and hrs ar; prereq ‡) Bauer, Carpenter, Dixit, Felts, Heggestad, Lazarow, Lindall, Murrell, Smithberg, Sundberg, Wells, Wood

205, 206, 207. Seminar: Anatomy. Reviews of current literature and discussion of research work being carried on in the department. (1 cr per qtr; prereq ‡) Lazarow and staff

211. Neurocytology. Ultrastructure, cytochemistry, and physiology. (3 cr; prereq 11 or ‡; offered winter 1966 and yearly thereafter) Lindall

ANESTHESIOLOGY

For staff and courses of study offered, see the ***Bulletin** of Graduate Programs in Medicine, Dentistry, and Pharmacy.*

ANIMAL SCIENCE

Professor

Clarence L. Cole, *head*
Ralph E. Comstock
John D. Donker
Edmund F. Graham, *director of graduate study (dairy husbandry)*
Lester E. Hanson, *director of graduate study (animal husbandry)*
Elton L. Johnson
Robert M. Jordan
Robert J. Meade
William E. Rempel
Robert N. Shoffner, *director of graduate study (poultry science)*
Hubert J. Sloan
Paul E. Waibel
Jesse B. Williams

Associate Professor

Franklin D. Enfield
Eldon G. Hill
Alan G. Hunter
Jay C. Meiske
Richard E. Phillips
David C. Snetsinger
Charles W. Young

Assistant Professor

John C. Forrest
Richard D. Goodrich
David L. Melliere
Donald E. Otterby
John D. Smith

Prerequisites—For major work, a baccalaureate degree in agriculture or biology with emphasis on the animal sciences and with substantial training in chemistry, physics, and mathematics. Deficiencies in previous training must be corrected, usually without credit, before the student becomes a candidate for a degree. For minor work the student must satisfy the department graduate faculty that he has an adequate background.

Major—Students doing major work for the Doctor's degree may emphasize breeding, genetics, meats, nutrition, or physiology. With the approval of the adviser, graduate courses in several subject matter disciplines may be approved for major work.

Minor—The minor area of work is taken in a field logically related to the student's major interest and, in addition to approval by his adviser, must meet the requirements established by the department offering the minor work. With the approval of his major adviser, the student may substitute a *supporting program* of study for the minor.

Students in this department may obtain degrees in animal husbandry, dairy husbandry, poultry science, in genetics, or in nutrition. See index for requirements in genetics and in nutrition.

Language Requirement—For the Master's degree, none. For the Ph.D. degree, this requirement may be fulfilled by (a) two foreign languages (French, German, Russian, or Spanish) or (b) one foreign language and the option of a special research technique or a collateral field of knowledge. Other appropriate languages may be approved.

Master's Degree—Offered under both Plan A and Plan B.

Doctor's Degree—Work leading to the Ph.D. degree is offered.

Animal Husbandry

107. Meat Technology. Carcass evaluation, processing and quality control of meats and meat products. (3 cr; prereq 30 or ‡) Forrest

160. Animal Breeding II. Systems of breeding and selection as applied to livestock populations. Problems and evidence in animal breeding. (3 cr; prereq 52) Rempel

163. Swine Production. Adaptability, breeding, feeding, care and management of commercial and purebred swine. (3 cr; prereq 37, 52 or ‡; also offered SSI 1966) Meade

164. Sheep Production. Adaptability, breeding, feeding, care and management of commercial and purebred sheep. (3 cr; prereq 37, 52 or ‡; also offered SSI 1968) Jordan

165. Beef Cattle Production. Adaptability, breeding, feeding, care, and management of commercial and purebred beef cattle. (3 cr; prereq 37, 52 or ‡; also offered SSI 1967) Meiske

166. Introduction to Animal Nutrition. Basic concepts of animal nutrition, nature of requirements, functions of various nutrients, nature of deficiencies, and critical evaluation of reports of scientific investigations in the field. (3 cr, §66; prereq 37...BioC 52 recommended or ‡; also offered SSI 1969) Smith

201. Advanced Animal Breeding. Assigned readings and lectures on more recently proposed techniques and their likely application to farm animals. (3 cr; prereq Gen 66, Biom 101) Rempel

205. Quantitative Inheritance. Application of principles in quantitative genetics to improvement of economic species. Selection indexes and choice of breeding systems. (3 cr; prereq Gen 262)

208, 209, 210.* Seminar: Animal Husbandry. Review of literature and discussion of problems in animal breeding, nutrition, management, meats, and related fields. (1 cr per qtr) Hanson

211. Experimental Methods. Theory, plan, and conduct of experimental work in animal sciences. Factors affecting results, sources of error, interpretation of data. (3 cr; prereq Biom 181) Goodrich

213.* Research in Animal Husbandry. Problems assigned to fit needs of student. (3-9 cr per qtr) Staff

222.* Energy in Animal Nutrition. Role; sources and their classification; measurements of energy intake, utilization and loss; expressions of energy value; interrelationships with other nutrients, and fate of energy in intermediary metabolism. (3 cr; prereq BioC 52(152) or equiv, or ‡BioC 143 recommended; offered 1966-67 and alt yrs) Donker

223.* Protein and Amino Acid Nutrition. Role; sources, how determined; measurements of protein quality, fate and use of ingested protein and amino acids and interrelationships with other nutrients. (3 cr; prereq BioC 52(152) or equiv or ‡...BioC 143 recommended; offered 1966-67 and alt yrs) Meade

224.* Vitamin Nutrition. Principles of vitamin nutrition for rats, poultry, swine, cattle, and sheep, including vitamin characteristics, interrelationships and requirements, and deficiency symptoms. (3 cr; prereq BioC 142 or ‡; offered 1967-68 and alt yrs) Waibel

225.* Mineral Nutrition. Principles of mineral nutrition for domestic and laboratory animals; mineral requirements, interrelationships, utilization, and metabolism are stressed. (3 cr; prereq BioC 52(152) or ‡...BioC 142 recommended; offered 1967-68 and alt yrs) Snetsinger

226.* Ruminant Nutrition. Development, physiology, and function of the rumen; role of rumen-microflora in digestion and synthesis and factors influencing these phenomena. (3 cr; prereq BioC 52(152) or ‡...MicB 121, 223 recommended; offered 1966-67 and alt yrs) Meiske

Dairy Husbandry

105. Seminar: Dairy Literature. Selected topics. Dairy literature. Preparation of bibliographies. Each student presents papers and reports on assigned subjects and reviews scientific investigations in dairy husbandry. (2 cr; prereq two courses in dairy husbandry)

120s. Feeding and Management. Status of the dairy industry and current dairy husbandry practices. Feed supplies and nutritive requirements, ration computations, housing requirements, milking techniques and equipment, and means of evaluating dairy cattle for economically important traits. (3 cr; prereq student in veterinary medicine or ‡)

121f.° Physiology of Lactation. Anatomy, physiology, and biochemistry of the mammary gland; hormonal and nervous factors responsible for mammary growth and lactation; physiology of milking process; milk synthesis and factors influencing the lactation curve. (3 cr)

122w. Principles for the Genetic Improvement of Dairy Cattle. Application of basic genetic and biometrical principles to genetic improvement of dairy cattle. Sources of biological variation and their importance; heritability, repeatability, selection and correlations; relationship and inbreeding; evaluation of sires, cows, and systems of mating; expected rates of genetic improvement with and without artificial insemination. (4 cr; prereq Gen 66 or equiv)

123s. Dairy Farm Management. Application of fundamentals of genetics, nutrition, reproduction, lactation, and economics to dairy farm management. Lectures, laboratory exercises, and farm visits. (3 cr)

124w. Dairy Cattle Nutrition. Application of principles of nutrition and economics to feeding dairy cattle. Feeding standards, rumen function, forage utilization and nutritional disorders. (3 cr; prereq AnHu 36)

149. Reproduction and Artificial Insemination. Fundamentals of physiology of reproduction. Includes functions of the reproductive organs, gametogenesis, fertilization, estrous cycle and its endocrine control, sire management, and operational problems of artificial breeding. Lectures and laboratory. (3 cr; enrollment limited to 20) Graham

199x. Special Problems. Research supervised by a senior staff member. Written and oral reports presented before departmental staff. (1-3 cr per qtr [may be repeated]; prereq ‡) Staff

202.° Research in Dairy Production. Study and experimental investigation of problems related to dairy husbandry. (Cr ar; open in summer session only to those who have had prelim grad work)

216. Seminar: Dairy Husbandry. (1 cr) Cole

217f.° Theory and Methodology for Dairy Cattle Inheritance. Gene and genotype frequencies; measurement of selection pressure and response; estimating heritability, repeatability, other genetic and phenotypic parameters; predicting results of various breeding programs applicable to dairy cattle. (3 cr; prereq Biom 100 and 101, Gen 66 or equiv; offered 1967-68 and alt yrs)

218w.° Review of Advances in Nutrition and Feeding of Dairy Cattle. (3 cr; prereq ‡; offered 1967-68 and alt yrs) Donker

219f. Dairy Cattle Reproduction. Intensive review of fundamental problems and literature related to reproduction in dairy cattle. Laboratory exercises and demonstration. (3 cr; prereq ‡; offered 1966-67 and alt yrs) Graham

220s.° Lactation. Recent advances in field of development and functioning of mammary gland. (3 cr; prereq 121 or ‡; offered 1966-67 and alt yrs)

Poultry Science

102w. Avian Genetics and Cytogenetics. Inheritance of qualitative and quantitative traits; application of cytogenetic principles; and cytotaxonomy in avian species. (3 cr; prereq Gen 66 or ‡) Shoffner

105f-106s. Comparative Vertebrate Physiology. Interrelationships between habitat, morphology, and organ systems and their changes through evolutionary processes. All vertebrate classes covered; specific reference to the fowl. (3 cr per qtr; prereq VPP 41 or ‡ for 105, 105 and VPP 42 or ‡ for 106; [1966-67], [1967-68])

153s. Poultry Nutrition. Nutrients and requirements, ration formulation, and current feeding practice of chickens and turkeys. (3 cr; prereq BioC 51 or ‡) Waibel

154f. Poultry Products. Technology involved in grading, processing, packaging, storage, and merchandising of poultry and eggs. (3 cr; prereq 1 or ‡)

214x.* Research in Poultry Science. Problems assigned to fit the needs of the student. (Cr ar; prereq ‡) Staff

215x.* Research in Poultry Nutrition. (Cr ar; prereq 9 cr in biochemistry or equiv) Waibel, Johnson, Snetsinger

216x.* Research in Avian Genetics and Cytogenetics. (Cr ar; prereq 9 cr in genetics or ‡) Shoffner

217x.* Seminar: Poultry Science. (1 cr per qtr; prereq ‡) Staff

218.* Research in Poultry Products. (Cr ar; prereq ‡)

219.* Research in Avian Physiology. (Cr ar; prereq ‡) Staff

ANTHROPOLOGY

Professor
E. Adamson Hoebel
Robert F. Spencer, *director of graduate study*

Associate Professor
Luther P. Gerlach
O. Elden Johnson
Frank C. Miller
Rupert I. Murrill
Pertti S. Pelto
Harvey B. Sarles

Assistant Professor
Richard F. W. Adams
Robert C. Kiste
Michael Salovesh

Visiting Lecturer
Grover S. Krantz

Language Requirement—For the Master's degree, one foreign language. For the Ph.D. degree, two foreign languages. Routinely acceptable languages are French, German, and Spanish.

Master's Degree—Offered only under Plan A.

Doctor's Degree—Work leading to the Ph.D. degree is offered. See departmental mimeographed statement for specific requirements.

Group I—Ethnology

100. Principles of Cultural Anthropology. Intensive introduction to elements of cultural anthropology. Analysis of range and variability of human behavior. Principles of cultural dynamics. (3 cr, §2A, may be taken in lieu of 2A) Gerlach, Miller, Salovesh

101. Principles of Biocultural Evolution. Intensive survey of human biological and cultural origins and evolution. Interpretation of paleontological and archaeological record. (3 cr, §1A, may be taken in lieu of 1A) Johnson

115. Indians of the Great Plains. Prehistoric origins of Plains tribes. Cultures of Missouri River tribes and nomads of the Plains. (3 cr; prereq 2A or 100 or △) Hoebel

117. Indians of South America. Ethnographic survey of South American Indians. Prehistory of various areas. Spanish and Portuguese contact and adjustment of various tribes to modern conditions. (3 cr; prereq 2A or 100) Salovesh

119. Peoples and Cultures of Middle America. Survey of both Indian-Spanish speaking peoples of Middle America. Processes of acculturation that have produced contemporary cultures of Mexico and Central America. (3 cr; prereq 2A or 100 [waived for majors in Latin-American Area Studies]) Miller, Salovesh

120. Peoples and Cultures of Africa. Survey: races, languages, and cultures of Africa, south of the Sahara. Peoples representative of each culture area—social organization, economic and political systems, and adjustment to modern conditions. (3 cr; prereq 2A or 100) Gerlach

121. Peoples and Cultures of the South Seas. Survey of races and cultures of Pacific Islands (Polynesia, Micronesia, and Melanesia). (3 cr; prereq 2A or 100) Murrill

124. Culture and Society in China and Japan. Development of Chinese institutions and other cultural manifestations. Their influence on cultures of Japan, Korea, and Viet Nam. Analysis of and comparison between contemporary Chinese and Japanese society. (3 cr; prereq 2A or 100 or △) Gerlach

125. Peoples and Cultures of India. Survey of tribes, Hindu caste society, and modern communities of India. (3 cr; prereq 2A or 100 or △) Spencer

126. Peoples and Cultures of Southeast Asia and Indonesia. Burma, Siam, French Indochina, and Malaysian archipelago. Influences from India on the area. Islamic influences in Indonesia. Modern ethnic, national, and colonial problems. (3 cr; prereq 2A or 100 or △) Spencer, Johnson

127. Islamic Culture Sphere. Mohammed and the founding of Islam. Development and spread of Islamic religion, law, government, and other institutions in the Middle East, Africa, and Asia. Culture and society in contemporary Middle East. (3 cr; prereq 2A or 100 or △) Gerlach

Group II—Archaeology

130. Method and Theory of American Archaeology. Examination of field methods, systems of data recording, analytical methods, and their conceptual bases. Abstract theory closely integrated with specific case material. Laboratory exercises in application of artifact analysis. (3 cr; prereq 90) Adams, Johnson

134. Archaeology of Middle America. Developmental stage survey of major features of prehistoric cultures of Mexico and Central America. (3 cr; prereq 90) Adams

135. Archaeology of South America. Developmental stage survey of major features of prehistoric cultures of South America. All major ecological zones covered. (3 cr; prereq 90) Adams

136. Paleolithic and Mesolithic Archaeology of the Old World. Survey of the archaeological record of human cultural origins and developments in the Pleistocene and early recent periods in Africa, Europe, and Asia. (3 cr; prereq 90) Johnson

137. Old World Prehistory: Europe, Near East, and Africa. Recent period prehistory stressing origins, development, and dispersion of systems of food production; origins of urbanism. (3 cr; prereq 90) Adams

138. Old World Prehistory: East and South Asia. Origins and developments of major Asian cultural traditions. (3 cr; prereq 90) Johnson

140su. Field Research in Archaeology. Archaeological field excavation, survey, and research in prehistoric village and mound sites in Minnesota. Intensive training in excavation techniques, recordation, analysis, and interpretation of archaeological materials. (6-12 cr [may be taken for cr only once]; prereq 90 and △) Johnson

Group III—Cultural Anthropology

150. Cultural Change and Development. Processes of cultural change: invention, diffusion, and acculturation. Effects of colonialism, urbanization, and modernization. Analysis of developing societies. (3 cr; prereq 2A or 100) Miller

151. Applied Anthropology. Application of methods and techniques of anthropology to current problems of government, industry, education, and social welfare planning. Role of anthropology in technical aid, public health, and other administrative activities. (3 cr; prereq 150 or △) Gerlach, Miller

154. Ethnological Field Techniques. Techniques of field observation, interviewing, and recording; field methods, presentation of data, and interpretation of results provided by laboratory exercises with informants. (3 cr; prereq △) Miller

160. Anthropology of Law. Theory and method of comparative legal systems. Cultural background of law and relation of law to society. Functions and evolution of law as revealed in analysis of cultures ranging from primitive to complex. (3 cr; prereq 2A or 100 [waived for majors in other social sciences]) Hoebel

161. Anthropology of Religion. Varieties and range of religious beliefs and practices. Relation of religion to other aspects of culture. (3 cr; prereq 2A or 100) Spencer, Miller

162. Comparative Technology. Analysis of inventions men have developed in adapting to varied environments of the world. Ideas and techniques involved in manufacture of food-getting equipment, means of transportation and communication, and other devices for satisfaction of human needs examined in historical and ecological context. (3 cr; prereq 2A or 100; offered when feasible) Adams, Pelto

163. Economic Anthropology. Analysis and comparison of varied systems of production and distribution; special reference to nonindustrial societies. Relationship between economic and social, political, religious, psychological, and environmental factors. Social and cultural aspects of economic development. (3 cr; prereq 2A or 100 [waived for majors in economics and business administration]) Gerlach

164. Social Anthropology. Structure of nonliterate and folk societies; systems of kinship and marriage and their relationship to economic, religious, and political institutions; functional and structural approaches in cultural anthropology. (3 cr; prereq 2A or 100) Pelto, Miller

165x.* Culture and Personality. Role of culture in the formation of personality. Problems of individual adjustments to demands of culture. Psychological approach to culture. (3 cr; prereq 2A or 100 or △, waived for majors in public health nursing, psychology, sociology, and social work) Pelto (w), Spencer (s)

166. Primitive Art. Technique, style, and symbolism in the arts of primitive peoples. Art and the artist in relation to primitive culture and society. (3 cr; prereq 2A or 100 or △; waived for art majors)

169. Comprehensive Survey. Integrated review of major anthropological concepts, methodologies, and theories. (3 cr; prereq △) Gerlach, Salovesh

Group IV—Physical Anthropology

170. Primate and Human Evolution. Origins and relationships of extinct forms of nonhuman primates and man. (3 cr; prereq 1A or 101) Murrill

171. Human Races. Evolution of races, present living races, mechanism of differentiation of major groups of man, physiological differences between races. (3 cr; prereq 170 or △)

172. Basic Principles of Blood Genetics. History of blood groups; blood groups and human genetics, ABO, MNS, P, Rh, Lutheran, Kell, Lewis, Duffy, Kidd, Diego, haptoglobines, transferines, gamma globulines, Gc system, hemoglobins; blood groups and disease; blood groups and linkage. (3 cr; prereq 1A, 101, or △) Yunis

173. Human Biology. Evolutionary processes in differential development of races. Physical characteristics, distribution, and relationships of living races of mankind. Human genetics, particularly of blood types in racial analysis. Influence of various environments on man. (3 cr per qtr; prereq 1A or 101) Murrill

175. Human Physical Growth and Development. Period of growth—prenatal, birth, infancy, childhood, and adolescence. Sex differences in growth, skeletal maturation. Development and growth of the head. Growth and eruption of teeth. (3 cr; prereq 1A or 101 or waived for majors in child development) Murrill

176. Growth and Development in Adolescents. Physical growth at adolescence, sex differences in physique, concept of physiological maturity, physiological changes, endocrinology of adolescence, changes in mentality, and behavior at adolescence. (3 cr; prereq 175 or ‡)

177-178-179. Physical Anthropology. Comparative osteology of man and the anthropoid apes. Variations related to sex, age, and race. Observations and measurements on the skeleton. Anthropometry (measurement of the living). Body size, proportions, and statistical analysis. Age, sex, and racial differences in body composition. Anthropometrical, roentgenographic, biophysical, and biochemical estimations of body compartments. (4 cr per qtr; prereq 1A or 101; 2 lect, 4 lab hrs per wk) Murrill

Group V—Linguistics

180-181.† Descriptive Linguistics. 180: Phonetics and phonemics. Analysis of speed sounds and practice in phonetic recording and phonemic analysis. 181: Morphology and syntax. Problems in phonologic, morphophonologic, morphological, and syntactic structures of selected languages outside the Indo-European speech family. (3 cr per qtr; prereq △) Spencer

186. Dynamics of Human Communication. Introduction to principles and concepts of kinesics: the dynamic study of human communication. (3 cr; prereq 181 or equiv) Sarles

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190-191-192. Directed Research. (Cr ar; prereq △) Staff

193-194-195. Topics in Anthropology. Special courses in all branches of anthropology. (Cr ar; offered by visiting professors when available; whenever offered, topic will be listed in Class Schedule and prereqs stated at that time) Staff

196. Proseminar in East and South Asia. (Same as Geog 196, Hist 196, Ortl 196, Pol 196) Integrating course for students majoring in East and South Asia Area Studies program. (3 cr) Interdepartmental staff

197-198-199.† India and Pakistan Since Independence. An interdisciplinary survey: policies of these countries in all fields of endeavor–social, cultural, economic, political, and foreign affairs; degree of success with which they are employing the opportunities provided by independence to meet "the revolution of rising expectations." See also Ortl 75, 76, 77, Asian Civilizations. (2 cr per qtr, no cr in anthropology major or minor sequence) Burke

200-201. Anthropology and Scientific Method. Development of anthropological theory and method. The men, theories, and techniques in relation to their times; permanence of their contributions. Principles of logic and scientific method as applied to anthropological research. Special qualities of anthropological method in social science research. (3 cr per qtr; required of *all* grad majors and minors) Hoebel, Miller

202. Proseminar: Introduction to Research Methods. (3 cr; required of all new grad students) Miller, Pelto

204, 205, 206. Seminar: Anthropology. (3 cr per qtr) Staff

220, 221, 222. Seminar: Ethnology. (3 cr per qtr) Hoebel, Spencer, Gerlach, Miller, Pelto, Kiste

230, 231, 232. Seminar: Archaeology. (3 cr per qtr) Adams, Johnson

240. Ethnological Field Session. Field research in social anthropology of American Indian or non-European communities. (Cr ar; offered when feasible) Miller, Pelto

250. Advanced Social Anthropology. (3 cr) Pelto

251, 252, 253. Seminar: Culture and Personality. (3 cr per qtr) Pelto

264. Seminar: Social Anthropology. (3 cr)

270, 271, 272. Seminar: Physical Anthropology. (3 cr per qtr) Murrill, Krantz

285. Seminar: Anthropological Linguistics. (3 cr per qtr) Spencer, Sarles

ARCHITECTURE

Professor
Ralph E. Rapson, *head*
Robert G. Cerny
John S. Myers
Walter K. Vivrett, *director of graduate study*
George C. Winterowd

Assistant Professor
Valerius L. Michelson

Prerequisites—Admission is limited to students of high academic standing who show promise for graduate study, and who already hold a first professional degree in architecture. (For the City Design Option, this professional degree may be in landscape architecture or in planning). It is desirable that prior work include at least one course in each of the fields of economics, political science, and sociology.

Applicants are required to submit examples (or photographs) of their original work in design. These should be addressed to the School of Architecture, 110 Architecture Building, University of Minnesota, Minneapolis, Minnesota 55455.

Language Requirement—None.

Master of Architecture Degree—Three programs leading to this degree are offered:

a. *Architecture Option*—Study in depth, at the scale of the single building or group of buildings, such as: a particular building type, structural systems in relationship to contemporary building technology, or systems of environmental control as they influence building design. Core of this one-year program is Arch 251-252-253. Offered under Plan A and Plan B.

b. *City Design Option*—Study, at the scale of the city, of the three-dimensional environment. Emphasis is on breadth, with a bringing together of the three disciplines: architecture, landscape architecture, and planning. Core of this one-year program is Arch 271-272-273. Offered under Plan B.

c. *Hospital Design Option*—In co-ooperation with the School of Public Health and its faculty in hospital administration, this program provides a high degree of specialization in medical facilities design. This two-year program, offered under Plan B, carries a requirement of 90 credits of graduate work distributed between the Schools of Architecture and Public Health.

Candidates will be expected to fulfill the general requirements of the Graduate School for the Master's degree under either Plan A or Plan B. An exception to this is that, in place of the usual major and minor requirements, a program of study, including courses drawn from one or more departments, will be planned for each student in consultation with the graduate faculty.

101-102-103. Tutorial Work in History of Architecture. Reading and written reports on special historical problems. (2 cr per qtr; prereq 56 or ‡) Winterowd

107. Dwelling Unit Design. Open to seniors and graduates in home economics. (2 cr) Vivrett

115-116-117. Structure and Form in Architecture. Structural materials and systems, and their application; logical structure as a form generator. (3 cr per qtr; prereq MM 92) Michelson

131f. Planning. The evolution of urban planning as a function of government, a profession, and an academic discipline. The theory of urban form and its organization and functioning. (3 cr) Iskander

132w. Planning. Conceptualization of the role of individual disciplines in the planning process; the physical, social, economic, and political aspects of urban organization and functioning as an aid to understanding urban areas. (3 cr) Iskander and visiting lecturers

133s.• Planning. Community facilities and housing. Problems; local and federal policies affecting the supply and quality of housing; health, educational, and recreational facilities and services which support urban residence. (3 cr) Vivrett

134.• Planning. Tutorial work in community facilities and housing. (3 cr; prereq 133 or ‡) Vivrett

150.• Institutional Planning. (2 cr; prereq 113 and ‡) Vivrett

151-152-153. Theory of Architecture. (2 cr per qtr; prereq ‡) Rapson and visiting lecturers

170.• Cityscape. The city and its components as aesthetic elements. (3 cr; prereq 93) Vivrett

171-172. Urban Form. Principles and techniques involved in city design. (3 cr per qtr; prereq 113 and 133)

201-202-203.• Special Research in Architectural History. (Cr ar; prereq 56 or ‡) Winterowd

231-232-233.• Planning. Individual problems and research in planning. (Cr ar) Rapson, Vivrett

251-252-253.• Architectural Design. Problems involving analysis, program, and design; individual and collaborative effort. (Cr ar) Cerny, Myers, Rapson, Vivrett

261-262-263.• Selected Problems in Architecture. Advanced architectural design problems; research and development of approaches to solutions. Experimental studies in development of significant architectural form. Individual and collaborative effort. (Cr ar; prereq minimum of 12 cr in 251, 252, 253, 271, 272, or 273) Cerny, Rapson, Vivrett

271-272-273.• Problems in City and Community Design. Studies in the development of city spaces and urban character as they relate to changing socio-economic needs and advancing technologies. (8 cr per qtr; prereq ¶274-275-276) Rapson, Vivrett

274-275-276. Seminar: Design Evaluation. Evaluation of student projects and exploration of alternatives with particular reference to the total urban context. (1 cr per qtr; prereq ¶271-272-273) Vivrett and visiting lecturers

ART HISTORY

Professor
Carl D. Sheppard, *head*
Hylton A. Thomas
Donald Torbert, *director of graduate study*
Dimitri T. Tselos

Associate Professor
Marion Nelson
Sidney Simon
Melvin Waldfogel

Assistant Professor
Norman Canedy
Sheila McNally
Robert Poor

Prerequisites—For the *master of arts degree,* undergraduate preparation of approximately 27 Upper Division credits in the history of art or its equivalent.

Language Requirement—For the two Master's degrees, reading knowledge of one foreign language, French or German. For the Ph.D. degree, two foreign languages, preferably German and French.

Master of Arts Degree (History of Art and Criticism)

Plan B—The candidate will offer a program of 45 credits, of which 30 will be earned in art history courses. Of the additional credits from related fields, 9 will ordinarily be earned in the field of history in courses related to those taken in art history. In this program the student will submit three papers in starred courses in lieu of the thesis.

Master of Arts Degree in Museology—This program places special emphasis on professional preparation for work in art museums (functions of the director, curator, registrar, educational director, exhibition designer). The candidate must have the equivalent of an undergraduate major in art history (approximately 27 quarter credits of Upper Division courses). Students for this degree (offered under Plan B) are not admitted directly into the program in museology, but as graduate students majoring in art history. The decision as to acceptance for candidacy for the degree in museology will be made at the end of the first year's work. A very limited number of candidates can be accepted.

To earn the degree a candidate must offer 50 credits of course work, of which 30 will be earned in art history, including 199, and 20 additional credits from 226-227-228-229-230, Museology (which comprise the internship program) earned in full-time apprentice work in two of the participating museums.

Doctor's Degree—Work is offered leading to the Ph.D. degree in the history and criticism of art.

100. Early Greek Art. Survey of the Bronze Age; concentration on architecture, sculpture, and painting beginning with the Iron Age and continuing to the Classical period. (3 cr; prereq 2, ‡) McNally, Tselos

101. Later Greek Art. Architecture, sculpture, and painting of Greece in the Classical and Hellenistic periods. (3 cr per qtr; prereq 2, ‡) McNally, Tselos

102. Roman Art. Architecture, sculpture, painting, and the minor arts of the Roman Republic Empire. (3 cr per qtr; prereq 2, ‡) McNally, Tselos

103f. Mediaeval Art. Early Christian and Byzantine architecture, sculpture, painting, and selected minor arts, including Russia and other Orthodox Christian countries, to the fall of Constantinople in 1453. (3 cr) Tselos, Sheppard

104w. Mediaeval Art. Survey of architecture, sculpture, painting, and selected minor arts of Western Europe from the Dark Ages to the Gothic period, including art of the Barbarian Kingdoms; Irish-Insular, Asturian, Mozarabic, Carolingian, Ottonian, Anglo-Saxon, and Romanesque styles. (3 cr) Tselos, Sheppard

105s. Mediaeval Art. Gothic architecture, sculpture, and painting from the twelfth to the fourteenth century. (3 cr) Tselos, Sheppard

106. Italian Art of the Fourteenth Century. Proto-Renaissance sculpture and painting and alternative trends. Painting after the Black Death. International style in painting and sculpture. (3 cr) Canedy

107. Early Fifteenth-Century Art in Italy and Northern Europe. Early Italian Renaissance architecture, sculpture, and painting; and Early Netherlandish painting. (3 cr) Canedy

108. Late Fifteenth-Century Art in Italy and Northern Europe. Painting, sculpture, and architecture in central and northern Italy; and northern European painting. (3 cr) Canedy

110. Art of India. Development of architecture, painting, sculpture, and minor arts. (3 cr; prereq 3 cr in art history) Poor

111. Art of China. Development of painting, sculpture, and minor arts in China from earliest times to present. (3 cr; prereq 3 cr in art history) Poor

112. Art of Japan. Development of painting, sculpture, and minor arts in Japan from earliest times to present. (3 cr; prereq **; offered when feasible) Poor

113. High Renaissance Painting in Italy and Northern Europe. Leonardo, Raphael, Michelangelo, Giorgione, and Titian. Grünewald, Holbein, and Dürer. (3 cr) Canedy

114. Sixteenth-Century Sculpture and Architecture. High Renaissance, Mannerism, and other trends in Italy and northern Europe. (3 cr) Canedy

115. Later Sixteenth-Century Painting. Mannerism and other trends in Italy and northern Europe. (3 cr) Canedy

116f. Baroque Art in Italy and Spain. Proto-baroque and early baroque painting; Barocci, the Carracci, Caravaggio. Early baroque architecture in Rome. Bernini and the High Baroque fusion of architecture, sculpture, and painting. Illusionistic ceiling painting. Classical tendencies in later seventeenth-century Roman art. Sculpture and painting in Naples, Bologna; architecture and painting in Venice. Piedmontese baroque architecture; Guarini, Juvara. Baroque painting in Spain: El Greco, Velasquez, Zurbaran, Mürillo. (3 cr; prereq **) Thomas

117. Baroque Art in France and England. Classicizing baroque art in France: Louis XIV, Versailles, and academic French art. Baroque art in French provinces. New tendencies in later seventeenth century. Late Renaissance and baroque architecture in England: Inigo Jones and Palladianism; Vanbrugh and Wren and the High Baroque. The English portrait. (3 cr; prereq **) Thomas

118. Baroque Art in Flanders and Holland. Flemish and Dutch baroque architecture and sculpture. Rubens and classical baroque painting in the north. Van Dyck and the aristocratic portrait. Flemish genre painting. Development of Dutch baroque painting: Hals and the portrait; Vermeer and De Hooch and genre painting; Ruisdael, Cuyp, and the Dutch landscape; minor specialists. Rembrandt and his school. (3 cr; prereq **) Thomas

126f.° Eighteenth-Century Art in Italy. Late baroque and classicizing trends in architecture. Neoclassic architecture. Roman, Neapolitan, and North Italian sculpture. Canova. Painting in Rome, Naples, Bologna, Genoa, and Venice. Prints. (3 cr) Thomas

127w.° Eighteenth-Century Art in France. Urban architecture; the town house. Provincial centers. Neoclassic architecture. Rococo and neoclassic sculpture. French painting: Watteau, Boucher, Fragonard, Chardin, David; the lesser masters. Prints. (3 cr) Thomas

128s.° Eighteenth-Century Art in England and Germany. The Palladian Revival in architecture. Robert Adam. The English portrait; Reynolds, Gainsborough. Hogarth. English landscape painting. German and Austrian late baroque and rococo architecture, sculpture, and painting. (3 cr) Thomas

129w. History of the Graphic Arts. Origins of woodcut and engraving. Renaissance and baroque master etchers and engravers. Mantegna, Raimondi, Schongauer, Dürer, Holbein, Lucas van Leyden, Callot, Rembrandt. Reproductive and portrait engraving of the 17th and 18th centuries. Lithography, Géricault, Delacroix, Daumier. Twentieth-century printmaking. (3 cr; prereq **; offered 1967-68 and alt yrs) Thomas

130w. Master Drawings. Historical survey of great drawings from Gothic period to present, covering work of such artists as Pisanello, Leonardo da Vinci, Dürer, Holbein, Raphael, Rembrandt, Rubens, Watteau, Tiepolo, Goya, Géricault, Daumier, Van Gogh, Matisse, Picasso. Stylistic analysis of master drawings and school copies. (3 cr; prereq **; offered 1966-67 and alt yrs) Thomas

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** Nine credits in history of art or 9 credits in literature or history with consent of department.

136. Art in the United States. Painting and sculpture from origins to mid-nineteenth century. Relations with England and Europe. Copely, Stuart, West, and their followers. Rise of landscape painting. Early weeks of the quarter devoted to analysis of means of expression common to the visual arts. (3 cr) Torbert

137. Art in the United States. Romanticism and realistic genre in painting and sculpture. Homer, Eakins, Ryder, and their influence. Impressionism, relations with Europe after the Civil War. (3 cr) Torbert

138. Art in the United States. Contemporary movements in painting and sculpture. The Armory Show, development of modern realism, expressionism, and abstractism. (3 cr) Torbert

139. Decorative Arts in England: 1700-1900. Major furniture styles in England from rococo to Art Nouveau. Consideration of porcelain, silver, and other decorative arts. (3 cr) Waldfogel

140f. Scandinavian Architecture. Development of native tradition in architecture from medieval stave churches, through folk architecture, to modern style. Survey of important architectural monuments in Scandinavia which are less native in character, but have contributed to local development. (3 cr; prereq **) Nelson

141w. Scandinavian Painting. Mediaeval wall and panel painting; folk painting and tapestry weaving in 17th, 18th, and 19th centuries; and modern painting—Edvard Munch and Norwegian mural painting. (3 cr; prereq **) Nelson

142. Scandinavian Sculpture and the Minor Arts. Mediaeval, neoclassical, and modern periods. In the minor arts emphasis will be primarily on development of contemporary Scandinavian design. (3 cr) Nelson

143. The Pre-Christian Art of Northern Europe. Art north of the Alps, neolithic ceramics, wood carving of the late Viking period. Concentration on Scandinavia; Stone Age, Bronze Age, and pre-Christian Celtic art of East, Central, and West Europe. (3 cr) Nelson

146. Modern American and European Architecture. European traditions and influences that shaped American building from early settlement. Jefferson and his influence. Early phases of revivalism. (3 cr) Tselos, Torbert

147. Modern American and European Architecture. Revivalist and progressive currents in the later 19th century; sources and founders of modern architecture. The Chicago School and its chief exponents. Richardson, Jenney, Sullivan, the early Wright; their European counterparts. Modern materials and techniques; rise of the skyscraper. (3 cr) Torbert

148.* Modern American and European Architecture. Development of modern architecture on the international scene. Later work of the modern pioneers. Wright, Berlage, Behrens, Gropius, Mies, Le Corbusier, and their influence. Modern uses of concrete; Wright, Perret, Nervi, Torroja, Candela, Tange, Saarinen. (3 cr) Torbert

156.* Nineteenth-Century French Painting, 1800-1860. David and his followers, the romantic figure style culminating in Delacroix, Corot, and the Barbizon landscape painters, the resurgence of Neoclassicism in the 1840's, and Courbet and his influence. (3 cr) Tselos, Waldfogel

157.* Nineteenth-Century French Painting, 1860-1900. Realism of Manet and Degas, the impressionist idea and its evolution, multiple styles of the post-impressionists, and aestheticism, symbolism and mysticism of the 1890's. (3 cr) Tselos, Waldfogel

158.* Nineteenth-Century German Painting. From Runge to Corinth: the romantic landscape, the Nazarones, Biedermeier, the realism of Menzel and Leibl, the eclecticism of the 1870's and 1880's, realism and impressionism at the end of the century. (3 cr) Tselos, Waldfogel

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** Nine credits in history of art or 9 credits in literature or history with consent of department.

159. English Painting from 1750 to 1850. Landscape painting from the topographers to Turner. Other artists and movements. Blake and Fuseli, Haydon and Etty, the pre-Raphaelites and Victorian narrative painters. (3 cr) Tselos, Waldfogel

161. Introduction to Roman Archaeology. (Same as Clas 123) Methods of gathering and interpreting archaeological data, introduced through a survey of major technologies and artistic media of the Romans, and a consideration of selected sites. (3 cr, §Clas 123) McNally

166. Chinese Painting. Survey of major works of Chinese painting from the 4th to the 17th centuries. Development of the landscape tradition and the literary genre of later Chinese painting. (3 cr; prereq 3 cr in art history or ‡) Poor

167. Japanese Painting. Survey of Japanese pictorial arts from earliest to modern times; works which best exemplify development of indigenous traditions. (3 cr; prereq 3 cr in art history or ‡) Poor

168. Modern Sculpture from Rodin to Roszak: 1875-1960. Rise and development of modern sculpture; romantic and revivalist currents; modeling and direct carving; cubist, neoplastic, expressionist, surrealist, and neo-Dada tendencies. (3 cr) Torbert, Tselos

169. Modern Sculpture from Houdon to Rodin: 1775-1920. The academic trend in late 18th century, classical revival, romantic, realistic, impressionistic, and expressionistic movements of the 19th century—highlighted by the work of Houdon, Canova, Rude, Carpeaux, Dalou, and Rodin—to the beginning of the 20th century. (3 cr) Tselos, Torbert

171. Greek Painting. Place of painting in Greek art; development of figure style. (3 cr; prereq 3 cr in art history; offered 1967-68 and alt yrs) McNally

173, 174, 175. Proseminar: Problems in Art History. (3 cr per qtr; prereq ‡) Thomas, Waldfogel

176. Twentieth-Century Painting. L'Art Nouveau, Fauvism, Cubism, Futurism, Orphism and School of Paris, Matisse, Picasso, Braque, Gris, Léger, Boccioni, Rousseau, de Chirico, etc. (3 cr) Simon

177. Twentieth-Century Painting. Jugendstil, Austrian expressionism, the Bridge group, the Blue Rider group, the New Objectivity and de Stijl. Kokoschka, Schiele, Kirchner, Schmidt-Rottluff, Nolde, Kandinsky, Marc, Klee, Beckmann, Mondrian, van Doesberg, Grosz, etc. (3 cr) Simon

178. Twentieth-Century Painting. Pre-Dada, Dada, Surrealism, Abstract Expressionism, COBRA group, Hard Edge, New Realism, Pop Art, Duchamp, Picabia, Arp, Ernst, Dali, Miro, Hofman, de Kooning, Pollock, de Stael, Dubuffet, etc. (3 cr) Simon

186-187-188. Art of the Film. Aesthetics of the film medium. Evaluation and analysis of the motion picture as an art form. Discussions of editing, montage, sound, and use of the camera, etc. Course illustrated with feature-length films and short subjects. Course is not applicable to the graduate major or minor in Art History. (3 cr, §87 for 187, §88 for 188) Amberg and staff

189. Art of the Late Antique Period. Architecture, sculpture, and painting of the 3rd, 4th, and 5th centuries. (3 cr; prereq 2, 102 or ‡) McNally

196f-197w-198s.† Readings in Art History and Criticism. (3 cr per qtr; prereq ‡) Art History staff

199. Methodology. Historical bibliography, problems of connoisseurship and attribution, criticism of types of art history. (3 cr; prereq art history major, ‡) Sheppard, Tselos

206-207-208. Mediaeval Art. (3 cr; prereq ‡) Tselos, Sheppard

216-217-218. Fifteenth- and Sixteenth-Century Art. (3 cr; prereq ‡) Canedy

226-227-228. Seventeenth- and Eighteenth-Century Art. (3 cr; prereq ‡) Thomas

236-237-238. Nineteenth-Century Art. (3 cr; prereq ‡) Tselos, Waldfogel

240, 241, 242. Seminar: Studies in Scandinavian Art. (3 cr; prereq ‡) Nelson

246-247-248. Twentieth-Century Art. (3 cr; prereq ‡) Simon, Torbert, Tselos

256-257-258. American Art. (3 cr; prereq ‡) Torbert

266-267-268. Special Problems in Art History. (3 cr; prereq ‡) Staff

276-277-278. Problems in Classical Art. (3 cr; prereq ‡) McNally

286-287-288. Oriental Art Seminar. (3 cr; prereq ‡) Poor

295. Museology I. Introduction to Museum Principles and Practices. Advanced problems in structure of museums: history, administration, programs, practices, community relations. Required for candidates for the M.A. in museology. (3 cr; prereq △) Simon

296-297-298-299.* Museology II, III, IV, V. Apprenticeship program in museum practices. Full-time internship activity in various departments of museums participating in the program—painting and sculpture, decorative arts, design, prints and drawings, and education departments. Required of candidates for M.A. in museology. (5 cr per qtr; prereq 295 and △) Simon

ASTRONOMY

Professor

Willem J. Luyten

The Astronomical Observatory possesses a 10½-inch refracting telescope; a 5-inch star camera; a photographic measuring machine by the Société Génévoise.

Prerequisites—For major work, Ast 51-52-53 and Math 50; for minor work, Math 50 and 3 credits in astronomy.

Language Requirement—Exemption from the language requirement for the Master's degree may be made in individual cases by petition. When a foreign language is offered, French, German, and Russian are acceptable.

Master's Degree—Offered under Plans A and B.

104. Celestial Mechanics. Central orbit theory. The two-body problem. Computation of an ephemeris. Determination of an orbit from observations. (3 cr; prereq Math 32 or Math 106)

105. Celestial Mechanics. The restricted three-body problems. Gravitational field of the earth. Numerical methods applicable to computations of special perturbations. First order theories of motion of the moon and of motion of a satellite of an oblate planet. Drag perturbed orbits. (3 cr; prereq 104)

106. Celestial Mechanics. Applications of contact transformations and the Hamilton-Jacobi equation to computation of general perturbations. Delaunay and Hill-Brown theories of motion of the moon. The motion of a satellite of an oblate planet. (3 cr; prereq 105)

121-122-123.* Astrophysics and Stellar Statistics. Introductory course on the motions of the stars. (3 cr per qtr) Luyten

211-212-213.* Seminar. For students who are prepared for advanced work along specific lines. (1, 2, or 3 cr per qtr) Luyten

BIOCHEMISTRY

(College of Biological Sciences)

Professor

David R. Briggs, Ph.D.
Stanley Dagley, D.Sc.
LaVell M. Henderson, Ph.D., *head, director of graduate study*
Robert Jenness, Ph.D.
Samuel Kirkwood, Ph.D.
Irvin E. Liener, Ph.D.
Walter O. Lundberg, Ph.D.**
Herman Schlenk, Ph.D.**
Max O. Schultze, Ph.D.

** Members of the Hormel Institute Staff.

Associate Professor
John E. Gander, Ph.D.
Robert L. Glass, Ph.D.
Helmut K. Mangold, Ph.D.**

Assistant Professor
Rex E. Lovrien, Ph.D.
Huber R. Warner, Ph.D.

Graduate training leading to the M.S. and Ph.D. degrees is offered jointly with the Biochemistry Department in the College of Medical Sciences, by co-operative effort maintained through an interdepartmental committee.

Prerequisites—For major work candidates must offer the equivalent of courses in analytical, organic, and physical chemistry as contained in an American Chemical Society approved curriculum. In addition the student is required to have at least one year of college physics, mathematics through integral calculus, and one year of biology (general, botany, zoology, or microbiology).

Students will be permitted to make up deficiencies in these requirements in the course of completing their graduate program.

Proficiency Examinations—All students are required to take proficiency examinations in analytical, organic, and physical chemistry. These examinations are offered at the time of admission and are used as a guide in the selection of graduate courses.

Major—Candidates for the Ph.D. degree must have credit in appropriate biochemistry courses as well as graduate survey courses in organic and physical chemistry. Two graduate courses in biology are also required. Thesis research may be undertaken in areas acceptable to the adviser.

Minor—Suitable courses to meet the requirements for the biochemistry minor will be selected in consultation with the department head.

M.S. Degree—Work for the Master's degree is offered only under Plan A.

Language Requirements—A reading knowledge of two foreign languages is required for the Ph.D. degree, one of which must be German; for the M.S. degree one foreign language from among French, German, or Russian. In special cases some other language may be substituted by petition.

Preliminary Examinations—Written and oral preliminary examinations for the Ph.D. degree are given twice a year.

101. Basic Biochemistry. Offered to enable students to make up certain deficiencies in background course work. (1-3 cr; prereq △) Staff

119. Physical Biochemistry. Lectures and assigned reading on colloid chemistry; surface chemistry, molecular kinetics, and their application to biochemical materials and processes. (3 cr; prereq OrCh 62, Phys 9) Briggs

141-142. General Biochemistry. (Same as MdBc 141-142) Course offered jointly by Department of Biochemistry, College of Biological Sciences, and Department of Biochemistry, College of Medical Sciences. Integrated series of lectures on chemical nature, properties, and biochemical reactions of components of biological systems. (3 cr per qtr; prereq ¶145-146 except with △, 1 yr organic chemistry and cr in physical chemistry or ¶PCh 101, 107 and 90 and ♯) Liener, Kirkwood

** Members of the Hormel Institute Staff.

143. Metabolic Reactions. Biochemistry of intermediary metabolism. (3 cr; prereq 142 and ‡) Gander

145-146. General Biochemistry Laboratory. Laboratory work paralleling and required of all who are registered in BioC 141-142 and MdBc 141-142 except with permission of department heads. (3 cr per qtr; prereq ¶141-142, 4 cr in analytical chemistry and ‡) Glass, Lovrien, Gander

147. Advanced Biochemical Techniques. Laboratory in modern methods for study of enzymatic and metabolic reactions. (3 cr; prereq 146 or MdBc 146, ¶143 and ‡) Warner

148. General Biochemistry Laboratory. For students in chemistry and chemical engineering. (2 cr; prereq 142, 4 cr in analytical chemistry and ‡) Schultze

151-152. Introduction to Biochemistry. Fundamentals of composition, chemical properties, reactions and interactions of biological materials; these are illustrated in part through laboratory exercises performed by the student. Term paper required. (4 cr per qtr; prereq OrCh 42 or 62 and ‡) Henderson, Schultze

153. Dairy Biochemistry. Problems in biosynthesis and physical properties of constituents of milk. Term paper on special topic required. (3 cr; prereq ¶163 except with ‡, 152) Jenness

163. Dairy Biochemistry Laboratory. Laboratory work paralleling and required of all who register in 153 except with permission. (2 cr; prereq ¶153, 152) Jenness

204. Tracer Techniques. Laboratory work on application of radioisotopes to study of metabolic processes. (3 cr; prereq ‡ and 143 or MdBc 144, 146 or MdBc 146...MeAg 127 advised) Kirkwood

220. Advanced Protein Chemistry. Lectures and assigned reading on composition, structure, chemical and physical properties, and biochemical functions of proteins and amino acids. (2 cr; prereq 143 or MdBc 144; offered 1966-67 and alt yrs) Briggs

221. Advanced Carbohydrate Chemistry. Lectures and assigned reading on composition, structure, chemical and physical properties, and biochemical functions of carbohydrates. (2 cr; prereq 143 or MdBc 144; offered 1967-68 and alt yrs)

222. Advanced Lipid Chemistry. Lectures and assigned reading on composition, structure, chemical and physical properties, and biochemical functions of fats and fat-like compounds. (2 cr; prereq 143 or MdBc 144; offered 1967-68 and alt yrs)

223. Advanced Enzyme Chemistry. Lectures and assigned reading on nature and function of enzymes. (2 cr; prereq 143 or MdBc 144; offered 1966-67 and alt yrs) Kirkwood

224. Vitamins. Lectures and assigned reading on biochemistry of vitamins and their physiological action. (3 cr; prereq 143 or ‡) Schultze

297. Special Topics in Biochemistry. Lectures and discussions varying from quarter to quarter according to staff availability and needs of the department. (1-3 cr; prereq 143) Staff

298. Graduate Seminar. Reports on recent development in biochemistry and on research projects in the department. (1 cr; prereq △) Staff

299. Graduate Research. Research problems in various fields in biochemistry represented by staff interests. (2-5 cr; prereq ‡) Staff

BIOCHEMISTRY

(College of Medical Sciences)

Professor

Wallace D. Armstrong, M.D., Ph.D., *head, director of graduate study*

Joseph T. Anderson, Ph.D.
Ellis S. Benson, M.D.
Charles W. Carr, Ph.D.
Ivan D. Frantz, M.D.
Helmut R. Gutmann, M.D.
Ralph T. Holman, Ph.D.
Joseph Larner, M.D., Ph.D.
Leon Singer, Ph.D.
Finn Wold, Ph.D.
Frank Ungar, Ph.D.

Associate Professor
Robert W. Bernlohr, Ph.D.
James F. Koerner, Ph.D.
John F. Van Pilsum, Ph.D.
Donald B. Wetlaufer, Ph.D.
Leslie Zieve, M.D., Ph.D.

Assistant Professor
Mary E. Dempsey, Ph.D.
Ronald D. Edstrom, Ph.D.
Ernest D. Gray, Ph.D.
Bernard Pollara, M.D., Ph.D.
Quenton T. Smith, Ph.D.

Graduate training leading to the M.S. and Ph.D. degrees is offered jointly with the Biochemistry Department in the College of Biological Sciences by a co-operative effort maintained through an interdepartmental committee.

Prerequisites—For a doctoral major in biochemistry (or physiological chemistry) courses in analytical, organic, and physical chemistry comparable to those of a baccalaureate chemistry major are expected. These minimum requirements for admission should include mathematics through calculus, one year of college physics, courses in inorganic and analytical chemistry, and one year of organic and physical chemistry. Candidates for the Master's degree with a major in biochemistry (or physiological chemistry) or those seeking a Ph.D. with a minor in biochemistry (or physiological chemistry) may be admitted with less rigorous courses in these fields of chemistry. Some admission deficiencies may be discharged in courses taken concurrently with graduate studies. One year's work in a biological science is desirable.

Language Requirement—Ordinarily German, French, or Russian. For the Master's degree, one foreign language. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and a collateral field of knowledge.

Master's Degree—Offered only under Plan A.

Doctor's Degree—Candidates for the Doctor's degree with a major in biochemistry (or physiological chemistry) will be required to present or to develop satisfactory competence in organic, analytical, and physical chemistry and in the biological sciences. The following courses are usually included in the program of graduate study: MdBc 141, 142, 144, 145, and 147 (or by permission MdBc 100-101) and AnCh 211-212, four of the eight biochemistry courses numbered 206, 207, 210, 213, 214, 215, 217, or 218, and other courses in biochemistry or logically related fields. These are not intended to be interpreted as minimum requirements, however, and each graduate student is expected to work out his full program in consultation with an adviser, with the understanding that needs may differ in individual cases. The department will supply full information on admission and graduate study requirements on request.

If MdBc 141, 142, 144, 145, 147, 100-101 or their equivalents have been taken 5 years or more prior to the time the candidate is to appear for the preliminary oral examination, these courses must be retaken.

100f,su-101w,su. Biochemistry. (8 cr per qtr; prereq physics, physical and organic chemistry) Armstrong, Carr, Ungar, Van Pilsum, Wetlaufer

141f. The Chemistry of Carbohydrates, Lipids, Proteins, and Nucleic Acids. (Same as BioC 141) (3 cr; prereq 1 yr organic chemistry, 2 qtrs physical chemistry [or concurrent registration], ¶145 or △) Liener, Wetlaufer

142w. Cellular and Intermediary Metabolism. (Same as BioC 142) (3 cr; prereq 141) Kirkwood, Von Korff

144s. Regulation of Cellular Metabolism. (3 cr; prereq 141-142 or 100-101) Staff

145f. Laboratory Course: The Isolation and Characterization of Natural Products. (2 cr; prereq ¶141; enrollment limited) Staff

147s. Laboratory Course: Metabolic Processes. (2 cr; prereq 142 and AnCh 212; biochemistry majors given priority) Staff

153f,w,s,su. Problems in Biochemistry. Special work arranged with qualified students. (Cr and hrs ar; may be taken 1 or more qtrs; prereq 144 or 101) Staff

200f,w,s,su. Seminar: Biochemistry. (1 cr) Staff

205f,w,s,su. Research in Biochemistry. (Cr and hrs ar) Staff

206f. Advanced Endocrinology and Steroid Chemistry. (3 cr; minimum of 8 students; prereq 144 or 101; offered 1967-68 and alt yrs) Ungar

207f. Radiotracers and Mineral Metabolism. (3 cr; minimum of 8 students; prereq 144 or 101; offered 1966-67 and alt yrs) Armstrong, Singer

210w. Metabolic Enzymology. (3 cr; minimum of 8 students; prereq 144 or 101; offered 1967-68 and alt yrs) Larner

213f,w,s. Clinical Biochemistry. (Cr and hrs ar)

214s. Kinetics and Mechanism of Enzymic Reactions. (3 cr, §PCh 214; minimum of 8 students; prereq 210, PCh 103 and ‡; offered 1967-68 and alt yrs) Lumry

215su. Topics in Lipid Metabolism. (3 cr; minimum of 8 students; prereq 144 or 101 or ‡; offered 1967 and alt yrs) Frantz

217w. Protein Chemistry. (3 cr; minimum of 8 students; prereq 144 or 101 or ‡ and PCh 103 or ‡; offered 1966-67 and alt yrs) Wetlaufer

218s. Physical Methods in Biopolymer Research. (3 cr; minimum of 8 students; prereq 217; offered 1966-67 and alt yrs) Lumry, Wetlaufer

236f,w,s. Radioisotope Seminar. (1 cr, §Rad 236) Loken, Armstrong, and staff

BIOLOGY

The major in biology is designed to accommodate students in areas of biological specialization which are by their nature interdepartmental. Faculty are drawn from members of the graduate faculty in the areas of biological, agricultural, and medical sciences. Note that majors in the biological sciences are also offered by many departments of the University.

Students who wish to earn an advanced degree in biology must demonstrate competence in the field as a whole and must complete a program of specialization.

Prerequisites—Students will be expected to have completed the equivalent of an undergraduate major in a biological science, organic chemistry, a year of college physics, and mathematics through calculus. Deficiencies must be removed during the first year of graduate work.

Doctor's Degree—To ensure basic competence in the entire field of biology, each student must pass a comprehensive examination. Questions will be drawn from the following areas: animal biology, plant biology, microbiology, biochemistry, genetics, general physiology, ecology, and developmental biology. Students will ordinarily write this examination at the beginning of their graduate training so that the results may be used as a basis for

evaluation and counsel. Those who perform well will not be required to retake the examination. Others will retake it when they have had the opportunity to correct earlier deficiencies.

Each student must also complete a program of specialization. Descriptions of the programs which have been formally established follow. If no suitable program has been established, a student may arrange (in consultation with his faculty adviser) for a unique program to be designed for him.

Language Requirements—For the Ph.D. degree, two foreign languages or one language plus a collateral field or a research technique are required, depending on the student's program.

Programs of Specialization—The following specializations have been formally established:

Cell Biology—Murray Rosenberg, program chairman. Students will be required to become proficient in advanced genetics, biomathematics, developmental biology, cell physiology, and specialized topics in physical chemistry and biochemistry, in addition to the advanced courses in cell biology.

Courses offered by the program include Advanced Topics in Cell Biology and Laboratory Techniques in Cell Biology.

Developmental Biology—Norman Kerr, program chairman. Students will be expected to become proficient in areas of advanced genetics, cell biology, physical chemistry, and biochemistry in addition to developmental biology.

Courses offered by the program include Biology 120, Developmental Biology, Biology 121, Laboratory, Research Training in Developmental Biology and Advanced Topics in Developmental Biology.

Ecology—A. J. Brook, program chairman. All students must develop a general competence in ecology and statistics. Depending on the area of ecology in which the student has special interest, courses will be chosen from the areas of agricultural sciences, biological sciences, earth sciences, and mathematics and statistics.

Evolutionary and Systematic Biology—Samuel Kirkwood, program chairman. Students should have some preparation in the taxonomy of groups of organisms which hold special interest for them. In addition to competence in biochemistry, genetics, biostatistics, and in the systematics of one or more of the major groups of organisms, students must develop a high level of competence in at least one of the following areas: (1) comparative biochemistry; (2) genetics of speciation, cytogenetics including cytotaxonomy, and experimental taxonomy; (3) phylogeny and taxonomy of living and extinct groups of organisms as seen from the viewpoint of comparative anatomy and morphology; (4) comparative physiology.

BIOMETRICS

Courses in Which Graduate Credit May Be Earned When Program Related

100. Statistical Analysis I. Statistical procedures in agricultural research; tests of significance, simple regression and correlation analysis, analysis of variance. (4 cr; prereq college algebra and Biom 90 or grad) Keenan

101. Statistical Analysis II. (Continuation of 100) Application of statistical methods to experimental research; multiple regression and correlation, covariance and extension of analysis of variance techniques. (4 cr; prereq 100 or equiv) Keenan

110. Computers in Agricultural and Biological Research. Impact of computers on research, FORTRAN programming, use of current libraries in processing statistical data, simulation techniques. (3 cr; prereq 101 or equiv)

171. Sampling Techniques in Agriculture. Simple random sampling, stratified random sampling, systematic sampling, cluster sampling; applications in agriculture and biology. (3 cr; prereq 101 or equiv) Keenan

181. Experimental Design. Principles of design in agricultural experimentation. Application, analysis, and interpretation of basic designs including factorials, incomplete blocks, change-over and long-time experiments. (3 cr; prereq 101)

BIOMETRY

Professor

Jacob E. Bearman, Ph.D.
Joseph Berkson, M.D., D.Sc.
Byron W. Brown, Jr., Ph.D., *head, director of graduate study*
Leonard T. Kurland, M.D.
Richard B. McHugh, Ph.D.

Associate Professor

Glenn E. Bartsch, Ph.D.
Lila R. Elveback, Ph.D.
Eugene A. Johnson, Ph.D.
Marcus O. Kjelsberg, Ph.D.
Marion W. Thornton, Ph.D.

Assistant Professor

James R. Boen, Ph.D.
Franklin W. Briese, Ph.D.
Robert L. Evans, Ph.D.
Kathleen M. Keenan, Ph.D.
Richard Pogue, Ph.D.

Prerequisites—For major work, completion of the premedical curriculum. Acceptable alternatives include the equivalent of an undergraduate major in one of the following two categories:

1. The biological and/or behavioral sciences,

2. The physical sciences and/or mathematics,

and the equivalent of a minor in the other category. If the major is in category 2, the candidate should be interested in application in category 1.

Language Requirement—For the M.S. degree, none. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge. Acceptable languages are Chinese, French, German, Italian, Japanese, Russian, Scandinavian languages, and Spanish.

Master's Degree—Offered under both Plan A and Plan B.

Doctor's Degree—Work for the Ph.D. degree is offered in accordance with the general requirements of the Graduate School.

Programs for the M.S. or Ph.D. degree with a major in biometry will include courses in the application of statistics, mathematics, and computer science to the biological, medical, and public health fields. These courses will be chosen from those listed below, supplemented with appropriate courses in statistical theory, mathematics, computer science, and biology.

For students minoring in biometry the sequences, PubH 110A,B,C and PubH 111A,B,C, or equivalent are required. The remainder of the program should be planned with the minor adviser before any other courses in the minor are taken.

PubH 110Af.* Biometry I. (Formerly 110) Basic concepts in probability; binomial, Poisson, and normal probability models; testing statistical hypotheses and estimation of parameters of probability models. (3 cr; prereq Math 10 or ‡ and ¶111A) Bartsch

PubH 111Af. Biometry Laboratory I. (Formerly 111) Application of concepts of probability to the development of probability models for random phenomena in the biological and medical sciences. (2 cr; prereq ¶110A) Bartsch

PubH 110Bw.* Biometry II. (Formerly 120) Further consideration of testing statistical hypotheses and interval estimation; regression analysis; correlation; use of ratios; analysis of variance; contrasts and multiple comparison techniques. (3 cr; prereq 110A and ¶111B) Bartsch

PubH 111Bw. Biometry Laboratory II. (Formerly 121) Application of concepts of testing and estimation concerning the parameters of the basic probability models; application of regression to bioassay; examples of the use and misuse of ratios; application of analysis of variance to bioassay. (2 cr; prereq ¶110B) Bartsch

PubH 110Cs.* Biometry III. (Formerly 130) Analysis of randomized block, factorial and split plot designs; χ^2 applied to frequency data; multiple regression. (3 cr; prereq 110B and ¶111C) Bartsch

PubH 111Cs. Biometry Laboratory III. (Formerly 131) Basic designs will be illustrated with numerous examples from the biological sciences; application of χ^2 to goodness of fit and heterogeniety tests. (2 cr; prereq ¶110C) Bartsch

PubH 120Af-Bw-Cs.* Biomedical Computing. Introduction to data processing concepts and equipment; information storage and retrieval; statistical analysis packages; dynamic programming; special input/output techniques for biological laboratory experimentation, epidemiology, hospital information systems, and pattern recognition. (3 cr per qtr; prereq Math 10) Johnson and staff

PubH 121Af-Bw-Cs.* Quantitative Mammalian Biology. A. Diffusion, surface tension, and mechanics of respiration, circulation, digestion, and locomotion. B. Chemical aspects of blood, respiration, renal function, nutrition, and metabolism. C. Endocrine, sensory, neuromuscular, and central neural functioning. (3 cr per qtr; prereq one-year sequences in mathematics, physics, chemistry, and biology or ‡) Evans

PubH 124. Medical Statistics II. Survey of biostatistics for dentists and physicians; elementary statistical methods and their application with emphasis on dental and medical research and appreciation of research literature; examples taken from recent dental and medical journals. (3 cr; prereq D.D.S. or M.D. or ‡) Bearman

PubH 140f. Vital Statistics I. Official sources; population changes; rates; trends; significant differences. (3 cr) Bearman, Thornton

PubH 144. History of Biometry. Development of probability theory and systems for collection of vital statistics; early application to life tables, medical, and biological problems; biographies of men important in development. (2 cr; prereq 3 cr in statistics) Thornton

PubH 150.* Vital Statistics II. Demographic techniques for biometry majors. (3 cr; prereq 140 and 110A or ‡) Brown

PubH 150A. Vital Statistics II. Demographic techniques and statistical inference for public health majors. (3 cr; prereq 140 with grade B) Thornton

PubH 180. Introduction to Biometry. Variation; frequency distribution; probability; estimation; significance tests; binomial, normal, Poisson distributions; serial dilutions, most probable number. (6 cr; prereq environmental health students only, others ‡) Boen

PubH 197Af-Bw-Cs.* Elements of Mathematical Biology. Physico-, chemico-, mathematical biology; statics and dynamics of tissues and fluids; biological reaction and compartment analyses, ion diffusions, and colloids; analog and digital computer uses in biomedicine. (5 cr per qtr; prereq mathematics through differential equations and 1-year sequences in physics, chemistry, and a basic biological science, with lab work in one or more, or ‡) Evans

PubH 200x.* Research. Opportunities are offered by the School of Public Health and by various co-operating organizations for qualified students to pursue research work. (Cr ar) Graduate staff

PubH 201x.° Topics in Biometry. Studies in special topics for advanced students. (Cr ar; prereq 110A and ‡) Staff

PubH 203Af-Bw-Cs.° Research Design in Biometry. Methodology of design of experiments and sample surveys in behavioral and biological sciences; randomized blocks, Latin-squares, factorials, incomplete blocks, long-term experiments and analysis of groups of experiments; simple random, stratified, multistage, and multiphase sampling designs. (3 cr per qtr; prereq 110C or ‡) McHugh

PubH 204Af-Bw-Cs.° Theory of Research Design in Biometry. Theory of linear estimation and general linear hypothesis; analysis of multiple classifications; components of variance; randomization theory of designs. (2 cr per qtr; prereq calculus and ¶203A-B-C) McHugh

PubH 211x.° Seminar: Biometry. (Cr ar) Staff

PubH 216A-B.° Biomedical Measurement Problems. Statistical aspects of biological assays and counting techniques, calibration problems, quality control procedures. (3 cr per qtr; prereq 110C) Brown

PubH 217A-B.° Theory for Biomedical Measurement Problems. (2 cr per qtr; prereq Stat 123 or Stat 133 or ‡, and ¶216A-B) Brown

PubH 250Af-Bw-Cs.° Foundations of Biometry. Measurement models, theories of probability, logic of induction, alternative theories of inference. (2 cr per qtr; prereq 204C, 217B or ‡) Staff

BIOPHYSICS

Committee:

Professor

Rufus W. Lumry, Ph.D., *chairman*
Kenneth N. Ogle, Ph.D.
A. Glenn Richards, Ph.D.
Otto H. Schmitt, Ph.D.
Carlo A. Terzuolo, M.D.

Associate Professor

Robert M. Benolken, Ph.D.

Staff:

Professor

Kenneth N. Ogle, Ph.D.
Murray D. Rosenberg, Ph.D., M.D.
Otto H. Schmitt, Ph.D.
Marvin M. D. Williams, Ph.D.

Associate Professor

Eugene Ackerman, Ph.D.
Robert M. Benolken, Ph.D.
Merle K. Loken, Ph.D., M.D.

Assistant Professor

Alan L. Orvis, Ph.D.

Additional staff for course work in biophysics are drawn from the Departments of Zoology, Physics, Chemistry, Genetics, Physiology, Chemical Engineering, and the Mayo Graduate School of Medicine. At present there are opportunities for thesis research in a limited number of areas including bioelectronics, metabolite and energy dynamics, neural and sensory physiology, radiology, membrane structure and function, certain aspects of computer research, and physical chemistry of proteins. There are opportunities for additional types of thesis research at the Mayo Graduate School of Medicine in Rochester, Minnesota. Ph.D. students doing thesis work at the Mayo Graduate School of Medicine customarily take the major part of their course work in Minneapolis. In addition there is a Master's program in biophysics at the Mayo Graduate School of Medicine which includes only courses given in Rochester.

Prerequisites—Basic preparation in biological and physical sciences and mathematics, with an undergraduate major in one of these areas, is required.

Language Requirement—For the Master's degree, either reading knowledge of one language (Russian or German recommended) or substitution of approved course work, choice of approved course work or language to be

made by the student's adviser. For the Ph.D. degree, either Russian or German and an additional language chosen from Russian, German, or French. A collateral field may be substituted for the second language.

Master's Degree—Offered under Plan A and Plan B.

Doctor's Degree—Work leading to the Ph.D. degree is offered.

Biophysics is a broad field including diverse biological and physical disciplines. Accordingly credit in biophysics is regularly granted for courses drawn from various departments. A wide diversity of appropriate courses is available in addition to those listed. The student's program should include courses from the following list supplemented by other courses listed under their respective departmental headings. In consultation with his adviser the student should plan a program tailored to his individual needs. Because biophysics is highly interdisciplinary a minor field is not identified as such on the student's program.

105. Review of Elementary Physics. For medical students by arrangement with instructor. (1 cr) Loken

138x. Seminar: Biophysics and General Physiology. (Cr ar) Staff

Zool 153. Molecular Biology. (3 cr; offered 1967-68 and alt yrs) Benolken

155,* 156,* 157.* Biophysics. Theoretical and experimental aspects of biology that can be studied by quantitative physical means. 155: Tissue ultrastructure (biostatistics) as revealed by hypermicroscopy, birefringence, X ray, electron and radioactive means, and by colloidal and micellar phenomena. 156: Dynamics of biophysical systems: excitatory state, contraction, secretion, synthesis. 157: Integrative biophysical systems; stability of systems, transmission of information, sensory mechanism. (3 cr per qtr; prereq 28 cr distributed between physics and biology, ‡...physical chemistry and physiology recommended; schedule ar) Schmitt

170, 171, 172. Radiation Biophysics. Theoretical and experimental aspects of radiological physics, medical physics, and radiobiology. Consideration of physical properties of various ionizing radiations, interaction of ionizing radiations with biological systems, and the use of radioactive isotopes as tracer elements. (3 cr per qtr; prereq ‡) Loken

204x.* Research in Biophysics and Radiation Biology. (Cr ar) Loken

218x. Seminar: Radiobiology. Discussion of research problems and current literature on the biological effects of ionizing radiations. (1 cr; prereq ‡)

221x*-222x*-223x.* Research in Biophysics. (Cr ar) Staff

Rad 236. Seminar: Radioisotope. (1 cr; prereq ‡) Loken

296*-297*-298.* Seminar: Biophysics. (Cr ar) Schmitt, Benolken

BOTANY

Professor

Ernest C. Abbe
Alan J. Brook
Murray F. Buell
A. Orville Dahl
Richard I. Evans
Albert W. Frenkel
Eville Gorham
John W. Hall, *director of graduate study*
Donald B. Lawrence
Albert J. Linck
Thomas Morley
Gerald B. Ownbey
Herbert E. Wright, Jr.

Associate Professor

S. Galen Bradley
Herbert Jonas
Douglas C. Pratt
Jack Van't Hof
Conrad J. Weiser

Assistant Professor

Edward J. Cushing
William B. Cunningham
William A. Reiners
Thomas K. Soulen

Prerequisites—For major work, general biology (Biol 1-2 or equivalent) and at least 17 additional credits in botany approved by the department; with consent of the major adviser, credits in related subjects may be substituted. For minor work, general biology (Biol 1-2 or equivalent).

Language Requirement—For the Master's degree, reading knowledge of scientific literature in one foreign language, preferably French, German, or Russian. For the Ph.D. degree, two languages, one of which must be German, the other either Russian or French.

Master's Degree—Offered under both Plan A and Plan B.

Doctor's Degree—Work leading to the Ph.D. degree is offered.

Note—For courses in plant pathology and mycology, see Plant Pathology; for courses in genetics and cytogenetics, see Genetics.

101f,w,s. Basic Botany. Individual work in some special discipline. (Cr ar; prereq Biol 2 or equiv and ‡) Staff

103f. Plant Embryology. Early stages of somatic development with emphasis on vascular plants. (3 cr; prereq 104 or ‡; offered when feasible) Abbe

104f.° Survey of the Plant Kingdom. A brief consideration of evolutionary relationships throughout the plant kingdom, illustrated by life histories. (5 cr; prereq Biol 2 or 51) Abbe

106w. Survey of Angiosperm Families. Detailed study of orders and families of flowering plants on a world-wide basis. (5 cr; prereq 52 or ‡; offered 1967-68 and alt yrs) Morley

108f. Pteridophytes. Classification of living ferns and fern allies, especially of temperate North America; terminology; keys; geographic distribution; distinguishing characters of families, genera, and species. (3 cr; prereq 52 or ‡; offered 1967-68 and alt yrs) Ownbey

110f. Gymnosperms. Taxonomy and phylogeny of gymnosperms; emphasis on living representatives. (3 cr; prereq 52 or ‡; offered 1966-67 and alt yrs) Ownbey

112su.° Aquatic Flowering Plants. The higher plants of aquatic and marsh habitats. Identification and adaptive morphology. (5 cr; prereq 52 or equiv or ‡; offered only at Itasca Biology Session)

114w.° Principles of Angiosperm Phylogeny. Evolutionary relationships and the various means of judging them within the angiosperms. Laboratory investigation of representative and critical groups. (3 cr; prereq 52 or ‡; offered 1968-69 and alt yrs) Morley

115s. Flora of Minnesota. Vascular plants of the state; taxonomic and floristic relationships; geographical distribution and variation; speciation; collecting and identification; field trips. (4 cr; prereq 52 or ‡) Ownbey

116su. Summer Flora of Minnesota. Survey of summer flowering plants and ferns of the state; local flora. Collection and identification; distribution in Minnesota; literature and taxonomic methods. (5 cr; prereq 52 or equiv or ‡)

118f,s. General Cytology. Introductory analysis of structure and related functions of intact cells and protoplasmic systems. Nature of cytoplasm, nuclei, and cell walls. Relationship of cytological data to life cycles, cytogenetics, cytotaxonomy, and cytochemistry. (5 cr; prereq 10 cr in biology, botany, or zoology, elementary genetics or ‡) Dahl, Van't Hof

119w. Experimental Cytology. Discussion and experimental analysis of suitable, current, specialized phases of cytology. Use of microscopical and cytochemical analytical methods to study cells *in vitro* and *in vivo*. (3 or 5 cr; prereq 118 or Zool 272) Van't Hof

121w.° Developmental Plant Anatomy. Microscopic structure of vascular plants; development in root, stem, and leaf. (5 cr; prereq Biol 2 or 51 or equiv) Abbe

125f.* Morphogenesis. Development of form and structure in ontogeny and phylogeny; phenomena and genetical factors involved. (5 cr; prereq 10 cr in botany or biology; offered when feasible) Abbe

126f. Pre-Pleistocene Palynology. Survey of pollen and spores primarily from Mesozoic and Tertiary deposits. Techniques of sample preparation; nomenclature and identification of fossil pollen and spores; their use in stratigraphy. (3 cr; prereq 165; offered 1966-67 and alt yrs) Hall

127.* Morphology of Vascular Plants. Vegetative and reproductive structure of living and fossil vascular plants. Their evolutionary relationships based on phylogenetic principles. (5 cr; prereq 104 or ‡; offered when feasible) Abbe, Hall

128s. Phyletic Paleobotany. Morphology, anatomy, and evolution of fossil plants, especially those occurring in the late Paleozoic. (3 cr; prereq ‡) Hall

129f. Floristic Paleobotany. Fossil floras from the late Paleozoic to the present; macrofossil remains, especially leaves, and their use in stratigraphy, paleoclimatic and paleoecologic interpretations. (3 cr; prereq ‡; offered 1967-68 and alt yrs) Hall

130f.* Ecology of Plant Communities. Patterns in development, structure, interrelationships, stability of plant communities. (5 cr; prereq Biol 80) Reiners

131w.* Structure and Function of Ecosystems. Energy exchange and cycles of water and nutrients, in relation to biological productivity and development and regulation of ecosystems. (5 cr; prereq Biol 80, 81, introductory chemistry and physics, or ‡) Reiners

133s.* Ecological Plant Geography. Ecological principles of plant distribution and landscape analysis, vegetation regions of North America, interpretation of regional vegetation patterns. (3 or 5 cr; prereq Biol 80 or ‡; offered 1967-68 and alt yrs) Lawrence, Cushing

135su. Ecology of the Itasca Region. Plant communities represented; their dynamic relationships. Relationships of local communities to vegetation of Minnesota as a whole. Use of modern methods of vegetation analysis and measurement of environmental factors. (5 cr; prereq Biol 80 or ‡; offered only at Itasca Forestry and Biological Station)

137s.* Ecological Life Histories of Plants. Influence of environmental factors on each developmental stage of life cycle under natural conditions. Individual species assigned for study at Cedar Creek Natural History Area. Weekly half-day field trips. (5 cr; prereq Biol 51, 80, 81, 91, 91A and ‡; offered 1968-69 and alt yrs) Lawrence

138su. Freshwater and Wetland Ecology. Nature, origin, and development of lake, marsh, swamp, and bog ecosystems; environmental control and productivity. (5 cr; prereq 15 cr in biological subjects, introductory chemistry, or ‡...Biol 80 recommended)

139s. Paleoecology. Nature of fossil evidence; problems and techniques for the reconstruction of past habitats, populations, communities, and ecosystems. Examples from various parts of the geologic column and from various groups of organisms. (3 cr; prereq 8 cr in geology and Biol 80, or ‡; offered 1966-67 and alt yrs) Cushing

141s. Survey of Plant Physiology. A critical study of the physiological processes which occur in living plants; emphasis on higher plants. Growth and development, energy relations, mineral nutrition, water relations, respiration, photosynthesis, and nitrogen metabolism. (3 cr; prereq Biol 2 or 51, course in organic chemistry) Frenkel

141As. Plant Physiology Laboratory. A laboratory course to accompany Bot 141. (2 cr; prereq 141 or ¶)

150f. Introduction to the Study of Algae. Structure, reproduction and life histories of major algal divisions. (5 cr; prereq 10 cr in botany or biology or ‡; offered 1966-67 and alt yrs) Brook

151f. Biology of Algae. Aspects of the biology of the algae; their culture, cytology, and ecology, and their importance in limnology, fisheries, public health, and water supplies. (5 cr; prereq 150 or ‡; offered 1967-68 and alt yrs) Brook

152su. Ecology of Freshwater Algae. Aspects of algal ecology in lakes and ponds; phytoplankton, benthos, and periphyton; also in streams, bogs, soils, and other terrestrial

habitats. Laboratory instruction in relevant research techniques. (5 cr; prereq 150 or 155 or ‡; offered only at Itasca Biological Station)

155su. Freshwater Algae. Morphology and taxonomy of freshwater algae; collection and identification of local algae. (5 cr; prereq 10 cr in biology or ‡; offered only at Itasca Forestry and Biological Station)

157su. Bryophytes and Pteridophytes. Field and laboratory study of mosses and liverwerts of Minnesota. (5 cr; prereq 10 cr in biology or ‡; offered only at Itasca Forestry and Biological Station)

158su. Theory and Practice in Environmental Measurement. Physical factors of environment: energy budget, water budget, and microclimatic variation. Modern field instrumentation. (5 cr; prereq college physics, ecology or physiology; offered only at Itasca Forestry and Biological Station)

159su. Lichens. Taxonomy, ecology, and floristics of the lichens of northern Minnesota; identification, sampling methods, microchemistry as a taxonomic tool. (5 cr; prereq 10 cr in botany or zoology or ‡; offered only at Itasca Forestry and Biological Station)

165w. Introduction to Pollen Analysis. Ontogeny, comparative morphology, and identification of pollen grains; preparation of reference collections, applications of pollen analysis to allergology, ecology, and phylogeny; practice in atmospheric analysis. (3 cr; prereq 10 cr in botany or biology or ‡; offered 1967-68 and alt yrs) Dahl

166s. Introduction to Palynological Analysis. Application of techniques of pollen-spore investigations to research analyses of atmosphere, recent and ancient deposits, systematic materials, allergology, etc. (5 cr; prereq 165 or ‡; offered 1966-67 and alt yrs) Dahl

169w.* Quaternary Phytogeography. Historical problems in interpretation of distribution of modern plant species. Applications of Pleistocene and recent pollen and plant macrofossil analysis; applications to phytogeography. Field and laboratory methods. (4 cr; prereq 165 and Biol 80, or ‡; offered 1967-68 and alt yrs) Cushing

182f. Plant Physiology. The plant cell and its organelles, metabolism including photosynthesis, and genetic control of physiological processes; dynamic aspects of these processes. (3 cr; prereq Biol 60 or equiv) Soulen, Olson

183w. Plant Physiology. Membrane phenomena, water relations, mineral metabolism, and translocation in plants. (3 cr; prereq Biol 2 or 51, OrCh 42 or 62, physics) Sudia and staff

184s. Plant Physiology. Growth of higher plants, including regulation by hormones, light, and temperature. (3 cr; prereq Biol 2 or 51, OrCh 42 or 62, physics) Brun and staff

185w.* Physiology of Photosynthetic Microorganisms. Primarily a laboratory course. Application of spectrophotometry, manometry, and other techniques toward elucidation of physiological behavior, chemical makeup, and intermediary metabolism of algae and photosynthetic bacteria. (3-5 cr; prereq ‡; offered 1966-67 and alt yrs) Frenkel

186w. Measurement of Plant-Environment Interactions. A laboratory course dealing with measurements using intact plants, including water balance, plant-radiation interactions, and gas exchange between plants and the environment. (1-4 cr; prereq PCh 90, and ‡) Sucoff and staff

187f. Methods of Plant Analysis. A laboratory course dealing with techniques of sample preparation, fractionation of plant material, and isolation and determination of compounds occurring in plants. (1-4 cr; prereq AnCh 57, 8 cr in biochemistry and ‡) Weiser and staff

188f,w,s. Research Perspectives in Plant Physiology. A laboratory course in which the student undertakes a well-defined research problem of limited scope. (1-4 cr; prereq ‡) Behrens and staff

280w. Radioisotope Techniques Applied to Biology. Lecture and laboratory course on uses of radioisotopes in biological research; problems in their use and measurement. (3 cr; enrollment limited; prereq nuclear physics) Linck, Rust

281s. Growth and Differentiation of Plants. Nature and characterization of plant growth, with analysis of the physiological changes which occur during growth and differentia-

tion of plants; hormonal control of growth processes. (3 cr; prereq 184; offered 1967-68 and alt yrs) Linck

282f. Advanced Topics in Plant Metabolism. Treatment in depth of one or more topics selected from the following: respiratory pathways, including modifications; organic acid metabolism; nitrogen metabolism; sulfur metabolism. Content of course will vary with instructor and may include topics not listed. (3 cr; prereq 182; offered 1967-68 and alt yrs) Olson, Soulen

283w. Structural Physiology. Interrelationship of chemical composition, physiological activity, and ultrastructure of biological systems. (5 cr; prereq ‡; offered 1967-68 and alt yrs) Cunningham

284s. Ecological Physiology. Organization, collection, and interpretation of physiological data so that it may have ecological significance particularly at the community level. (3-5 cr; prereq ‡; offered when feasible)

285w. Photosynthesis. Detailed survey of the present state of knowledge of photosynthesis. (3 cr; prereq 182; offered 1966-67 and alt yrs) Frenkel

297f,w,s. Special Topics. Treatment in depth of one or more biological topics. (Cr ar; prereq ‡) Staff

298f,w,s. Seminar. (1 cr per qtr) Staff

299f,w,s. Research Problems. (Cr ar) Staff

BUSINESS ADMINISTRATION

Professor

Robert G. Berryman
Gordon B. Davis
George W. England
Richard K. Gaumnitz
Nicholas Glaskowsky, *director of graduate study*
Paul V. Grambsch, *dean*
Robert S. Hancock
Donald V. Harper
Delbert C. Hastings
Herbert G. Heneman, Jr.
Thomas R. Hoffmann
Robert J. Holloway
Richard L. Kozelka
Edwin H. Lewis
Thomas A. Mahoney
John Neter
Edmund A. Nightingale
George Seltzer
Allen R. Solem
Harold W. Stevenson
Albert K. Wickesberg
C. Arthur Williams, Jr.

Associate Professor

Jack C. Gray
J. Russell Nelson
Charles R. Purdy
Jay M. Smith
Raymond E. Willis

Assistant Professor

Ellen Berscheid
Gary Dickson
John J. Mauriel, Jr.
Ernest S. Pavlock
Peter Rosko
Cyrus F. Smythe
Curtis H. Stanley

Eligibility Examination—Applicants for work in business administration are required to present a report of their performance on the Admission Test for Graduate Study in Business as part of the application for admission to graduate work in that field. Since this test is given at limited times and places during the year, students would be well advised to make early arrangements for registration for the examination. For information concerning registration for the examination, students should write to the Educational Testing Service, P.O. Box 966, Princeton, New Jersey.

Master of Business Administration

1. **Purpose**—This degree is designed for the individual who desires to build upon a general competence in business administration the ability to analyze and solve problems faced by business managers. To this end, the student's primary orientation is directed in the areas of administrative responsibility and decision making.

2. **Degree Requirements**—Participants must complete the requirements outlined in the sections which follow. Requirements in the "Tool Areas and Underlying Disciplines" and "Basic Business Core" (sections a and b below) may be met through appropriate courses taken in the student's undergraduate program. Students lacking any of these courses or their equivalents must take courses necessary to meet the requirements of these two sections. Any deficiencies may be removed during regular enrollment in the M.B.A. program.

a. *Tool Areas and Underlying Disciplines*—All students must complete two introductory courses in managerial accounting; two introductory courses in the behavioral sciences (psychology, sociology); and one introductory course in each of the following: statistics, quantitative approaches to administrative problems (QA 258), managerial economics, national income and employment, and elementary differential and integral calculus.

b. *Basic Business Core*—Students must also complete:

(1) one introductory course in each of the following: fundamentals of management, business finance, marketing fundamentals, administration of production, and manpower management; and

(2) one introductory course in each of two areas selected from the following three: business law, risk management and insurance, and transportation and business logistics.

All participants in the M.B.A. program are required to complete the requirements outlined in the sections "Advanced Managerial Core" and "Areas of Interest" while enrolled in the M.B.A. program at the University of Minnesota.

c. *Advanced Managerial Core*—The M.B.A. candidate must complete:

(1) all of the following: Executive Leadership (Mgmt 250), Government and Business Enterprise I and II (Mgmt 256-257), Quantitative Approaches to Administrative Problems II (QA 259), and Strategy Formulation and Implementation (Mgmt 260); plus

(2) three courses to be selected from among the following: Production Management (Prod 100), Risk Management and Insurance II (Ins 163), Traffic Management (Tran 174), Intermediate Labor Marketing and Manpower Management (IR 182C), Marketing Management (Mktg 247), Managerial Cost Accounting (Acct 265A), Financial Management (BFin 257)

d. *Areas of Interest*—For purposes of Graduate School credit requirements, the M.B.A. degree program consists of 45 graduate credits earned under the requirements in sections c and d. In meeting this requirement, each candidate must select at least three elective courses (9 credits). Students with extensive undergraduate background in business may need to elect additional graduate courses to bring their graduate credit total to 45. All elective courses must comply with the requirements in sections d(1) and d(2) which follow. (Up to 12 graduate credits earned

under sections a and b may be included in the candidate's formal program to meet the Graduate School's 45-credit minimum).

(1) The following areas in business administration may be used as areas of interest in which the student may take additional course work:

Accounting	Production
Business finance	Quantitative analysis
Industrial relations	Risk management and insurance
Management	Transportation and business logistics
Marketing	

(2) Electives selected under this section must be distributed so that no more than two courses beyond those required in sections a, b, and c are selected in any one area as defined in d(1). Courses in business law and office management may be used as electives. A maximum of two courses may be taken outside the Graduate School of Business Administration.

e. *Written Reports*—At least 9 credit hours of the requirements in paragraphs c and d must be earned in courses requiring the preparation of written reports which represent the quality but not the range of a Master's thesis. These "Plan B papers" must be prepared for courses beyond the introductory course of the area in at least two different areas. Courses used to meet this requirement must receive the prior approval of the course instructor and the major adviser.

f. *Examinations*—All candidates will be required to take a final oral or written examination, or both, at the discretion of the examining committee.

g. *Foreign Language*—A foreign language is not required.

Master of Science

1. **Purpose**—This degree is recommended for those individuals who wish intensive preparation in a functional area of business activity leading to professional status in their chosen area of specialization (e.g., accounting, investment analysis, market research, traffic, personnel, operations research, production control, and similar areas).

The M.S. is offered either with or without thesis and may be completed in from 1 to 2 years depending on the extent of the person's undergraduate preparation.

2. **Degree Requirements**—

a. ALL CANDIDATES (Plan A and Plan B) must complete the requirements as outlined in the sections "Tool Areas and Underlying Disciplines" and "Basic Business Core," sections a(1) and a(2). Appropriate courses in the student's undergraduate program may be submitted to meet these requirements. Students lacking any of these courses or their equivalents

must take courses necessary to meet the requirements of these two sections. Any deficiencies may be removed while the student is regularly enrolled in the M.S. program.

(1) *Tool Areas and Underlying Disciplines*—All students must complete two introductory courses in managerial accounting; two introductory courses in the behavioral sciences (psychology, sociology); and one introductory course in each of the following: statistics, quantitative approaches to administrative problems (QA 258), managerial economics, national income and employment and elementary differential and integral calculus.

(2) *Basic Business Core*—All students must complete one introductory course in each of the following: fundamentals of management, business finance, marketing fundamentals, administration of production, and manpower management.

b. DEGREE REQUIREMENT, PLAN B (WITHOUT THESIS)—In addition to the requirements in paragraph 2a, students seeking the M.S. degree (Plan B) must satisfy the following:

(1) *Major Field of Concentration*—

(a) The major field must be selected from the following areas in business administration:

Accounting	Production
Business finance	Quantitative analysis
Industrial relations	Risk management and insurance
Management	Transportation and business logistics
Marketing	

(b) The major field consists of a minimum of 21 quarter credits in graduate courses selected at the adviser's discretion from courses within the major area as identified in b(1)(a) and where appropriate from other areas in the Graduate School of Business Administration and/or other fields of instruction in the Graduate School, subject to the limitations in section b(3).

(2) *Related Fields or Underlying Disciplines*—

(a) A minimum of 18 quarter credits in graduate courses in only two related fields or areas, with a minimum of 6 credits in each, will be offered to meet this requirement. At least one of these fields or areas must be outside the Graduate School of Business Administration. A related field within the Graduate School of Business Administration may be selected from any of the areas listed in section b(1)(a) above, other than the major area. Courses selected under sections a(1), a(2), and b(1) cannot be used to meet this requirement except as permitted under the conditions of section b(3).

(3) *Additional Requirements and Recommendations*—

(a) For purposes of Graduate School credit requirements, the M.S. degree Plan B credit program consists of 45 credits earned under the requirements of sections b(1) and b(2) except that up to 6 graduate credits earned under sections a(1) and a(2) may be included to meet this requirement.

(b) It is highly recommended that some research methodology courses, such as QA 251 and/or QA 191, be incorporated in the degree program, either as part of the major requirement or as a related field.

(4) *Written Reports*—At least 9 credit hours of the requirements in sections b(1) and b(2) must be earned in courses beyond the introductory course of the area requiring the preparation of written reports which represent the quality but not the range of the Master's thesis. Of the 9 credit hours, 6 must be in the major field of study and 3 outside the major field. Courses used to meet this requirement must receive the prior approval of the course instructor and the major adviser.

(5) *Examinations*—All candidates are required to take a final oral or written examination, or both, at the discretion of the examining committee.

(6) *Foreign Language*—A foreign language is not required.

c. Degree Requirements, Plan A (with thesis)—In addition to the requirements in paragraph 2(a), students seeking the M.S. (Plan A) must satisfy the following:

(1) *Major Field of Concentration*—

(a) The major field will be selected from the following areas in business administration:

Accounting	Production
Business finance	Quantitative analysis
Industrial relations	Risk management and insurance
Management	Transportation and business logistics
Marketing	

(b) The major field consists of 18 quarter credits in graduate courses selected at the adviser's discretion from courses within the major area as identified in c(1) (a) and where appropriate from other areas in the Graduate School of Business Administration and/or other fields of instruction in the Graduate School.

(2) *Related Field or Underlying Discipline*—A single field outside the Graduate School of Business Administration and totaling 9 credits

in graduate courses must be selected from among those fields of instruction recognized by the Graduate School.

(3) *Additional Requirements and Recommendations*—

(a) Courses used to meet the requirements in sections a(1) and a(2) cannot be used to fulfill the requirements of sections c(1) and c(2).

(b) It is highly recommended that some research methodology courses be incorporated in the degree program. Courses such as QA 251 and/or QA 191 may be included as part of the major requirement. Research methodology courses from other areas of instruction within the Graduate School may be used as the related field.

(4) *Thesis*

(5) *Examinations*—All candidates are required to take a final oral or written examination, or both, at the discretion of the examining committee.

(6) *Foreign Language*—A foreign language is not required.

Doctor of Philosophy

Candidates for the doctor of philosophy degree must complete the following, subject to the approval of the Graduate School:

1. **General Competence**—For admission to the doctoral program, each prospective candidate must demonstrate competence in tool areas, underlying disciplines, and the basic business core as outlined under the requirements for the master of science in business degree. The level of competence is that typically to be obtained from two introductory courses in each of the areas of accounting and the behavioral sciences; one introductory course in each of the following: statistics, quantitative approaches to administrative problems, managerial economics, national income and employment, differential and integral calculus, fundamentals of management, business finance, marketing fundamentals, administration of production, and manpower management.

2. **Major Field of Concentration in Business**—The prospective candidate must pass a comprehensive written proficiency examination in his major field of concentration to be selected from the following:

Accounting	Production
Business finance	Quantitative analysis
Industrial relations	Risk management and insurance
Management	Transportation and business logistics
Marketing	

3. **Related Field of Concentration in Business**—The prospective candidate must also demonstrate basic competence by passing a written examination in a

related field within business administration to be selected from the fields listed in paragraph 2 above.

4. **Research Methodology and/or Technique**—A minimum of 9 credits in research methodology and/or technique courses numbered 100 or higher must be completed with grades of C or better to give the student technical research competence in his area of specialization. The courses selected to meet this requirement must provide for an integrated development of this research competence, and must be approved by the adviser and by the Program Review Committee of the graduate faculty in business administration.

5. **Underlying Discipline**—The following fields are identified as underlying disciplines for business administration: economics, mathematics, psychology, and sociology. The prospective candidate must achieve basic competency in one or two of the underlying disciplines by completing either:

a. one of the above underlying disciplines as a minor field; in this case, all of the minor field requirements as set forth by the Graduate School must be met; or

b. 12 graduate credits in one underlying discipline selected from the four listed above plus 12 graduate credits in a related field also outside the area of business administration (this latter related field may be a second underlying discipline from the four listed above); an average of B or better must be earned in the courses used to meet the requirements of this subsection.

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

7. **Oral Examination**—Within a reasonable time after successful completion of the written examinations in the major and related fields in business, students will take a comprehensive oral examination. This examination may cover any work in the student's approved program with the exception of the thesis. Successful completion of this examination formally admits the student to candidacy for the degree.

8. **Thesis and Final Oral**—The candidate will complete a doctoral dissertation and final oral examination as prescribed by the Graduate School.

9. **Ph.D. Minor**—Business administration may be selected as a minor, or as part of a supporting program, for the Ph.D. A minor in business administration shall consist of either:

a. a cohesive program of 24 credits of graduate work in business administration developed in consultation with an adviser who is a full member of the graduate faculty in business administration, or

b. passing a written Ph.D. preliminary examination in one of the fields in business administration. (See list of fields in paragraph 2, above. Persons wishing to minor in industrial relations should consult the chairman of the Department of Industrial Relations.)

Management

Mgmt 150A. Fundamentals of Management. A first course in management at the graduate level; functions of manager-planning, organization, staffing, direction, and control. Activities, problems, and common remedies under each of these functional headings. Case analysis designed to bring out specific points and develop insights into management problems. (3 cr) Glaskowsky

Mgmt 250. Executive Leadership. Behavior theory and principles applied to understanding and performance of leadership function in management of organizations. Laboratory procedures used to highlight individual and group concepts in processes of problem sensing, location, and solution, and to provide practice in basic skills. (3 cr) Solem

Mgmt 251. Superior-Subordinate Problems. Theory, methods, and skill development in the application of behavior concepts to management problems. Problem solving, role playing, discussion methods, and readings from current literature. (3 cr; prereq 250) Solem

Mgmt 256. Government and Business Enterprise I. Varied interrelations of governmental and business activities in American society. Recent trends and future prospects regarding the scope of such relationships. Government as: (a) a rule maker for business —in peace and war-time contexts; (b) a direct participant in the economic process—e.g., procurement practices, employment policies, and operation of publicly owned enterprises; and (c) an indirect participant in business activities—e.g., programs regarding small business, urban redevelopment and housing, "distressed" areas, research, plant construction, resource conservation and development. (3 cr) Seltzer

Mgmt 257. Government and Business Enterprise II. Relationship between governmental policy and maintenance of competitive markets. Purpose, substance, and problems of antitrust law and administration. Desirability, feasibility, and effectiveness of antitrust policy. Meaning of "effective competition," "workable competition," and "countervailing power." Considers: (a) relation between business size and efficiency; and (b) compatibility of antitrust and range of other governmental policies. (3 cr; prereq 256) Seltzer

Mgmt 260. Strategy Formulation and Implementation. Integrating course in area of policy formulation and administration. Duties and responsibilities of top management in establishing objectives and co-ordinating interdepartmental policies and activities. Student draws on his knowledge of marketing, production, finance, accounting, personnel, statistics, and other related fields in solving organization-wide administrative problems. (3 cr, §60; prereq 250 and 256 or ¶) Mauriel

Mgmt 270. Evolution and Development of Managerial Thought. Intensive study of outstanding writers and practitioners in building a theory and philosophy of management. Examines case to be made for management as a distinct functional activity. Evaluates the movement to apply methods of science to the area of management. Contributions made by engineering, sociology, psychology, economics, etc., to concept of management. Projects role of executive into the firm and society of the future. (3 cr; prereq 2nd yr grad or equiv) Wickesberg

Mgmt 290A. Readings in Management Theory and Administration. Readings should involve intensive research into a particular subject and normally require preparation of a major term paper. (Cr ar; prereq consent of adviser and ‡, 2nd yr grad standing in requisite introductory courses)

Mgmt 290B. Graduate Research in Management Theory and Administration. Special research projects in co-operation with a specific problem in a business firm. (Cr ar; prereq consent of adviser and ‡, 2nd yr grad standing in requisite introductory courses)

Mgmt 340. Seminar: Interpersonal Relations. (3 cr; prereq 251) Solem

Mgmt 360. Seminar: Management. (3 cr; prereq 260 or equiv) Gaumnitz and others

Production

Prod 100. Problems in Production Management. Current problems and techniques. Builds upon the introductory course in developing maturity and insight into production factors. Similar problem areas. (3 cr; prereq 50 or equiv) Dickson

Prod 110. Systems and Procedures Analysis. Management systems concepts; application and implementation of information and communication networks in the firm, integrated cybernetic systems and work relationships of groups, individuals, machines, and management as evaluated through time and productivity measurements. (3 cr; prereq 50 or equiv) Dickson

Prod 150B. Administration of Production. Fundamentals of production from management point of view. Techniques, managerial problems, and decision-making processes in administration of production function. Limited use of case material and/or field study to observe practical difficulties in utilizing operating principles. (3 cr, §50; prereq Mgmt 150A or ‡) Hoffmann

Prod 220. Production Planning and Control. Production forecasting, process planning and routing, material and tool control, loading, scheduling, dispatching, and mathematical analysis of managerial production control problems. (3 cr; prereq 150B, QA 61, QA 258 or ‡) Hoffmann

Prod 290A. Readings in Production. Intensive research into a particular subject; preparation of a major term paper normally required. (Cr ar; prereq consent of adviser and ‡, 2nd yr grad standing in requisite introductory courses)

Prod 290B. Graduate Research in Production. Research projects in co-operation with a specific problem in a business firm. (Cr ar; prereq consent of adviser and ‡, 2nd yr grad standing in requisite introductory courses)

Prod 350. Seminar: Production. (3 cr; prereq 100 or equiv) Hoffmann

Quantitative Analysis

QA 150. Mathematics for Business Analysis. Introduction to mathematical concepts and notation as applied to the description and analysis of business operations. Applications of differential and integral calculus to business problems. For graduate students with limited mathematical background. (3 cr, §Math 40, §Math 24A; prereq Math 10 or equiv) Willis, Neter

QA 151. Elements of Statistics. Statistical description, frequency distributions, probability, sampling, introduction to statistical estimation and decision making. (3 cr, §51; prereq Math 10 or equiv) Kozelka, Hastings, Neter

QA 171. Statistical Methods for Sample Surveys. Introduction to commonly used sampling methods, including stratified sampling, multistage sampling and cluster sampling; methods of estimation, including ratio and regression estimates; design of surveys taking into account various costs; statistical measurement and control of nonsampling errors. (3 cr; prereq 51 or 151 or 54 or equiv) Hastings, Neter

QA 175. Business Forecasting. Use of quantitative methods in forecasting and planning for the business firm. Forecasting models; time series analysis; regression and correlation analysis; computer usage; survey of forecasting materials; critique of methods and materials; preparation of a forecast. (3 cr; prereq 51 or 151 or 54 or equiv)

QA 181. Quality Control and Industrial Statistics. Acceptance sampling by attributes and variables; construction of single, double, and multiple acceptance sampling plans; statistical control charts and their operation; effectiveness of control charts; modification of control charts for special problems. (3 cr; prereq 51 or 151 or 54 or equiv) Hastings, Neter

QA 191A-B. Statistical Methods in Business Administration. Tests on nature of population and population characteristics. Normal, t, chi square, F distributions. Multiple linear and curvilinear regression and correlation. Other measures and tests of association. Introduction to design and analysis of experiments. Nonparametric estimation and tests. Conditions when a particular statistical method is appropriate; illustrations of applications of statistical methods. (3 cr per qtr; prereq 51 or 151 or 54 or Econ 121A or ‡, 191A for 191B) Hastings, Neter

QA 193. Statistical Design of Experimental Research in Business. Basic concepts of statistical design and analysis of results. Randomized block, Latin-square, cross-over, factorial designs; confounding, estimation, and comparison of effects; response surfaces;

applications in business administration. (3 cr; prereq 191B or equiv or ‡) Hastings, Neter

QA 231. Mathematical Programming for Business Analysis. Introduction to linear and other programming techniques useful in analyzing business operations. For graduate students interested in applying these techniques in functional areas of business operations. (3 cr; prereq 258) Willis

QA 236. Stochastic Models for Business Analysis. Techniques and use of differential and difference equation models and models based on stochastic processes. For graduate students interested in applying these techniques to dynamic and stochastic problems in functional areas of business operations. (3 cr; prereq 150 or Math 40 or equiv, 258, familiarity with FORTRAN or ¶FORTRAN seminar)

QA 251. Business Research Methods and Techniques. Examination of research methods and techniques and their application to individual problems. Introduction to sources of business information. Place of business research in business management. (3 cr; prereq 51 or 151) Hastings

QA 258-259. Quantitative Approaches to Administrative Problems I and II. Uses of probability, statistics, mathematics, economic analysis, and operations research in the solution of business problems at administrative levels. (3 cr per qtr, §58 to 258; prereq 151, Econ 65 or 165 or equiv) Willis, Andrew

QA 261. Use of Computers in Business Research. Problem-oriented computer programming; computer simulation; use of the computer for business research; individual programming projects relating to specific research problems of each student. (3 cr; prereq 258 or 191A or equiv, presentation of suitable research project, and ‡)

QA 291A. Readings in Quantitative Analysis. Special readings especially useful to student's individual program and objectives, but not available in regular course offerings. (Cr ar; prereq consent of adviser and inst in field covered)

QA 291B. Graduate Research in Quantitative Analysis. (Cr ar)

See also the following courses in economics in the subfield of econometrics and statistics.

Econ 101A—Foundations of Mathematics for Social Scientists

Econ 101B—Introduction to Decision Theory

Econ 131—Elements of Econometrics

Econ 195A,B—Decision Making—Operations Analysis

Econ 201A—Econometrics A

Econ 201B—Econometrics B

Econ 201C—Econometrics C

Econ 301—Seminar: Statistical Inference and Econometrics

Manpower Economics and Industrial Relations

For descriptions of the following courses see Industrial Relations.

IR 142. Settlement of Industrial Relations Disputes

IR 152. Systems of Industrial Relations: Labor Marketing

IR 152C. Industrial Relations Fundamentals

IR 162. Union Government and Policies

IR 172. Principles of Industrial Relations: Manpower Management

IR 175. The Employment Interview

IR 182A. Intermediate Labor Marketing

IR 182B. Intermediate Manpower Management

IR 182C. Intermediate Labor Marketing and Manpower Management

IR 192. Industrial Relations Practices and Techniques

IR 202. Organization and Staffing

IR 210. Organization Theory

IR 212A. Labor Education

IR 212B. Employee Development and Training

IR 222. Compensation and Reward

IR 232. Collective Bargaining: The Process

IR 242. Management Development

IR 252. International Manpower Development and Utilization

IR 262. Compensation and Reward Administration

IR 272. Graduate Topics in Industrial Relations

IR 282. Collective Bargaining: Legal Framework and Public Policy Issues

IR 292A. Readings in Manpower Economics and Industrial Relations

IR 292B. Graduate Research in Manpower Economics and Industrial Relations

IR 322. Seminar: Staffing, Training, and Development

IR 332. Seminar: Compensation

IR 352. Seminar: Labor Marketing

IR 362. Seminar: Organization Theory

IR 372. Seminar: Industrial Relations Research Methodology

IR 382. Seminar: Systems of Industrial Relations

IR 392. Seminar: Collective Bargaining

See also the following course in economics in the subfield of labor.

Econ 182—Economic Security

Risk Management and Insurance

Ins 113. Actuarial Science Principles—Life and Health Insurance. Construction and characteristics of mortality and morbidity tables; computation of life and health insurance premiums and reserves; nonforfeiture values; dividend calculations. (3 cr, §Math 21; prereq 53 or 153 or ‡) Williams

Ins 153. Risk Management and Insurance I. Nature and economic significance of risk. Recognition, measurement, and treatment of risk; insurable risks and insurance. Application of these concepts to property, liability, and personnel risks faced by a business firm or by a family. The risk management function in business and its relationship to other business management functions. Public policy and risk management; the problem of the uncompensated automobile accident victim, social insurance, and government regulation of insurance. (3 cr, §53; prereq Econ 2 or equiv) Whitman, Williams

Ins 163. Risk Management and Insurance II. A more intensive study of concepts presented in Risk Management and Insurance I and application to selected risk management situations. (3 cr; prereq courses in tool areas and underlying disciplines and basic business core including 153) Whitman, Williams

Ins 173. Senior Topics: Risk Management and Insurance. Individual student reports on topics of special interest and discussion of important current problems in risk management and insurance. (3 cr; prereq 6 cr in insurance) Whitman, Williams

Ins 193. Actuarial Science Principles—Property and Liability Insurance. Rate-making methods in property and liability insurance; statistical plans; determination of reserves. (3 cr; prereq 53 or 153 or ‡) Williams

Ins 203. Life and Health Insurance. Nature and relative importance of insurable risks; analysis of life and health insurance contracts; programming; estate planning; business insurance; pricing, underwriting, and marketing methods. (3 cr, §73; prereq 53 or 153) Whitman, Williams

Ins 213. Group Insurance. Group life insurance (term and permanent plans); group pensions (fixed and variable annuities); and group health insurance (disability income and medical expense plans). Basic principles, types of benefits, marketing and administration, methods of financing, and methods of funding. (3 cr, §83; prereq 53 or 153) Whitman, Williams

Ins 223. Property and Liability Insurance I. Nature and relative importance of insurable property and liability risks; analysis of property and liability insurance contracts; insurance surveys—optimum property and liability insurance programs. (3 cr, §93; prereq 53 or 153) Whitman, Williams

Ins 233. Advanced Life and Health Insurance. Advanced programming; premiums and reserves; dividends; underwriting and reinsurance; production; claims; the financial statement; insurer organization and capital structure; government regulation; current problems. (3 cr; prereq 203) Whitman, Williams

Ins 243. Property and Liability Insurance II. Types of property and liability insurers; problems in marketing, underwriting and reinsurance, and loss adjusting; essentials of insurance law; rates and reserves; investments; analysis of financial statements; regulation and taxation; some current problems and social aspects. (3 cr, §103; prereq 53 or 153) Whitman, Williams

Ins 293A. Readings in Risk Management and Insurance. Readings useful to student's individual program and objectives, but not available in regular course offerings. (Cr ar; prereq consent of adviser and inst in field covered)

Ins 293B. Graduate Research in Risk Management and Insurance. (Cr ar)

Ins 303. Seminar: Life and Health Insurance. Selected current problems in life insurance and health insurance. Oral and written student reports on individual research. (3 cr; prereq 53 or 153 and ‡) Whitman, Williams

Ins 313. Seminar: Property and Liability Insurance. Selected current problems. Oral and written student reports on individual research. (3 cr; prereq 53 or 153 and ‡) Whitman, Williams

Transportation

Tran 144. Transportation Pricing. Rationale and applications of modern rate and fare structures of the regulated carriers. Principles, problems, and cases relating to construction, interpretation, and application of carrier classifications and tariffs. Competitive aspects of exempt and private transportation. Fundamentals of rate negotiation between shippers and carrier pricing departments or rate bureaus. Relation of transportation pricing to successful operation of business logistics systems. (3 cr; prereq 54 or 154) Nightingale

Tran 154. Fundamentals of Transportation. Organization and economic aspects of the transportation system of the United States including rail, highway, air, pipeline, and water transportation. The nature of the transportation function in business. Regulatory problems associated with transportation. Current transportation developments and problems. (3 cr, §54; prereq Econ 2 or equiv) Harper

Tran 164. Business Logistics. Physical supply and distribution activities in the firm as a logistics system. Topics: elements of logistics systems; constraints on logistics systems; planning, organization, management, and operation of logistics systems. (3 cr; prereq 54 or 154) Glaskowsky

Tran 174. Traffic Management. Managerial problems associated with the shipper's use of transportation services. Topics: problems concerning organization for traffic management, transportation pricing, service alternatives, documentation, routing, consolidation, equipment utilization, warehousing, government regulation, use of private transportation, and others. (3 cr; prereq 54 or 154) Harper

Tran 184. Carrier Management. Managerial problems of carriers by rail, highway, air, and water. Topics: problems associated with carrier organization, operations, traffic and sales, finance and control, labor relations, and public policy issues. (3 cr; prereq 54 or 154) Glaskowsky

Tran 194A. Transportation Regulation and National Policy I: Domestic Transportation. National policies (regulatory and promotional) with respect to railway, highway, air, water, pipeline, and urban transportation. Interstate Commerce Act, Federal Aviation Act, and Administrative Procedure Act. Organization and functions of Interstate Commerce Commission, Civil Aeronautics Board, and Federal Aviation Agency. Practice and procedure before Interstate Commerce Commission. Analysis of leading I.C.C., C.A.B., and Supreme Court decisions. (3 cr; prereq 54 or 154) Nightingale

Tran 194B. Transportation Regulation and National Policy II: International Transportation—Marine and Air. National policies (regulatory and promotional). Merchant Marine statutes and Federal Aviation Act. Organization and functions of Federal Maritime Commission, Maritime Administration and of Civil Aeronautics Board and Federal Aviation Agency with respect to international air transportation. Marine shipping conferences and the dual-rate contract system: regulation of foreign freight forwarders and customs brokers. Agreements and organizations among governments and among carriers for the facilitation of international air transport. Analysis of leading F.M.C., C.A.B., and Supreme Court decisions. (3 cr; prereq 54 or 154) Nightingale

Tran 194C. Transportation Regulation and National Policy III. Analysis of current major issues, pertinent studies and reports in national policy and regulatory areas, including recent proposed legislation and Congressional hearings thereon. I.C.C. cost studies. Evaluation of the impact of regulation and national policies on the economy. Role of federal government as largest user of transportation services and as an operator of transportation facilities (MATS and MSTS). Individual research. (3 cr; prereq 54 or 154...194A advised) Nightingale

Tran 294A. Readings in Transportation and Business Logistics. Readings useful to student's individual program and objectives, but not available in regular course offerings. (Cr ar; prereq consent of adviser and instructor in field covered) Staff

Tran 294B. Graduate Research in Transportation and Business Logistics. (Cr ar; prereq consent of adviser and instructor in field covered) Staff

Tran 304. Seminar in Transportation. Selected current problems in the field of national transportation policy. (3 cr; prereq 54 or 154 or equiv or ‡) Nightingale

Accounting

Acct 105A. Intermediate Accounting I. Historical review of search for accounting principles, present value analysis and price level indices, nature and measurement of income and funds flows. (3 cr; prereq 25, 26 or equiv) Berryman, Purdy, Smith

Acct 105B. Intermediate Accounting II. Accounting for acquisition and subsequent measurement of business assets. (3 cr; prereq 105A, ¶75B) Heller, Purdy, Stanley

Acct 105C. Intermediate Accounting III. Accounting for equities, including creditors' equity and owners' equity for corporations, proprietorships, nonprofit organizations, and consolidated entities. Analysis and interpretation of financial statements. (3 cr, §55D; prereq 105A) Purdy, Simmons

Acct 115A. Cost Accounting. Concepts and procedures of cost accumulation including job order, process, and standard cost systems. Use of standard costs and budgets as tools of planning and control. Examination of the informational needs in the design of systems for data accumulation. (3 cr, §55C; prereq 25, 26 or equiv) Davis, Gray

Acct 115B. Cost Accounting. Analysis of use of cost information in managerial decision making. Topics include direct costing, capital budgeting, nonmanufacturing costs, inventory planning and control, appraisal of managerial performance, and other applications of accounting data. (3 cr, §55C; prereq 115A) Gray, Pavlock

Acct 125. Auditing Principles and Procedures. Analysis of the audit function, including both internal and external applications. Use of computer and statistics to assist in performance of the audit. (4 cr; prereq 105C or ¶105C and 105B) Berryman, Smith

Acct 135. Income Tax Accounting. Consideration of the more common and important provisions of the Federal and State of Minnesota income tax systems. Problems and case research for individuals, partnerships, and corporations are included. (4 cr; prereq 55D or 105A or ‡) Berryman, Heller

Acct 145A. Readings in Accounting Literature. Discussion and reports on selected topics in practice and theory as found in current accounting literature. (3 cr; prereq 12 cr upper division accounting; may be repeated for cr) Berryman

Acct 145B. Advanced Topics in Accounting. Specialized topics in the field of accounting, changing from quarter to quarter. (3 cr; prereq 12 cr upper division accounting; may be repeated for cr)

Acct 155A-B. Introduction to Managerial Accounting. Elementary course for graduate students only. Use of accounting as a tool of business management. (3 cr per qtr, §24-25-26, §55A-B) Davis

Acct 175A. Advanced Cost Accounting. Analysis of use of cost information for managerial control. (3 cr; prereq 115B) Davis

Acct 175B. Data Processing Systems. Analysis of business information systems. Application of manual, tabulating, and electronic data-processing systems. (3 cr; prereq 115B) Davis, Gray

Acct 175C. Controllership Functions and Procedures. Place and functions of the controller in modern business. Control systems which safeguard assets and assist in efficient utilization of the firm's resources. (3 cr; prereq 115B) Smith

Acct 175D. Budgetary Control. Fundamentals of establishing and operating a budgetary control system. Role of computers and computer simulation in budgeting. Effect of human behavior on the design of budgeting systems. (3 cr; prereq 115B or ‡) Davis, Gray

Acct 185A. Advanced Accounting. Consolidated statements, fiduciary and fund accounting, partnership accounting. (3 cr; prereq 105C or ¶105C) Heller

Acct 185B. Auditing and Public Accounting. Work of public accountants, including internal controls, fraud, programming, standards of practice, reporting, ethics, legal responsibility, nonaudit work. (3 cr; prereq 125) Berryman

Acct 185C. Governmental Accounting. Government budgets and fund accounting. (2 cr; prereq 105A)

Acct 195A. Internship in Public Accounting. Student will work full time for a public accounting firm and will write a report on his activities. (3 cr; prereq 125 and ‡) Smith

Acct 195B. Internship in Internal Accounting. Student will work full time for 1 quarter in the accounting department of an industrial organization and will write a report on his activities. (3 cr; prereq 115B and ‡)

Acct 215. Accounting and Business Policy. Advanced consideration of use and limitations of accounting data as a basis of management policy. (3 cr; prereq 55C or 115B) Purdy

Acct 235A. Taxation and Business Planning. (3 cr; prereq 155B or equiv) Berryman

Acct 235B. Tax Accounting Problems. (3 cr; prereq 135) Berryman

Acct 265A. Managerial Cost Accounting. Use of cost accounting and analysis of its use by management in making decisions, setting policies, and establishing controls over costs. (3 cr, §55C, 115A, B; prereq 26 or equiv) Gray, Pavlock

Acct 265B. Corporate Statements. Preparation of corporate statements and analysis from management, investment, and credit viewpoint. (3 cr, §55D, §105C; prereq 26 or equiv) Purdy

Acct 275A. Internal Auditing. Relationships between internal auditor and the accounting and operating departments. Audit of financial and nonfinancial activities. (3 cr; prereq 115A) Berryman

Acct 275B. Case Studies in Specialized Accounting. (3 cr)

Acct 285. Accounting Under Government Regulation. (3 cr)

Acct 295A. Readings in Accounting. Readings especially useful to student's individual program and objectives, but not available in regular course offerings. (Cr ar; prereq consent of adviser and inst in field covered)

Acct 295B. Graduate Research in Accounting. (Cr ar)

Acct 305A. Seminar in Accounting Theory: Valuation and Principles. (3 cr)

Acct 305B. Seminar in Accounting Theory: Income Determination and Statement Presentation. (3 cr)

Acct 305C. Seminar in Accounting Theory: Financial Statements. (3 cr)

Acct 315. Seminar: Cost Accounting. (3 cr) Purdy

Acct 325. Seminar: Auditing. (3 cr) Berryman

Acct 345A-B. Advanced Accounting Problems. (3 cr per qtr) Berryman

Business Finance

BFin 156. Business Finance Fundamentals. Study of the financial management of firms. Principles governing the planning, raising, and control of short- and long-term funds. Attention directed to capital structures, valuation situations, capital budgeting, dividend policy. Presented through text, problem, and case material. (3 cr, §56; prereq grad, Acct 26 or Acct 155B) J R Nelson

BFin 257. Financial Management. Analysis of financial problems of business enterprises, including the planning, raising, and control of short- and long-term funds. Application of principles to case situations, supplemented with readings covering fund flows, debt-equity choices, valuation, capital budgeting, mergers. Discussions and written reports. (3 cr, §57, §old 76; prereq 56 or 156) Stevenson

BFin 258. Topics in Financial Management. Intensive treatment of certain financial management problems such as capital budgeting, investment banking and long-term capital raising, valuation, mergers, refundings, and reorganizations. Presentation through readings, student projects, and case material. (3 cr, §58 and 196; prereq old 57 or 257 or ‡) Stevenson

BFin 266. Investment Fundamentals. Introduction to the appraisal of securities and the management of investment funds, essentially from the viewpoint of the individual investor. Stresses principles of value determination and risks associated with various types of securities, including bonds, preferred stocks and common stocks and their use in portfolios. Coverage includes industrials, utilities, financial institutions, and government issues. Lectures, readings, and student projects. (3 cr, §66; prereq 56 or 156) Stevenson

BFin 267. Investment Analysis. Development through research projects of the principles of financial analysis. Techniques in collecting, adjusting, and interpreting data affecting the present and future values of common stocks. Selection of senior security issues. Primarily for students with a professional interest in investments. Readings and student projects. (3 cr; prereq 66 or 266) Stevenson

BFin 268. Investment Management. Development of principles and policies governing security portfolio management for individuals and institutions. Primarily for students with a professional interest in investments. Readings and case material and student projects. (3 cr, §126; prereq 66 or 266) Stevenson

BFin 276. Capital Markets and Institutions. Study of the characteristics and institutional structure of the money and capital markets; flow of funds analysis; markets for equity and debt securities; the role of institutional and individual investors; regulation of securities markets; price behavior of specific types of securities. (3 cr, §76, §old 72; prereq 56 or 156) J R Nelson

BFin 277. Problems in Management of Financial Institutions. Considerable attention to the study of loan and investment policies of commercial banks and other lending and savings institutions; liquidity and solvency problems; methods of evaluating the soundness of individual institutions. Primarily for students with a professional interest in the management of financial institutions. Presentation of cases by officers of financial

institutions in the Twin Cities area; readings and student projects. (3 cr; prereq 76 or 276) J R Nelson

BFin 286. Real Estate Fundamentals. The nature of real estate values and finance, urban land economics, the structure and growth of cities; land development, zoning and other factors affecting real estate values. Lectures by businessmen, readings, and student projects. (3 cr, §86) Staff

BFin 296A. Readings in Business Finance. Readings useful to student's individual program and objective, but not available in regular course offerings. (Cr ar; prereq consent of adviser and inst in field covered)

BFin 296B. Graduate Research in Business Finance. (Cr ar)

BFin 356. Seminar: Business Finance. (3 cr; prereq 156 or ‡)

BFin 366. Seminar: Investments. (3 cr; prereq 266 or ‡) Stevenson

BFin 376. Seminar: Financial Markets. (3 cr; prereq 276 or ‡) J R Nelson

Marketing

Mktg 147. Advanced Advertising Procedure. Problems in advertising research, stressing both traditional and more recent techniques such as motivation research. (3 cr; prereq 77 or 207) Longstaff

Mktg 157. Marketing. Basic concepts as reflected by the environment and market forces. Includes the behavioral, economic, legal, and ethical aspects. Cast in this framework, direction of the marketing effort and marketing activities include product, pricing, market development, and physical distribution policies. (3 cr, §57; prereq Econ 2 or equiv) Hancock

Mktg 177. International Marketing. Export and import procedures and practices. Organization for exporting, channels of distribution, foreign trade promotion, financing shipment, insurance, tariffs, and governmental export and import regulations. Character and development of United States trade. (3 cr; prereq 57 or 157) Lewis

Mktg 197. Purchasing. Purchasing of materials, supplies, and equipment as a major function in business. Basic principles of purchasing in industrial, governmental, and institutional organizations. Quantity and quality decisions, forward buying, evaluation of purchasing procedures, and pricing policies. (3 cr; prereq 57 or 157) Holloway

Mktg 207. Advertising and Sales Promotion. The marketing program. Sales promotion mix components. Establishing objectives and budgets for sales promotion activities. Advertising and sales strategy. Media decisions. Advertiser-agency relationships. Measuring the effectiveness of sales promotional activities. Social and ethical implications of sales promotion. (3 cr, §77; prereq 57 or 157) Lewis

Mktg 217. Market Analysis and Research. Techniques used in marketing research, marketing information which can aid in solution of marketing problems; survey research techniques; some attention to nonsurvey techniques. (3 cr, §97; prereq 51 or 151 and 57 or 157) Holloway

Mktg 217C. Marketing Research II. Experimental techniques in marketing; laboratory and field studies. (3 cr, §97C; prereq 97 or 217) Holloway

Mktg 227. Retail Management. Retailing principles and methods; relation of retailing to other parts of the economy; problems associated with operation of stores of various types. (3 cr, §107; prereq 57)

Mktg 237. Sales Management. Sales policies and planning; sales organization; selection, training, and compensation of salesmen; control of sales performance, sales budgets; cost control. Case materials. (3 cr, §117; prereq 57 or 157) Lewis

Mktg 237C. Marketing Topics. Analysis of marketing costs, channels of distribution, marketing of selected commodities. (3 cr, §117C; prereq 57)

Mktg 247. Marketing Management. Managerial aspects of marketing: marketing policies, marketing management concepts. Extensive use of cases with a marketing decision orientation. (3 cr; prereq 57 or 157) Holloway

Mktg 287. Price Policy. Managerial problems concerning pricing and price policy. Methods used and factors considered in pricing goods and services in industrial and consumer markets. Topics include administered pricing, nonprice competition, government intervention, pricing objectives, organization for pricing, price leadership, and others. (3 cr, §187; prereq 57 or 157) Harper

Mktg 297A. Readings in Marketing. Readings useful to student's individual program and objectives, but not available in regular course offerings. (Cr ar; prereq consent of adviser and inst in field covered)

Mktg 297B. Graduate Research in Marketing. (Cr ar)

Mktg 298. Social Psychology of Behavior. Presentation of basic principles of social influence and research techniques used in the area. Emphasis on the experimental approach. (3 cr; prereq 57)

Mktg 299. Communication and Attitude Change. Immediate and direct ways in which persuasive communications influence attitudes. Various models of attitude change are presented along with current research. (3 cr; prereq 98 or ‡)

Mktg 307. Seminar: Marketing Theory. (3 cr; prereq 157 or equiv and ‡) Lewis

Mktg 317. Seminar: Consumer Behavior. (3 cr; prereq 157 or equiv and ‡) Holloway

Mktg 327. Seminar: Social and Economic Aspects of Marketing. (3 cr; prereq 157 or equiv and ‡) Hancock

Business Law

BLaw 158. Business Law: Contracts. Legal principles governing contracts; examination of the law of contracts. Readings in law, study of representative decisions, written analyses. (3 cr, §58) Wright

BLaw 178. Business Law: Agency, Partnership, and Corporations. Law of agency, and consideration of problems of partnerships and corporations. Based upon readings in law, case histories, written analyses, pertinent decisions. (3 cr, §78; prereq 158 or equiv)

BLaw 188. Business Law: Sales and Negotiable Instruments. Utilizes readings, representative legal cases and decisions, written analyses. (3 cr, §88; prereq 158 or equiv)

BLaw 198. Business Law: Property Rights and Obligations. Legal principles governing transfer of title to, control of, and mortgaging of property, real and personal, including abstract examinations; also related principles of trusts and liquidation. Current statutory developments. Special readings. (3 cr, §98; prereq 158 or equiv) Neville

CHEMICAL ENGINEERING**

Professor

Neal R. Amundson, *head, director of graduate study*
Rutherford Aris
Norman H. Ceaglske
John S. Dahler
Arnold G. Fredrickson
Herbert S. Isbin
William E. Ranz
L. Edward Scriven II
Henry M. Tsuchiya

Associate Professor

Arthur J. Madden

Assistant Professor

Robert W. Carr, Jr.
Kenneth H. Keller
Lanny D. Schmidt

Prerequisites—For major work, the Bachelor's degree in chemical engineering, chemistry, or physics. If he has not met this requirement, the student must pursue such additional preparatory studies as may be prescribed by his adviser.

** Professional degrees in engineering are all administered by the Institute of Technology.

For minor work, mathematics including integral calculus, physics, organic and physical chemistry.

Major and Minor—For the Master's degree under Plan A, the student must present a thesis based on experimental work.

Major candidates for the Master's or Doctor's degree must have completed, as undergraduate or graduate, a year's work in physical chemistry equivalent to PCh 101-102-103 with laboratory.

Language Requirement—For the Master's degree, none. For the Doctor's degree, two foreign languages, one of which must be German. The second language may be chosen from French, Japanese, or Russian.

Examinations—The written and oral preliminary examinations in chemical engineering for the Doctor's degree will be given at least twice each year, normally during the first 2 weeks of fall and spring quarters.

Master's Degree—Offered only under Plan A.

Doctor's Degree—Work leading to the Ph.D. degree is offered.

100. Numerical and Computer Methods in Chemical Engineering. Computer programming with applications to chemical and engineering problems. This course is a prerequisite to all other courses in the field. (2 cr) Ceaglske

101. Principles of Chemical Engineering. Energy and material balances. Equilibrium stage operations applied to chemical engineering unit operations. (5 cr; prereq ¶100, ¶PCh 101A) Staff

102. Principles of Chemical Engineering. Fluid dynamics and its application to chemical engineering unit operations. (5 cr; prereq 100 and 101) Scriven

103. Principles of Chemical Engineering. Heat and mass transfer and its application to chemical engineering unit operations. (5 cr; prereq 102) Ranz

104. Chemical Reactor Analysis. Chemical kinetics. Principles of reactor design for homogeneous and heterogeneous reactions. Analysis of the reactor from a kinetic and thermodynamic point of view. (5 cr; prereq 103, 120, PCh 104A)

111. Chemical Engineering Laboratory. Applications of unit operations; principles in fluid flow, heat and mass transfer experiments, with reports. (2 cr; prereq 103) Fredrickson

112. Chemical Engineering Laboratory. (See ChEn 111) (2 cr; prereq 111) Fredrickson

113. Chemical Engineering Laboratory. (See ChEn 111) (2 cr; prereq 112) Fredrickson

116-117. Process Evaluation and Design. Dynamics of chemical engineering industries, economics of process evaluation, bases for cost estimations, and expansion of activities considered. Plant designs prepared and compared with actual installations. Applications of unit operations, reaction kinetics, and thermodynamics. (3 cr per qtr; prereq 103) Madden

119-120. Chemical Engineering Thermodynamics. Three principles of thermodynamics applied to batch and particularly to flow systems. Generalized law of corresponding states and fugacity applied in practical problems of physical and chemical equilibriums. (3 cr per qtr; prereq 100 and 101A and PCh 101A)

122-123. Biochemical Engineering. Application of biochemical and microbiological principles to industrial processes. (3 cr; prereq 103, MicB 153 or ‡) Tsuchiya, Keller, Rosenberg

152. Chemical Process Laboratory. Applications of principles covered in 104 in pilot or semiplant laboratory. (2 cr; prereq 101, 104) Madden

153, 154, 155, 156. Special Problems. Investigations in chemical engineering. Library or laboratory research. (Cr ar)

161-162-163. Nuclear Reactor Design. An engineering approach to development and application of nuclear reactor theory, including basic nuclear chemistry and physics, mathematical developments and special techniques, design, operation, and control of homogeneous and heterogeneous reactors, and nuclear reactor economics. Laboratory credit available. (3 cr per qtr; prereq ‡) Isbin

171-172. Process Control. Theory and application of instrumentation and control with particular emphasis on application to the chemical industry, including analytical methods. (3 cr per qtr; prereq ‡) Ceaglske

173. Advanced Process Control. (Continuation of 171-172) Additional methods such as the root-locus and Guillemin's for analysis and design of process control systems are covered. (3 cr; prereq 172) Ceaglske

201, 202, 203. Seminar. Presentation and discussion of papers concerning the newer developments in chemical engineering. (1 cr per qtr)

205, 206, 207. Physical Rate Processes and the Transfer Operations. Advanced unit operations principles developed in terms of equilibrium and physical rate processes. Transport theories and important mass transfer and separation operations: distillation, absorption, extraction, leaching, etc. Typical problems solved for design of ideal stage and transport-controlled multistage or columnar contacting equipment. (3 cr per qtr; prereq 103 and ‡) Ranz, Scriven

208-209-210. Physical Rate Processes and the Transfer Operations. (Continuation of 205-206-207) Advanced treatment of the laws of heat mass and momentum transfer. (3 cr per qtr; prereq 103 and ‡) Fredrickson, Scriven

211-212-213. Molecular Theory of Transport Processes. Theory and interpretation of fluid transport phenomena in terms of molecular-scale processes. (3 cr per qtr; prereq ‡) Dahler, Davis

214-215-216. Advanced Mathematics for Chemical Engineers and Chemists. Numerical analyses; ordinary and partial differential equations; Fourier series and special functions; finite difference equations; partial differentiation. Theory of heat conduction and diffusional operations. (3 cr per qtr; prereq differential equations) Amundson, Aris

217. Analysis of Chemical Engineering Problems. Critical analysis of current chemical engineering literature. (3 cr; prereq 216) Amundson

218. Advanced Topics in Chemical Engineering. (3 cr)

219-220. Advanced Chemical Engineering Thermodynamics. Recent advances in theory and applications, particularly to flow systems. Topics: equations of state and generalizations, solution equilibriums, chemical equilibriums, irreversible thermodynamics, etc., with problems. (3 cr per qtr; prereq 120 or ‡) Davis

221-222-223. Chemical Rate Processes and Reactor Design Principles. Theory of chemical engineering reaction kinetics based on chemical rate processes and thermochemical, fluid mechanical, and heat and mass transfer considerations. Applications to industrial reactor-design problems. Batch processes and continuous tubular and staged reactor systems. Typical problems for homogeneous, multiphase, catalytic, and radiation-induced reactions. (3 cr per qtr; prereq ‡) Aris

225-226-227. Fluid Mechanics and Related Topics. Navier-Stokes's equations; advanced topics in ideal, viscous, and turbulent flow, eddy diffusion, and heat transfer. Transport theory. (3 cr per qtr; prereq ‡) Fredrickson, Ranz, Scriven

264. General Survey of Chemical Engineering. Independent reading under the guidance of the staff. (1 cr; prereq ‡; this course is prereq to candidacy for Ph.D. degree with major or minor in chemical engineering, and an exam must be taken by end of fall qtr of 2nd yr in residence)

301-302-303. Research in Chemical Engineering. Heat and mass transfer, fluid dynamics, chemical kinetics, chemical reactor theory, thermodynamics, process control, microbiology, applied mathematics. (Cr ar) Staff

CHEMICAL PHYSICS

Professor

Bryce Crawford, Jr.
Edward L. Hill
Rufus W. Lumry
Albert J. Moscowitz
Alfred O. C. Nier
Stephen Prager
John E. Wertz, *head, director of graduate study*

Associate Professor

James R. Bolton
John S. Dahler
H. Ted Davis
Sanford Lipsky
C. Alden Mead
John Overend

Doctor's Degree—The Ph.D. program in chemical physics will include topics both in physics and in chemistry, together with the requisite mathematical studies. Thesis research on an appropriate problem will be under the direction of a graduate faculty member in chemical physics. Candidates will enjoy the facilities of both schools and will be eligible for fellowships available in either. Candidates in this program will attend and participate in appropriate seminars in each of the areas of study.

Prerequisites—A prospective candidate must first have been accepted as a graduate student either by a department of the School of Chemistry or by the School of Physics. A prerequisite for admission to chemical physics is sufficient preparation in intermediate physics, mathematics, and physical chemistry.

Requirements for Candidacy—Qualifying examinations in chemistry (the proficiency examinations in physical and inorganic chemistry must be passed). Qualifying examinations in physics (this requirement may be met by passing final examinations in one of the following courses with or without taking the courses themselves: Phys 104, 112, 173 or any course for which one of these is a prerequisite). Qualifying course work (final examinations in three chemistry and three physics courses numbered 100 and above must be passed with or without taking the courses themselves.) One of the courses in chemistry must be Chemical Thermodynamics.

Language Requirement—Reading proficiency in two of the following: German, French, Russian.

Preliminary Examinations—Four cumulative examinations in physical chemistry must be passed. A grade of A in one of the courses PCh 115, 116, 204, 205, 206, or passing the preliminary written examination in physics, will reduce this requirement to three cumulative examinations. The preliminary oral examination may be taken after three cumulative examinations have been passed and three required course examinations in Quantum Mechanics have also been passed and the language requirements have been satisfied.

Doctoral Program—The usual Graduate School rules apply.

CHEMISTRY

Professor

Stuart W. Fenton, *chairman*

Work in the Department of Chemistry is organized in five principal areas —analytical, inorganic, organic, physical chemistry, and chemical physics.

The candidate for a higher degree is expected to show, in addition to the completion of the prescribed work, a maturity acquired by intensive personal study of the literature and of the methods of chemistry.

Prerequisites—For a major in chemistry, all candidates must offer the substantial equivalent of the courses in inorganic chemistry, analytical chemistry, organic chemistry, and physical chemistry required of undergraduate students in the chemistry curriculum, at least 1 year of college physics, and college mathematics through calculus.

A minor in chemistry can be arranged by consultation with the departmental chairman.

Proficiency Examinations—Students working toward *any* graduate degree in chemistry are required to take a set of four proficiency examinations, one in each of the fields of chemistry: analytical, inorganic, organic, and physical. These examinations are taken on *entrance* and are offered in the fall *during the week preceding the first day of classes* and again during the week following the close of the winter quarter. The results of these examinations are used for orientation and guidance. If an examination is failed, the student must take and pass it the next time it is offered. The following texts are indicative of the material to be considered:

Organic: Any modern textbook used in a 1-year course for chemists—such as Noller, *Chemistry of Organic Compounds;* or Fieser and Fieser, *Textbook of Organic Chemistry.*

Physical: Undergraduate material from an elementary physical chemistry text—preferably *Physical Chemistry* by Moore; or *Principles of Physical Chemistry* (third edition), by Maron and Prutton.

Analytical: A standard textbook such as Kolthoff and Sandell, *Textbook of Quantitative Analysis* (omitting sections in fine print), or Blaedel and Meloche, *Elementary Quantitative Analysis.*

Inorganic: A textbook such as Sienko and Plane, *Chemistry;* also Cotton and Wilkinson, *Advanced Inorganic Chemistry.*

Minor—The choice of the particular courses to be presented in fulfillment of a minor in graduate work will be made after consultation with the student's adviser.

Language Requirement—Candidates for the Master's degree must have a reading knowledge of German. For the Doctor's degree, two foreign languages are required, one of which must be German. Either French or Russian is acceptable as the second language.

Preliminary Examinations—Written and oral preliminary examinations in chemistry for the Doctor's degree will be given twice each year.

Master's Degree—Work for the Master's degree is offered under Plan A. Plan B is occasionally permitted.

Doctor's Degree—Graduate work leading to the Ph.D. degree is offered.

Analytical Chemistry

Professor
Stanley Bruckenstein, *chief, director of graduate study*
Edward J. Meehan
Ernest B. Sandell

Associate Professor
Harold S. Swofford, Jr.

Assistant Professor
Peter J. Lingane

103. Qualitative Inorganic Microanalysis. Use of microscope. Technique of handling small amounts of materials. Inorganic qualitative analysis by means of crystal reactions and modern spot reactions. (3 cr; prereq 47) Sandell

104. Polarizing Microscope. Its use and application to chemistry. Identification of substances. (3 cr; limited to 16 students; prereq 47 and Phys 3, 6 or 9 or ‡) Sandell

105. Quantitative Inorganic Microanalysis. Representative methods of micro- and semimicroanalysis; gravimetric, volumetric, and colorimetric. (3 cr; limited to 16 students; prereq 47) Sandell

106, 107, 108. General Technical Analysis. Analysis of commercially important materials such as iron, steel, nonferrous alloys, ores, and glass; use of microscope in technical problems; quantitative analysis of heterogeneous mixtures, particle size determinations. (2-3 cr per qtr; prereq 47) Sandell

111. Physicochemical Methods of Analysis. Lecture. Optical and electrochemical methods and methods of separation. (3 cr; prereq 47, PCh 101 and ¶PCh 103A) Swofford

112. Physicochemical Methods of Analysis. Laboratory. Quantitative application of electrochemical, optical, and other physical techniques. (2 or 3 cr; prereq 102, 111–2 cr, prereq 47, 111–3 cr)

113. Physicochemical Methods of Analysis. Laboratory. More advanced treatment of material covered in 112. (3 cr; prereq 111 and ‡)

115. Advanced Analytical Chemistry. Condensed review of fundamentals of gravimetric and volumetric analysis. (2 cr; prereq 47) Meehan

116.° Solution Equilibria. Lecture. Systematic treatment of aqueous and nonaqueous equilibria. Principles underlying volumetric endpoint detection techniques. (3 cr; prereq 115) Bruckenstein

117.° Electrochemical Methods of Analysis. Lecture. Potentiometric, coulometric, polarographic, and other electrical methods. (4 cr; prereq 111 or 211) Bruckenstein

118. Electrochemical Methods of Analysis. Laboratory course. (3 cr; prereq 117) Bruckenstein

123.° Analysis of Complex Materials. Literature study, critical selection and application of fundamentals of analysis to complex materials. (3 cr; prereq 212) Sandell

140. Water Analysis. Analysis of potable water with interpretation of results. (2 cr; prereq 47) Sandell

141, 142, 143.° Seminar: Modern Problems in Analytical Chemistry. (1 cr per qtr; prereq 111) Bruckenstein

201, 202, 203.° Selected Topics in Analytical Chemistry. (Cr ar; prereq 212) Staff

211. Physicochemical Methods of Analysis. Lecture. Optical and electrochemical methods and methods of separation. (4 cr; prereq 111 or ‡) Bruckenstein, Meehan

212. Physicochemical Methods of Analysis. Laboratory course. Quantitative application of electrochemical, optical, and other physical techniques. (3 cr; prereq 211)

227. Optical Methods of Analysis. Lecture. (2 cr; prereq 211; offered 1967-68 and alt yrs) Meehan

235, 236, 237. Research Seminar: Analytical Chemistry. Current research, especially that carried on in the department. (Cr ar) Staff

262. General Survey of Analytical Chemistry. Independent reading which is prerequisite to candidacy for the Ph.D. degree. See section under Proficiency Examinations. (1 cr)

301, 302, 303.° Research in Analytical Chemistry. (Cr ar) Staff

Inorganic Chemistry

Professor
Robert C. Brasted
J. Doyle Britton
Z Z. Hugus, Jr., *chief, director of graduate study*
Otto H. Johnson
Paul R. O'Connor

Associate Professor
Henry A. Bent
Lawrence E. Conroy
Warren L. Reynolds
R. Stuart Tobias

Assistant Professor
H. Fred Henneike, Jr.
Steven T. Spees, Jr.

Prerequisites—For major or minor work, a Bachelor's degree with a major in chemistry including 1 year each of organic and physical chemistry, together with calculus, physics, and German. An average of B or better is required.

Language Requirement—German is required for the Master's and Doctor's degrees. French or Russian is acceptable as the second language for the Ph.D. degree, but another language may be substituted by petition.

Master's Degree—Offered under Plan A only.

Doctor's Degree—Candidates must maintain better than a B average.

103. Inorganic Chemistry I. Atomic structure, structure and bonding in covalent molecules and ionic crystals, thermochemistry of chemical bonding. Applications to chemistry of nontransition elements. (3 cr; prereq PCh 102A) Tobias

104. Inorganic Chemistry II. Chemistry of transition metal and rare earth compounds: nomenclature and stereochemistry; thermodynamics and kinetics of complex ion reactions; crystal field, ligand field, molecular orbital, and valence bond descriptions of bonding; solution chemistry of transition elements. (3 cr; prereq InCh 103 or ‡) Reynolds

106. Oxidation-Reduction Systematics. Application of tabulated thermodynamic data, including potential diagrams, to prediction of chemical reactions. (3 cr; prereq PCh 101A) Hugus

111. Silicon and Related Elements. Review of current studies on silicon, germanium, tin, and lead, with emphasis on recent silicon chemistry. (3 cr; prereq OrCh 62; offered 1966-67) Johnson

112. Radioactivity and Nuclear Chemistry. Properties of nuclei, distintegration, properties of radiation; natural and artificial radioactivity; modern views of nuclear structure. (3 cr; prereq PCh 103A; offered 1967-68 and alt yrs) O'Connor

113. Mechanisms of Inorganic Reactions. Prevalent ideas concerning mechanisms of inorganic oxidation-reduction and substitution reactions. (3 cr; prereq PCh 103A; offered 1967-68 and alt yrs) Reynolds

122. Advanced Inorganic Chemistry Laboratory. Measurements of equilibria and kinetics of selected inorganic reactions, and advanced synthetic methods. (2 cr; prereq AnCh 46 and 47 and PCh 103A) Hugus, Tobias, Britton

134, 135, 136. Seminar: Modern Problems in Inorganic Chemistry. (1 cr per qtr; prereq PCh 103A and ‡) Staff

203. Advanced Inorganic Chemistry, I. Atomic Structure and the Chemical Bond. A nonmathematical introduction to the application of quantum theory to atomic and molecular electronic systems. Structural inorganic chemistry. Valence bond and molecular orbital approaches. Groups I and VII of the periodic table. (3 cr; prereq PCh 102A, OrCh 62 or equiv) Conroy

204. Advanced Inorganic Chemistry, II. Thermodynamics and Kinetics of Inorganic Chemical Reactions. Application of thermodynamics and ideas of chemical kinetics to inorganic chemical reactions, particularly those involving compounds of the elements of groups V and VI. (3 cr; prereq 203 or ‡) Bent

205. Advanced Inorganic Chemistry, III. Survey of the Chemistry of the Transition Metals. Reactions and properties of the transition metals, including the rare earths, and their compounds. A survey of co-ordination chemistry using elementary ideas of ligand field theory. (3 cr; prereq 204 or ‡) Henneike

206. Advanced Inorganic Chemistry, IV. Survey of the Chemistry of the Nontransition Elements. Reactions and properties of the nontransitional elements, including the rare gases, and their compounds. (3 cr; prereq 205 or ‡) Britton

207. Advanced Inorganic Chemistry, V. Applications of Ligand Field Theory. Development of ligand field theory, at a relatively advanced level, and numerous applications of the theory to problems of stability reactivity, magnetic properties, and optical properties of transition metal compounds. (3 cr; prereq 206 or ‡) Hugus

211, 212, 213. Selected Topics in Inorganic Chemistry. (Cr ar; prereq △)

220, 221, 222. Advanced Inorganic Chemistry Laboratory Methods. Such topics as advanced qualitative analysis, synthetic inorganic chemistry, radiochemical techniques. (Cr ar; prereq ‡)

260. General Survey of Inorganic Chemistry. Independent reading which is prerequisite to candidacy for the Ph.D. degree. See section under Proficiency Examinations. (1 cr)

301, 302, 303. Research in Inorganic Chemistry. (Cr ar) Hugus, Brasted, Johnson, O'Connor, Britton, Reynolds, Bent, Conroy, Tobias, Henneike, Spees

Organic Chemistry

Professor
Raymond M. Dodson
Stuart W. Fenton
C. Frederick Koelsch
Maurice M. Kreevoy
Edward Leete
Wayland E. Noland
William E. Parham, *head, director of graduate study*

Associate Professor
Edgar W. Garbisch, Jr.

Assistant Professor
Richard Borch

Prerequisites—For major work, Bachelor's degree, with minimum average of B, from an approved curriculum involving 4 years of chemistry and including 1 year each of organic and physical chemistry together with the necessary supporting subjects (integral calculus, physics, and German). For minor work, 1 year of organic chemistry and an approved course in physical chemistry.

Language Requirement—German is required for the Master's degree. For the Ph.D. degree, German and French or Russian are required, but another language may, by petition and with the approval of the graduate faculty, be substituted for French or Russian. Native languages, except German, French, or Russian, are in general not acceptable substitutes.

Master's Degree—Offered under both Plan A and Plan B.

Doctor's Degree—To merit admission to candidacy for this degree, a student must meet the prerequisites outlined above, must maintain an average grade considerably above B, and must meet all the other requirements of the Graduate School. The research may, in so far as facilities permit, be taken with any member of the graduate faculty.

103. Special Methods for Organic Qualitative Analysis. Advanced course. Instrumental methods in organic qualitative analysis. (4 cr; prereq 65 or 102) Fenton

139. Advanced Organic Chemistry Laboratory Work. Selected laboratory synthetic problems, which may include original work. Includes considerable individual instruction. (2-5 cr; prereq 64 or 65 or equiv; 6-15 hrs lab work ar) Noland

142. Chemistry of Natural Products. Including acetogenins, terpenes, alkaloids, biogenesis. (3 cr; prereq 63; offered 1967-68 and alt yrs) Leete

143. Chemistry of Natural Products. Steroidal hormones, their isolation, proof of structure, synthesis, and action. (3 cr; prereq 63; offered 1968-69 and alt yrs) Dodson

144. Heterocyclic Compounds. Typical classes of heterocyclic compounds, their chemical and physical properties and uses, synthesis. (3 cr; prereq 63; offered 1966-67 and alt yrs) Leete

165. Organic Qualitative Analysis. Reactions of typical functional groups and introduction to methods of organic qualitative analysis. (4 cr, §65; prereq 63) Fenton

201, 202, 203.* Organic Chemistry Seminar. (1 cr per qtr; required of all grad students taking major work in organic chemistry) Staff

230.* Advanced Organic Chemistry. Nonquantitative theory and mechanism. (4 cr; prereq 63 or equiv) Noland

231. Advanced Organic Chemistry. Nonquantitative theory, chemistry of functional groups. (4 cr; prereq 230 or ‡) Parham

232.* Stereochemistry. Stereochemistry of carbon compounds and of organic reactions. (3 cr; prereq 230 or ‡) Dodson

233. Theoretical Organic Chemistry. More quantitative aspects of organic theory including kinetics and equilibrium studies. (3 cr; prereq 232, PCh 103 and calculus, or ‡) Kreevoy

234.* Advanced Organic Chemistry. Synthetic methods. (3 cr; prereq 232 or ‡) Borch

238. Introduction to Research. Practical application of nuclear magnetic resonance, infrared and ultraviolet spectral analysis to solution of organic problems. (4 cr; prereq 63, 65, or equiv) Fenton, Garbisch

240s. Introduction to Research. Advanced laboratory problems, including original work. (4 cr; prereq 65, 238, or ‡) Noland and staff

246. Introduction to Research. Practical application of ultraviolet, mass spectrometry and other spectral techniques to solution of organic problems. (4 cr; prereq 238 or ‡)

250. Theoretical Organic Chemistry. Application of chemical kinetics, thermodynamics, and simple quantum mechanics to problems of organic chemistry. (3 cr; prereq 233 or ‡, PCh 103A and integral calculus) Kreevoy

251s. Theoretical Organic Chemistry. Empirical and theoretical correlations of nuclear magnetic resonance. (3 cr; prereq 238 or ‡) Garbisch

261f,w,s. General Survey of Organic Chemistry. Independent reading which is prerequisite to candidacy for the Ph.D. degree. See section under Proficiency Examinations. (1 cr) Parham

301, 302, 303.* Research in Organic Chemistry. (Cr ar; prereq 238, 239, and △) Staff

Graduate Thesis in Organic Chemistry. Open only to Ph.D. candidates who have completed all the requirements for the degree except the dissertation and final oral examination. (No cr)

Physical Chemistry

Professor

J. Doyle Britton
Bryce Crawford, Jr.
Edward L. Hill
Z Z. Hugus, Jr.
Maurice M. Kreevoy
Robert S. Livingston
Rufus W. Lumry, *head, director of graduate study*
Albert Moscowitz
Paul R. O'Connor
Stephen Prager
John E. Wertz

Associate Professor

James R. Bolton
John S. Dahler
Sanford Lipsky
C. Alden Mead
John Overend

Assistant Professor

H. Ted Davis

Candidates for an advanced degree in the Graduate School who are not majoring in chemistry may offer PCh 101A, 102A, 103A, 104A or 107-108 in partial fulfillment of the course requirements for a minor in physical chemistry.

101A. Physical Chemistry. Basic thermodynamics. (4 cr; prereq 1 yr college chemistry, Phys 9 or Phys 6 with △, Math 32 or 44)

102A. Physical Chemistry. Atomic and molecular structure. (4 cr; prereq 1 yr college chemistry, Phys 9 or Phys 6 with △, Math 32 or 44)

103A. Physical Chemistry. Electrochemistry, theory of liquid and solid states. (4 cr; prereq 101A)

104A. Physical Chemistry. Statistical mechanics and reaction kinetics. (4 cr; prereq 101A and 102A)

105A. Laboratory. (1, 2, or 3 cr; prereq 101 or 102 or 101A or 108)

105B. Laboratory. (1, 2, or 3 cr; prereq 101 or 102 or 101A or 102A or 108)

106A. Laboratory. (1, 2, or 3 cr; prereq 105A)

106B. Laboratory. (1, 2, or 3 cr; prereq 105A)

107-108. Elementary Physical Chemistry. Brief general survey. (3 cr per qtr; prereq 1 yr college chemistry, Phys 9 or Phys 6 with △, Math 25A or 32 or 44) Lipsky

111. Thermodynamics. Application of principles of thermodynamics to chemical phenomena including those occurring in solutions of electrolytes. (2 cr; prereq 101A; offered when demand warrants) Livingston

112. Atomic and Molecular Structure. An experimental viewpoint. (3 cr; prereq 103 or 103A) Wertz

113. Quantum Mechanics. Applications to molecular structure. Theory of the chemical bond. (3 cr; prereq 112 or equiv) Wertz

114. Physical Chemistry. Principles of classical thermodynamics. (4 cr; prereq 101A, 103A)

115. Physical Chemistry. Statistical mechanics and kinetic theory. (4 cr; prereq 104A)

116.* Physical Chemistry. Statistical mechanics, kinetic theory and application to theories of reaction rates. (4 cr; prereq 115)

117.* Fundamentals of Reaction Kinetics. Empirical analysis of rate measurements, collision theory, transition state theory, chain reactions. (3 cr; prereq 103 or 103A) Livingston

120. Mathematical Methods of Physical Chemistry. Introduction to topics in mathematics necessary for advanced work in physical chemistry. Subjects include: vector calculus, matrices, complex variable theory, Fourier analysis, calculus of variations. (3 cr)

127. Physical Chemistry of High Polymers. Molecular weight measurements and molecular weight distributions in macromolecules, thermodynamics of polymer solutions, rubber elasticity and viscoelastic behavior. (3 cr; prereq 104; offered 1967-68 and alt yrs) Prager

128. Colloid and Surface Chemistry. Fundamental principles of colloid chemistry, surface chemistry, electrokinetic phenomena, lyophobic and lyophilic colloids. (3 cr; prereq 103 or 103A; offered 1967-68 and alt yrs) Lumry

204-205-206. Quantum Mechanics. Fundamental principles of quantum mechanics and their applications to atomic and molecular structure and spectra. (4 cr; prereq ¶120 or equiv for 204)

214. Kinetics and Mechanism of Enzymic Reactions. Biological catalysis including basic studies in chemical kinetics and the structure of proteins in its relation to enzymic function. Application of thermodynamics, statistical mechanics, and chemical kinetics to biological systems. (3 cr, §MdBc 214; prereq 103 or 103A, 117 or equiv, ‡; offered 1967-68 and alt yrs) Lumry

215. Physical Chemistry of Proteins. Introduction to present state of protein physical chemistry, including thermodynamic, statistical mechanical, and kinetic aspects of conformational stability, protein structure and structure-function relations in protein mechanisms. (3 cr, §MdBc 217; prereq 103 or 103A or equiv; offered 1967-68 and alt yrs) Lumry or Wetlaufer

217. Physical Methods in Biopolymer Research. Techniques and theory of major physical methods in biopolymer research. Introduction and present status. Topics include: optical rotatory dispersion, calorimetry, proton-exchange, spectroscopy, chromatography, sedimentation. (3 cr, §MdBc 218; prereq 103 or 103H or equiv, ‡; offered 1966-67 and alt yrs) Lovrien, Lumry, Rosenberg, Wetlaufer

221, 222, 223. Seminar: Radiation Chemistry. (Cr ar) Lipsky

250, 251, 252. Physical Chemistry Seminar. (1 cr per qtr; required of all grad students majoring in physical chemistry)

253, 254, 255. Seminar: Molecular Spectroscopy. (Cr ar) Crawford, Overend

256, 257, 258. Seminar: Theoretical Chemistry. (Cr ar) Moscowitz

259, 260, 261. Seminar: Photochemistry. (Cr ar) Livingston

263. General Survey of Physical Chemistry. Independent reading which is prerequisite to candidacy for the Ph.D. degree. See section under Proficiency Examinations. (1 cr)

265, 266, 267. Seminar: Magnetochemistry. (Cr ar) Wertz

268-269-270. Seminar: Statistical Mechanics. (Cr ar) Prager

271, 272, 273. Seminar: Physical Chemistry of Biological Systems. (Cr ar) Lumry

274, 275, 276. Seminar: Quantum Mechanics. (Cr ar) Mead

290, 291, 292. Selected Topics in Physical Chemistry. When demand exists, advanced seminars are held in subjects such as quantitative theory of valence, advanced thermodynamics, polymers, transport processes, magnetochemistry, structural and related properties of solids, photochemistry, and radiation chemistry. (Cr ar) Bolton, Crawford, Dahler, Davis, Lipsky, Livingston, Lumry, Mead, Moscowitz, Overend, Prager, Wertz

301, 302, 303. Research in Physical Chemistry. Defects in crystals and solids, electronic structure of molecules, high polymers, infrared and Raman spectroscopy, molecular structure, NMR and EPR spectroscopy, optical activity, photochemistry, protein chemistry, quantum mechanics, radiation chemistry, reaction kinetics, statistical mechanics, transport processes. (Cr ar) Bolton, Britton, Crawford, Dahler, Davis, Hugus, Kreevoy, Lipsky, Livingston, Lumry, Mead, Moscowitz, O'Connor, Overend, Prager, Wertz

CHILD PSYCHOLOGY

Professor

John H. Flavell
Norman Garmezy
Willard W. Hartup
Shirley G. Moore
Merrill F. Roff
Harold W. Stevenson, *director*
Mildred C. Templin
Robert D. Wirt

Associate Professor

William Charlesworth
Jan Duker
A. Jack Hafner
Carl P. Malmquist
Herbert L. Pick, Jr.
Britton K. Ruebush
John C. Wright

Assistant Professor

Paul C. Goldin
Marian D. Hall
John P. Hill
Murray K. Reed

Prerequisites—Courses in child psychology are open to all regularly enrolled graduate students who meet the prerequisites as listed in the *Class Schedule*. It is expected that all entering graduate students with a major in child psychology shall have completed at least 12 hours in psychology and 3 hours in statistics.

Language Requirement—For the Master's degree, one foreign language—French, German, Spanish, or Russian. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge. If two languages are offered any combination of those listed above may be approved.

Master's Degree—Offered under both Plan A and Plan B.

Doctor's Degree—Work leading to the Ph.D. degree is offered.

Information about additional requirements for graduate training in child psychology may be obtained from the office of the Director, Institute of Child Development.

125. Experimental Research with Children. Supervised research experience. Design and conduct of experiments on child behavior in controlled laboratory situations. (3 cr; prereq 80, ‡) Wright, Pick, Charlesworth

126. Case Study of Children. Supervised intensive study of intellectual, personality, and social development and functioning of individual normal children. (3 cr; prereq 80, ‡) Goldin

127. Social Behavior of Children. Behavior of children in groups; supervised observation and experience. (3 cr; prereq 80, ‡) Moore

132. Adolescent Development. Primarily for students in the College of Education. Discussion of the various physical, personal, and social changes that occur during adolescent years. (3 cr, §81; prereq 12 cr in psychology, educational psychology, sociology, or home economics) Roff

140. Behavior Problems. Types, origin, development, and treatment of behavior difficulties in normal children. (3 cr; prereq 80 or equiv) Goldin

142. The Psychology of Handicapped Children. Research related to sensory, speech, language, physical disabilities of children. (3 cr; prereq 80 or equiv) Templin

143. Problems of Mental Deficiency. Diagnosis, care, training; social and vocational problems. (3 cr; prereq 80 or equiv) Pick

144. Psychology of the Gifted Child. Psychology and development of high intellectual ability and of special talents. (3 cr; prereq 80 or equiv) Charlesworth

179. Clinical Procedures with Children. Survey of methods of clinical psychology emphasizing basic concepts and research problems in clinical work with children. Primarily for students not majoring in clinical psychology. (3 cr; prereq 12 cr in psychology, educational psychology, sociology, or child psychology) Reed

180. Personality Development. Development of personality in children. Psychoanalytic and behavior theory formulations and related research literature. (3 cr; prereq 80) Hartup, Hill

181. Social Development. Family and peer influences; social interaction and social relations; developmental changes. (3 cr; prereq 80) Hartup, Moore

183. Language Development. Development of the structure and function of language, methodological problems; speech and language development; language scales; theories of language development. (3 cr; prereq 80) Templin

184. Sensory and Motor Development. Development of sensory and perceptual processes; simple and complex motor skills. (3 cr; prereq 80) Roff

190. Topics in Child Psychology. Independent reading or research. (Cr ar; prereq ‡) Staff

210-211. Advanced Child Psychology. Discussion and critical evaluation of current theories and research in child psychology. (3 cr per qtr; prereq ‡) Graduate staff

212. Research Methods in Child Psychology. Review of principal research methods and designs in child psychology. (3 cr; prereq ‡) Charlesworth, Stevenson

213. Advanced Adolescent Psychology. Discussion and evaluation of current research in adolescent development; principles of growth and development; problems and interests of adolescents. (3 cr; prereq 12 cr in psychology, educational psychology, sociology, or home economics)

214. Learning in Children. Discussion of experimental literature on theoretically critical issues in children's learning. (3 cr; prereq Psy 129 or ‡) Stevenson, Wright

215. Perception in Children. Review and discussion of experimental and theoretical literature on children's perception; change of perception with age and experience. (3 cr; prereq Psy 150 and ‡) Pick

216. Cognitive Development. Development of thinking in children; theories of concept formation, problem solving and reasoning. (3 cr; prereq 12 cr in child development or psychology) Wright, Charlesworth

217. Advanced Personality Development. Critical evaluation of current theory and research in personality development. (3 cr; prereq ‡) Hartup, Ruebush

218. Abnormal Child Psychology. Dynamics of psychopathology in children. Critical evaluation of current theory and research in abnormal child psychology. (3 cr; prereq 217 and ‡) Ruebush

219. Advanced Social Development. Theory and research related to acquisition of social behavior by children, including effects of interaction with social environment. (3 cr; prereq ‡) Moore, Hartup

220, 221, 222. Seminar: Current Issues in Child Psychology I. Problems and issues in professional child psychology for first-year graduate students. (1 cr per qtr; prereq ‡) Graduate staff

223, 224, 225. Seminar: Developmental Psychology. Intensive study of selected topics. (Cr ar; prereq ‡) Graduate staff

226. Advanced Language Development. Critical evaluation of current theory and research in language development. (3 cr; prereq 12 cr in child psychology or psychology and ‡) Flavell

227. Multiple Factor Analysis. Mathematical rationale and concrete applications. (2 cr; prereq 3 qtrs statistics and mental measurement) Roff

230, 231, 232. Seminar: Recent Literature. Topic varies from quarter to quarter; consideration of specific contemporary issues in developmental psychology. (2 cr per qtr; prereq ‡) Graduate staff

233, 234, 235. Seminar: Current Issues in Child Psychology II. Problems and issues in professional child psychology for advanced graduate students. (1 cr per qtr; prereq ‡) Staff

248. Clinical Child Psychology. Theories of psychodiagnosis: case history, prediction, and psychotherapy in clinical work with children. (3 cr; prereq ‡) Wirt

249. Treatment of Disturbed Children. Supervised experience. Restricted to Ph.D. candidates. (3 cr; prereq ‡) Wirt

250, 251. Practicum in Clinical Child Psychology. Supervised experience in psychodiagnostic work with emotionally disturbed children and their families. (5 cr per qtr; prereq ‡) Ruebush

285-286. Theory and Practices in the Preschool. Educational philosophy of the preschool. Intellectual growth and development of communicative skills. Curricular experiences in science, literature, art, and music. Use of free play and play materials with young children. (2 cr per qtr; prereq ‡) Moore

287. Behavior of Preschool Children. Use of group setting for study and guidance of personality and social development of young children. (3 cr; prereq ‡) Moore

291. Psychological Evaluation of Infants and Preschool Children. Discussion and practice in administering and interpreting psychological tests for infants and preschool children. (3 cr; prereq ‡) Clinic staff

292. Practicum in Psychological Appraisal of Children. Supervised experience in administering and interpreting psychological tests for children. (Cr ar; prereq ‡) Clinic staff

295. Seminar: Projective Methods with Children and Adolescents. Demonstrations, critical analysis, and discussion of research tools and clinical devices. (3 cr; prereq ‡)

CIVIL ENGINEERING**

Professor
Paul Andersen
Alvin G. Anderson
Charles E. Bowers
Lawrence E. Goodman, *head, director of graduate study*
Miles S. Kersten
John F. Ripken
George J. Schroepfer
Edward Silberman
Theodor W. Thomas

Associate Professor
Jesse E. Fant
Walter T. Graves
John T. Hanley
John W. Hayden
Walter K. Johnson
Chieh S. Song

Assistant Professor
Anil K. Chopra
Walter J. Maier
Lyle P. Pederson
Russell H. Susag

Students who wish to do major work in civil engineering should consult the director of graduate study, 123 Main Engineering Building.

Language Requirement—For the Master's degree, none. For the Ph.D. degree two foreign languages. These must be languages in which a substantial portion of the world literature in the candidate's area of specialization appears. In special cases a research technique may be substituted for the second language.

Master's Degree—Offered under Plan A. Plan B may be accepted when approved by the student's adviser.

Doctor's Degree—Work leading to the Ph.D. degree is offered. Within civil engineering graduate work is offered in a number of areas of concentration. The most prominent of these are: structural design and analysis, hydraulic engineering, sanitary engineering, transportation engineering, and soil mechanics. Students may do major work in any of these areas of concentration. It should be appreciated, however, that any sound program of graduate training in civil engineering will require training in collateral fields outside the department. In consultation with the adviser for his major area of concentration, the student will be expected to develop a well-rounded course of study.

Structural Engineering

126. Approximate Methods of Structural Analysis I. Numerical determination of slope, moment, shear and deflection in statically determinate and statically indeterminate structural members that have nonuniform deformation properties. Numerical methods for obtaining influence lines for statically indeterminate structures with variable properties. Rapid determination of elastic and inelastic buckling loads and combined bending and axial loads in beams and frames by approximate methods. (3 cr; prereq 82)

136. Advanced Topics in Structural Analysis. Analysis of space frameworks. Theory of the design of structural steel and reinforced concrete members subjected to torsion. Influence of axial loads on moment distribution. Theory of stability of continuous beam columns and frameworks. (3 cr; prereq 141A)

137. Structural Laboratory. Theoretical and experimental study of structural models. Probability and statistics in design of experiments and analysis of experimental data. Similitude and theory of scale models. Lectures, demonstrations, and laboratory exercises

** Professional degrees in engineering are administered by the Institute of Technology.

on experimental stress analysis of model beams, trusses, and bents under static and dynamic loading. (3 cr; prereq 83)

138. Matrix Methods in Structural Analysis. Development of flexibility and stiffness matrices for structures. Determination of deflections and analysis of redundant structures using matrices. Applications to continuous beams, rigid frames, space frameworks and stiffened shell structures. (3 cr; prereq 83) Graves

139f. Structural Dynamics I. Elastic response of lumped and distributed parameter systems to dynamic loading. Problem formulation, and methods of solution for single degree-of-freedom systems, n-degree-of-freedom systems, and infinite degree-of-freedom systems with specific applications in structural engineering. (3 cr; prereq 83, MM 193, Math 147, or ‡) Hanley

141Af. Intermediate Structural Design. Structural steel design by plastic methods. Design of timber members, connections, and frames. Properties of reinforced concrete. Design of reinforced concrete by working stress method and ultimate strength method. Design of slabs, beams, and columns. Design diagrams and tables. (3 cr; prereq 83)

142Aw. Advanced Structural Design. Two-way slab and flat slab structures. Statically indeterminate frames of reinforced concrete. Prestressed concrete structures. Footings and retaining walls. Composite construction of structural steel and reinforced concrete. (3 cr; prereq 141A)

143. Design of Shell Structures. Analysis and design of roof and tank structures using surfaces of revolution and translation. Design of folded plates. Applications of prestressed concrete to shell structures. Computer methods in shell design. (3 cr; prereq 142A)

144. Arch Analysis and Design. The arch as an equilibrium polygon. Numerical analysis, graphical analysis, and influence lines for three-hinged, two-hinged, and fixed arches. Theory of angle changes and the method of the elastic center. The differential equation for the arch axis and applications to spandrel and earth-filled arches. Economic rise-span ratio. Theory of arch dam analysis and applications. (3 cr; prereq 83) Andersen

145. Structural Design by the Ultimate Load Theory. Plastic design of steel structures with applications to continuous beams, portal frames, and gabled frames. Investigation of deflections at ultimate load. Limit design of reinforced concrete frameworks. Yield line theory for slabs. Ultimate load theory applied to design and analysis of reinforced concrete shell structures. (3 cr; prereq 141A) Graves

147s. Foundations. Earth pressure theories by Rankine, Coulomb, and Poncelet. Flexible bulkheads. Soil bearing power. Footings. Piles of steel, timber, and concrete. Pile driving formulas. Driving and handling stresses. Cellular cofferdams, single-wall cofferdams. Caissons. Bridge piers. Port structures and installations. (3 cr; prereq 81) Andersen

227w. Approximate Methods of Structural Analysis II. Application of advanced computational methods to analysis of equilibrium eigenvalue and propagation problems in structural and foundation engineering; discrete systems. (3 cr; prereq 126) Hanley

228s. Approximate Methods of Structural Analysis III. Application of advanced numerical methods to solution of equilibrium, eigenvalue, and propagation problems in structural engineering; continuous systems. (3 cr; prereq 227 or ‡) Hanley

234f*-235w.* Advanced Theory of Structures. Theoretical foundations of structural analysis. (3 cr per qtr; prereq 141A) Andersen, Goodman, Graves, Chopra

236s.* Shell Structures. Design of roof and tank structures using surfaces of revolution, cylinders, surfaces of double curvature, and folded plates. (3 cr; prereq 83) Graves

240f-241w-242s. Advanced Structural Laboratory. Experimental determination of principal strains by use of three or four intersecting gaugelines; plastic flow and shrinkage; prestressed reinforced concrete; moment redistribution; theory of limit design; theory of similitude; statistical data. Vierendeel trusses. (3-5 cr per qtr; prereq 137) Staff

244. Structural Dynamics II. Elastic and plastic response of lumped parameter systems to dynamic loads. Stress propagation in solids and soil-structure interaction. Energy meth-

ods and numerical methods of analysis. Leads to formulation and justification of design expressions for structural elements and systems. (3 cr; prereq 139 or ‡) Hanley

245. Structural Design for Dynamic Loads. Design of beams, slabs, frames, and shells subjected to dynamic loading such as earthquakes, wind forces, blast loads, and moving loads. Determination and idealization of loading functions. Determination of idealization of resistance functions. Design philosophy and procedures for both elastic and plastic response. (3 cr; prereq 244 or ‡) Hanley

246w. Foundation and Harbor Engineering. Earth pressure theories. Flexible bulkheads and retaining walls. Footings. Piles. Cofferdams. Caissons. Port structures and installations. Breakwaters. Theory of elastic supports; impact stresses in waterfront structures. (3 cr) Andersen

247f°-248w-249s. Seminar: Structures. Special topics in the higher theory of structures. (3 cr per qtr; prereq 83, 142)

Transportation Engineering and Land Development

111. Land Surveying. Minnesota Public Land Survey. Federal and state laws governing resurveys, registered land surveys, and subdivision plats. Court decisions and legal principles involving boundary line determinations. Interpreting and writing deed descriptions. (3 cr; prereq 63 or ‡) Fant

112. Aerial Surveying and Photogrammetry. Theory and methods of making planimetric and topographic maps by photogrammetric methods with second order stereoscopic plotters. Control nets, state co-ordinates, and astronomy as used in large-scale mapping projects. (3 cr; prereq 62 or ‡) Fant

113. Land Planning and Subdivision Design. Study and analysis of land planning and development problems. Economics and design of road patterns, lot and block layout, drainage, utilities, etc. Design, computations, and preparation of record plats. (3 cr; prereq 63 or ‡) Fant

152s.° Highway Design. Geometric design of rural highways. Design of intersections, interchanges, and freeways. (3 cr; prereq 52) Thomas

154w. Design of Highway and Airport Pavements. Advanced studies of theories and practices in design of rigid and flexible pavements. Strength tests of subgrades and base courses. Pavement evaluation. (3 cr; prereq 53) Kersten

156f. Highway Traffic Engineering. Characteristics of vehicle and driver. Traffic stream characteristics. Traffic control. Accidents and their prevention. (3 cr; prereq 52) Thomas

158f. Airport Design. Field layout, capacity, drainage, and studies of bases and surfaces for aprons, runways, and taxiways. (3 cr; prereq 52) Kersten

Sanitary Engineering

170w,s. Water Supply. Sources of water supply; quality of water, collection, distribution, and water purification; test methods. Laboratory problems in analysis and design. Inspection trips. (3 cr; prereq 160A) Johnson, Maier, Susag

171s,f. Sewerage and Waste Water Treatment. Sources and quantities of waste water; sanitary, storm, and combined sewer systems; materials and methods of construction; physical, chemical, and biological characteristics of waste water. Disposal by dilution. Domestic and industrial waste treatment. Laboratory problems in analysis and design. Inspection trips. (3 cr; prereq 161, 170 or ‡) Johnson, Maier, Susag

172f. Sanitary Laboratory. Biological, bacteriological, physical, and chemical analyses of water, waste water, air, coagulant chemicals, disinfectants, waste water sludge, etc. (3 cr; prereq 171) Johnson

173f.° Sanitary Engineering Problems: Water. (Supplements 170) Investigations of problems in water supply. Collection, distribution, and purification. Economic studies. (3 cr; prereq 170) Schroepfer

174w.* Sanitary Engineering Problems: Waste Water. (Supplements 171) Investigations of problems in waste water treatment. Stream pollution control, economic studies of various types and degrees of treatment. (3 cr; prereq 171) Schroepfer

175s.* Industrial Waste Disposal. Investigation of quantity and quality characteristics of industrial wastes. Problems with separate treatment or disposal to municipalities. Legal responsibility and ordinances. Determination of equitable charges. Economic studies. (3 cr; prereq 174) Schroepfer

176f,* 177w,* 178s.* Sanitary Engineering Seminar. Reports and discussions on selected topics in the field of sanitary engineering with presentations by off-campus lecturers. (1 cr per qtr; required of grad students emphasizing sanitary engineering; prereq 171) Schroepfer

179f.* Ground Water and Surface Water Quality Problems. Water resources quality. Water quality as related to various beneficial uses. Physical, chemical, and microbiological characteristics of pollutional components. Pollution and recovery characteristics of surface and ground waters. (3 cr; prereq 170 and 171) Susag

180s.* Solid Waste Disposal Problems. Engineering factors in collection and final disposal of solid wastes from urban areas. Regulations, economic factors, and health and aesthetic considerations. Inspections and problems. (3 cr; prereq 170 and 171) Susag

261w.* Water Plant Design. Design of water purification works. (3-5 cr; prereq 173) Schroepfer

262s.* Waste Water Plant Design. Design of treatment works. (3-5 cr; prereq 174) Schroepfer

264ISS. Sanitary Engineering Unit Operations. Lectures, laboratory studies, and pilot-plant-scale studies on screening, hydraulic separation, chemical coagulation, aeration, filtration, disinfection, drying, incineration, and digestion. (3-5 cr; prereq 172) Johnson

276f.* Advanced Sanitary Engineering (Water). Principles of water collection, distribution, and purification. Inspections and investigations of water works systems. Advanced study of certain phases of purification. (3-5 cr; prereq 173) Schroepfer

277s.* Advanced Sanitary Engineering (Waste Water and Industrial Wastes). Principles of waste water collection and treatment, and of industrial waste disposal. Investigation of waste water works systems. Advanced study of certain phases of waste water treatment. (3-5 cr; prereq 174) Schroepfer

General

101. Contracts and Specifications. Synopsis of the law of contracts, sales, agency, negotiable instruments, real property, personal property, partnerships, corporations, insurance contracts, workman's compensation, labor law, mechanics' liens, government construction contracts, and torts with applications to the performance of engineering and construction contracts. (3 cr) Westin

102. Building and Construction Contracts. Contracts with public authorities; the invitation, bid award; potential problems. Private construction. Legal problems in construction; contract administration. (3 cr; prereq 101) Westin

121. Applications of Linear Programming. Classical and modern methods of mathematical model formulation for operations analysis, with specific emphasis on problems encountered in civil engineering. Various methods of solution for specific classes of problems. Introduction to dynamic programming applications. (3 cr; prereq Math 32 or equiv) Hanley

125. Introduction to Computer Applications in Civil Engineering. Basic instruction in programming and utilization of digital computers in solution of civil engineering problems. Execution of actual problems in surveying, structures, hydromechanics, etc., in co-operation with the Numerical Analysis Center. (3 cr; prereq 64, 83, 160A or 2) Staff

169f. Public Works Engineering. Engineering phases and relationships of public works. Federal, state, and local administration problems. Present trends and practices. Need

for adequate public planning, design, and construction. Responsibilities of the engineer. Typical problems. (3 cr; prereq ‡) Schroepfer

194f, 195w, 196s. Advanced Problems in Civil Engineering. Studies in planning, design or analysis of complex civil engineering systems. Individual laboratory research problems, literature studies and reports. (1-3 cr; prereq approval of faculty sponsor) Staff

280f*-281w*-282s.* Civil Engineering Research. Original work in concrete, structural steel, soils, hydraulics, municipal, sanitary, or transportation problems. Investigations, reports, tests, designs. 3-5 cr per qtr; prereq ‡) Graduate staff

Hydromechanics and Hydraulic Engineering

Note—"Hydromechanics" courses carry the designation Hydr.

Hydr 101w,s. Fluid Mechanics. Fluid statics and dynamics for liquids and gases. Viscous effects, dimensional analysis and similitude, potential flow. (3 cr; prereq MM 35, Math 31) Staff

Hydr 104f,w,s. Fluid Mechanics Laboratory. Introduction to laboratory techniques, calibration principles and fluid measurements. Open channel, pipe line, and hydraulic machinery experiments. (1 cr; prereq 101 or ¶101 or ChEn 101) Staff

Hydr 161f.* Open Channel Flow. Theory of uniform and varied flow, with applications to hydraulic structures, channel transitions, hydraulic jump, discharge measuring devices, etc. Computations of water surface profiles, forces on structures, hydraulic pump properties. (3 cr; prereq 101 or ‡) Anderson

Hydr 162w.* Natural and Artificial Waterways. Mechanics of sediment transport. Control of natural and artificial waterways. Design of artificial channels in alluvium. Relationship of sediment transport to channel geometry, deposition in reservoirs, local scour, aggradation and degradation. (3 cr; prereq 161 or ‡) Anderson

Hydr 163s. Groundwater Hydraulics. Flow of fluids through porous media including fundamental equations, potential flow theory, and approximate solutions; application of these theories to seepage through and under dams and cofferdams, wells, well point systems, and stratified media. (3 cr; prereq 101) Hayden

Hydr 167f. Hydraulic Measurements. Laboratory and field methods and instruments for measurement of hydraulic pressure, velocity, and discharge. (3 cr; prereq 101 or ‡) Ripken

Hydr 168w. Hydraulic Pumps and Turbines. Introductory theory of hydraulic pumps, turbines, motors, and transmissions including energy concepts, drag and lift of hydrofoils, and limitations of cavitation. (3 cr; prereq 101 or ‡) Ripken

Hydr 184f-185w-186s.* Advanced Hydraulic and Hydrologic Problems. (1-3 cr per qtr; prereq 161 or ¶161 or ‡; offered when demand warrants) Staff

Hydr 187f,s. Intermediate Fluid Mechanics. One- and two-dimensional flow of an ideal fluid, energy and momentum relations, fluid forces, boundary layer theory, separation and cavitation, hydrofoils. (3 cr; prereq 101 and 104) Ripken, Silberman, Song

Hydr 188w.* Incompressible Potential Flow. Potential flow methods and their application to engineering problems. (3 cr, §Aero 104; prereq 187) Silberman, Song

Hydr 189s.* Incompressible Boundary Layer Flow. Some applications of boundary layer methods to engineering problems. (3 cr, §Aero 101A; prereq 187 or ‡) Silberman, Song

Hydr 190w. Hydraulic Transients. Hydraulic transients encountered in coastal and water resource engineering, including oscillatory, solitary, tidal and flood waves; water hammer; hydraulic jumps; forced vibration of gates and other components of hydraulic structures; and hydrodynamic flutter. (3 cr; prereq CE 160A or ‡) Bowers, Song

Hydr 191s.* Mechanics of Similitude and Dimensional Analysis. Applications of dimensional analysis to hydraulic problems and to similitude. Theory of models, conditions for similarity in the case of hydraulic structures, elastic structures, aircraft, ships, waves, etc. (3 cr; prereq 101 or ‡) Anderson

Hydr 194f-195w-196s.* Advanced Hydraulic Laboratory. Experimental and analytical studies of hydraulic phenomena relating to fluid measurement, pumps, spillways, stilling basins, wave absorption, flow transients, and other selected topics. (2 cr per qtr; prereq 101 and 104)

Hydr 287. Fluid Turbulence. The statistical theory of turbulence with particular application to free turbulence. (3 cr; prereq 187; offered when demand warrants) Silberman

Hydr 290-291-292. Advanced Fluid Mechanics. Application of fluid mechanics principles in design of machinery, structures, and instrumentation and to study of waves, sediment transport, acoustic problems, ship motion, and related topics. (3 cr per qtr; prereq 188, 189 or ‡; offered when demand warrants) Silberman and staff

Hydr 293-294-295. Hydrodynamics of the Boundary Layer. Laminar and turbulent boundary layers and their interaction with the potential flow. Free turbulent flows. (3 cr per qtr; prereq 187 or ‡) Silberman

Hydr 296, 297, 298. Special Topics in Hydrodynamic Theory. Linearized theory, wave motion, cavity and separated flows and other topics to meet special requirements of students. (3 cr per qtr; prereq 295 or ‡; offered when demand warrants) Silberman, Song

CE 160Af,w. Applied Hydraulics. Uniform and varied flow in artificial and natural open channels. Analysis of closed conduit pipe and culvert flows. Characteristics and applications of centrifugal pumps. Flow measurement in pipes and open channels. Applied problems pertaining to spillways and outlet works. (4 cr; prereq Hydr 101, 104) Bowers

CE 161w,s. Hydrology. Basic data and methods available for analysis of precipitation and runoff, including stream flow, groundwater, infiltration, unit hydrographs, flood frequencies, flood routing, and probable maximum floods. (3 cr; prereq Hydr 101) Bowers

CE 164s. Water Conservation. The occurrence of water. Problems in water utilization from the technical economic, legal, and social viewpoints with relation to municipal water supply, waste disposal, power production, irrigation, navigation, recreation, and flood control. Basin-wide planning. National and state water policies. (3 cr) Johnson

CE 166s.* Water Power. Stream flow and water power estimates. Storage problems. Analysis, design, and selection of water power structures and equipment. Types and purposes of dams. Turbine analysis. Transmission lines. Cost and value of water power. Typical problems, inspection trips. (3 cr; prereq 161) Ripken

CE 293. Advanced Hydraulic Engineering Problems. Special hydraulic problems in laboratory, drafting room, and field. (3-5 cr; prereq 104, Hydr 161, 162, 163, 190 or equiv, and ‡) Bowers, Anderson, Ripken, Silberman

Soil Mechanics and Construction Materials

146f,s. Concrete and Concrete Materials. Design and control of concrete mixtures, air-entrained concrete, properties of concrete, and constitution of cement, and construction practice. (3 cr; prereq 51) Thomas

148w. Special Problems in Concrete Materials. Short laboratory research studies. (2-3 cr; prereq 146) Thomas

151w.* Advanced Highway Laboratory. Special experimental studies of highway materials. (3 cr; prereq 52) Thomas

153f. Soils in Highway Engineering. Classification, soil maps, frost action, surveys, physical tests, compaction, design of graded mixes, and soil stabilization. (3 cr; prereq 53) Pederson

157s. Slope Stability. Permeability, seepage, dewatering, analysis of slope stability problems. (3 cr; prereq 53)

159w. Bearing Capacity. Consolidation, stress distribution. Settlement analysis; bearing capacity. (3 cr; prereq 53) Pederson

251w,s-252s.* Advanced Soil Mechanics Laboratory. Consolidation; permeability; direct shear; triaxial compression; California bearing ratio; stabilometer resistance value; and other special laboratory problems in soil mechanics. (3 cr per qtr; prereq 159 or ¶159) Kersten, Pederson

CLASSICS

Professor
Norman J. DeWitt
John Ferguson
William A. McDonald
Victor Pöschl

Robert P. Sonkowsky, *chairman, director of graduate studies*
Donald C. Swanson

Associate Professor
Margaret M. Forbes
R. Joseph Schork

Prerequisites—In special cases some prerequisites can be completed concurrently with graduate work.

For Major—1. Not less than 21 quarter-credits (or equivalent) in one classical language, 6 of which must be at Upper Division level.

2. Either 3 additional quarter-credits (or equivalent) at Upper Division level in the same classical language or 6 quarter-credits (or equivalent) in the other classical language.

For Minor—Lat/Grk 51 or equivalent.

Language Requirement—For the M.A., reading knowledge of one modern foreign language. For the Ph.D., two modern foreign languages. German is frequently recommended for the first language and French or Italian for the second.

Advanced Degree Programs—Students who are admitted to graduate course work may qualify for degree candidacy in one of the following programs:

Master's Degree

Plan A (arranged with special permission of classics graduate faculty or Classics Secondary Education Committee).

1. 18 quarter-credits in one classical language plus as many additional credits, if any, as necessary to demonstrate graduate level proficiency.

2. Proficiency in the other classical language at the level of Lat/Grk 3 or 51 or equivalent.

3. 9 quarter-credits in graduate courses in the other classical language or in graduate courses approved by the classics graduate faculty in such subjects as anthropology, art, comparative literature, education, English, history, linguistics, Italian, philosophy, political science, speech and theatre arts.

4. The thesis may fall within one of the subfields of classics, such as, archaeology, epigraphy, history, linguistics, literature, etc., or in one of the fields to which classics is basic and in which the candidate takes courses for his minor.

Plan B with Greek or Latin Major

1. 27 quarter-credits in one of the two classical languages.

2. 9 to 15 quarter-credits in the other classical language; or proficiency in that language as indicated in A2 above, plus 9 to 15 quarter-credits in such subjects as those listed in A3 above, with special permission of classics graduate faculty or Classics Secondary Education Committee.

3. 6 to 9 quarter-credits in such subjects as those listed in A3 above, for a second "related field."

Plan B with Classics Major (a combined major)

1. Not less than 27 quarter-credits in a combination of courses in Greek *and* Latin; at least 9 of the 27 must be in one of the two languages.

2. 18 quarter-credits in "related fields" (see lists in 3 and 4 under Plan A, above).

Plan B with Major in Classical Area Studies

1. Normally 12 to 18 quarter-credits in Greek *or* Latin and additional credits in "classics" courses (i.e., nonlanguage courses, see page 127) to a total of 27 credits.

2. 18 quarter-credits in "related fields" (see lists in 3 and 4 under Plan A, above).

All the above programs are completed with a written examination.

Doctor's Degree—There are two programs leading to the Ph.D. in classics; these differ in residence requirements only.

1. The Cooperative Ph.D. Program: candidates spend one year at each of the Universities of Iowa, Minnesota, and Wisconsin; and a fourth year at whichever of the three is chosen for the dissertation.

2. The Minnesota Ph.D. program: candidates do not necessarily study at Iowa or Wisconsin but satisfy the same academic requirements as in number 1. The requirements for the M.A. degree, or equivalent, must be passed nonterminally before admission to Ph.D. candidacy.

Comparative Literature—For information on this program, see page 127.

Greek

100. The Craft and Context of Translation. Analysis of problems of translating the Greek classics for contemporary readers. Examples of translation in previous centuries and today. Practice in translation with attention to literary skill and meaning. (3 cr; prereq Grk 63 or ‡; offered 1967-68 and alt yrs) DeWitt

101w or s. The Structure of Greek. Application of descriptive linguistic principles to the Greek language; morpheme and tagmeme identification, structuralization of data, linguistic and statistical patterns. (3 cr; prereq 5 qtrs Greek and Clas 56; offered when feasible) Swanson

111. Advanced Prose Composition. (3 cr; prereq 24 cr in Greek or ‡; offered when feasible)

161f. Plato: Selections. Meets with 61, but advanced independent work in addition to regular class assignments is required. (3 cr; prereq △)

162w. Greek Tragic Drama. Meets with 62, but advanced independent work in addition to regular class assignments is required. (3 cr; prereq △)

163s. Homer. Meets with 63, but advanced independent work in addition to regular class assignments is required. (3 cr; prereq △)

174A-D, 176A-D, 178A-D. Greek Literature. Authors read vary from term to term and from year to year. One or more appropriate authors are studied in a given course. (3 cr per qtr; prereq △)

174A. Oratory (3 cr), B. Tragedy (3 cr), C. Comedy (3 cr), D. Directed Reading and Research (3 cr; prereq △)

176A. History (3 cr), B. Philosophy (3 cr), C. Geography (3 cr), D. Directed Reading and Research (3 cr; prereq △)

178A. Epic (3 cr), B. Lyric (3 cr), C. Romance (3 cr), D. Directed Reading and Research (3 cr; prereq △)

194f. Proseminar: Introduction to Classical Studies. Survey of research in classical scholarship, methods and bibliography, textual history and criticism. (3 cr [required of all new grad students], §Lat 194; prereq grad major or ‡) Swanson

211-212-213.* Seminar: Greek Epic. (3 cr per qtr) McDonald

241-242-243.* Seminar: Greek Lyric Poetry. (3 cr per qtr)

261-262-263. The Conflict of Religions in the Roman Empire. (3 cr per qtr, §Lat 261-262-263; prereq 171 or equiv and △)

271f-272w-273s. Seminar: Greek Rhetoric. (3 cr per qtr) Sonkowsky

Latin

100. The Craft and Context of Translation. Analysis of problems of translating the Latin classics for contemporary readers. Examples of translation in previous centuries and today. Practice in translation with attention to literary skill and meaning. (3 cr; prereq Lat 63 or ‡; offered 1966-67 and alt yrs) DeWitt

101f-102w-103s.† The Structure of Latin. Application of linguistic principles to the Latin language; morpheme and tagmeme identification, structuralization of data, linguistic patterns. (1-2 cr per qtr; prereq Lat 63 or equiv, Clas 56 or equiv, or ‡) Forbes, Erickson

111. Advanced Prose Composition. (3 cr; prereq 73 or △; offered when feasible)

133. Vulgar Latin. Development of Latin into Romance languages. (3 cr; offered 1967-68) Swanson

135s. Medieval Latin. Survey of Latin literature from 5th to 12th century; Carolingian and 12th-century renaissance. (3 cr; prereq ‡)

161f-162w-163s. Survey of Latin Literature. Meets with 61-62-63; but advanced independent work in addition to regular class assignments is required. (3 cr per qtr)

161f. Literature of the Roman Republic. Readings from Plautus, Terence, Lucretius, and others. (3 cr, §61; prereq △)

162w. Latin Lyric Poetry. Readings from Horace and/or Catullus and others. (3 cr, §62; prereq △)

163s. Golden and Silver Latin. Selections from history, satire, nonlyric verse, the novel, and other genres. (3 cr, §63; prereq △)

174A-D, 176A-D, 178A-D. Latin Literature. Authors read vary from term to term and from year to year. One or more appropriate authors are studied in a given course. (3 cr per qtr; prereq △)

174A. History (3 cr), B. Epistles and Essays (3 cr), C. Oratory (3 cr), D. Directed Reading and Research (3 cr; prereq △)

176A. Epic and Pastoral Poetry (3 cr), B. Lyric and Elegaic Poetry (3 cr), C. Drama (3 cr), D. Directed Reading and Research (3 cr; prereq △)

178A. Satire (3 cr), B. Law (3 cr), C. Patristics (3 cr), D. Directed Reading and Research (3 cr; prereq △)

194f. Proseminar: Introduction to Classical Studies. Survey of fields of research in classical scholarship, methods and bibliography, textual history and criticism. (3 cr [required of all new grad students], §Grk 194; prereq grad major or ‡) Swanson

201f, 202w, 203s.* Seminar: Cicero. (3 cr per qtr; offered when feasible) Sonkowsky

221-222-223.* Seminar: Latin Lyric Poetry. (3 cr per qtr)

232w. Seminar: Augustan Poetry. (3 cr; offered 1966-67) Pöschl

251-252-253.* Seminar: Roman Drama. (3 cr per qtr) DeWitt

261-262-263. The Conflict of Religions in the Roman Empire. (3 cr per qtr, §Grk 261-262-263; prereq 171 or equiv and △)

Classics Courses

(for which no Latin or Greek is required)

106w-107s. Introduction to the Study of Language. (3 cr per qtr; prereq 56 or ‡) Swanson

108. The Classical Voices of Poetry: Epic, Lyric, Dramatic. (Same as Spch 108) Oral performance of Greek and Roman texts both in original language and in translation. Previous upper division work either in study of a literature or in performance is expected. (3 cr, §Spch 108; prereq Spch 82 or Spch 83, or Th 61, or 3 cr in Latin or Greek courses numbered 60 or above, or 3 cr in upper division courses in English literature or foreign literature, or ‡) Sonkowsky

122w. Introduction to Greek Archaeology. (Same as Art 161) (3 cr, §Art 161) McDonald

123s. Introduction to Roman Archaeology. (3 cr) McNally

180f. Classical Epic in Translation. Meets with 80, but advanced independent work in addition to regular class assignments is required. (3 cr, §80) McDonald

181w. Greek Tragedy in Translation. Meets with 81, but advanced independent work in addition to regular class assignments is required. (3 cr, §81) Sonkowsky

182s. Aristophanes and Roman Drama in Translation. Meets with 82, but advanced indedependent work in addition to regular class assignments is required. (3 cr, §82) DeWitt

190. Proseminar: Classical Archaeology. (3 cr; prereq Clas 122, 123, or ‡) McDonald

191f, 192w, 193s. Classical Literary Traditions. (3 cr per qtr; prereq 9 cr in English literature, English beyond A-B-C, or foreign literature) DeWitt

Sanskrit

181f-182w-183s. Readings in Sanskrit. (3 cr per qtr; prereq at least 2 upper division courses in early European languages; offered 1967-68 and alt yrs) Swanson

COMPARATIVE LITERATURE

Committee:

G. Robert Stange, *chairman* (English)
Alrik Gustafson (Scandinavian)
John D. Hurrell (English)
Richard B. Mather (East and South Asian Languages)
Walter T. Pattison (Romance Languages)
Armand A. Renaud (Romance Languages)
Gerhard H. Weiss (German)
Frank H. Wood (German)

Degree of Master of Arts

The Master's degree is offered under Plan B only.

Prerequisite for Admission—An undergraduate major in one field of language and literature or its equivalent.

Language Requirements—In addition to being completely proficient in English, candidates for the Master's degree must, during their first year of graduate work, pass reading examinations in two languages from the following list: French, German, Italian, Spanish, Russian, Latin, Greek, Swedish, Norwegian, Chinese, Japanese. One examination must be taken during the first quarter of residence, and the second before the end of the first year.

Program of Study—A candidate for the Master's degree will arrange his program of study with his adviser, who will be a member of the Committee on Comparative Literature. The introductory course, Theory and Methods of Comparative Literature, is required for the M.A. Of the remaining required credits at least 21 must be taken in one literature, and the rest represent a coherent study of a period or literary type. The program of study should involve course work in at least two languages, and must have the approval of the chairman of the Committee on Comparative Literature.

Examination—Toward the end of their course of study candidates for the Master's degree will take a written examination on a specified list of texts.

Degree of Doctor of Philosophy

Prerequisites for Admission—A Master's degree in comparative literature, or in any one field of language and literature, or the equivalent.

Language Requirements—A reading knowledge of three foreign languages will be required for the Doctor's degree. Students with a Master's degree from this University will take the examination in a third language within a year of their admission to candidacy for the Ph.D. Students who have not already taken reading examinations in two languages will arrange a schedule of examinations with the chairman of the Committee on Comparative Literature.

Preliminary Examinations—(a) The student will pass a written examination administered by the Committee with the co-operation of the student's adviser. The examination will be on the theory, methods and bibliography of comparative literature.

(b) In his proposed course of study for the Doctor's degree, a student will designate a principal subfield of study which is the area of his dissertation topic. The subfield may be either a historical period or a literary type as it is represented in at least three literatures. At his preliminary oral examination for the Ph.D. the student will be examined on both his principal subfield and on a similar secondary subfield to be designated by him.

The Minor in Comparative Literature

There is no minor as such in comparative literature, but a supporting program for the Ph.D. may be arranged with the approval of the chairman of the Committee on Comparative Literature.

The major proportion of course work for degrees in comparative literature is offered by the graduate faculties in departments of literature and languages. In special cases, approval may be given for inclusion in graduate programs of graduate courses in such departments as philosophy, history, and art.

CONTROL SCIENCES

Professor

Lawrence Markus (Mathematics), *chairman*
Neal R. Amundson (Chemical Engineering)
Rutherford Aris (Chemical Engineering)
Warren S. Loud (Mathematics)
Katsuhiko Ogata (Mechanical Engineering)
Patarasp R. Sethna (Aeronautical Engineering)
Marvin L. Stein (Mathematics and Computation Center)

Associate Professor

Richard P. Halverson (Electrical Engineering)
E. Bruce Lee (Electrical Engineering)
Bernard W. Lindgren (Mathematics and Statistics)
John H. Park, Jr. (Electrical Engineering)
Charlotte Striebel (Statistics)

Assistant Professor

K. S. Prasanna Kumar (Electrical Engineering)

The program in control sciences leads to the Ph.D. degree. No M.S. degree or minor specialization is planned in the field of control sciences.

Prerequisites—Candidates for the Ph.D. program in control sciences will normally have completed an undergraduate degree or an M.S. in one of the related fields of engineering, mathematics, statistics, or physics. Prior to his admission to the program the student must be admitted as a graduate student to one of the relevant departments. Admission to the program must be approved by the Graduate School on recommendation of his department and the subcommittee on control sciences. Any applicant whose scientific and engineering training is adequate to follow the program will be considered.

Approval of Program—The candidate's tentative program will be planned with the aid of an adviser selected from those listed on the faculty of the Center for Control Sciences. This faculty will consider the program and transmit it to the Physical Sciences Group Committee with recommendations. Approval and appointment of a thesis committee will be handled as usual.

Major Program—The course work in the major should normally be selected from those courses in science and engineering that are particularly relevant to the field of control sciences. As it is intended that this program should provide an opportunity for a broad training, it is desirable that at least 9 credits of 200-series courses be selected from each of three of the related major areas. The candidate must prepare for a preliminary examination covering each of the following four basic divisions:

1. Mathematical and physical control models

2. Stability and control of linear and nonlinear deterministic processes
3. Stochastic processes and information theory
4. Numerical and computer techniques and implementation of control concepts in scientific and engineering processes

Normally a student can prepare for the preliminary examination by completing 9 credits of 200-series (or suitably advanced) courses in each of the four divisions. The remaining course work for the Ph.D. will be selected in consultation with an adviser.

Minor Program—There will be no official minor program. Therefore, all courses on the doctoral program must be passed with a grade of B or better. Each candidate is required to attain a high level of mathematical proficiency.

Language Requirement—All candidates must satisfactorily meet the requirement of two foreign languages, usually selected from French, German, or Russian.

COURSES CARRYING GRADUATE CREDIT WHEN THEY ARE PROGRAM RELATED

FS 161. Seminar: Foreign Study I. Directed field study in selected foreign countries, investigating current economic, political, educational, cultural, and religious patterns of life. Each student will study the country carefully before embarking and write a comprehensive report of his findings upon returning. (6 cr [grad students pay for 6 cr but receive 3 cr on their grad records]; prereq approval before December by a faculty selection committee; grad students must also have approval of their faculty advisers) Stavrou

FS 162. Seminar: Foreign Study II. Continuation of 161. (6 cr [grad students pay for 6 cr but receive 3 cr on their grad records]) Stavrou

Hum 131-132-133. Humanities Proseminar. Selected interdisciplinary topics in the humanities. (3 cr per qtr) Berryman

NSci 171, 172, 173. Development of the Sciences. Seminar on works of great scientists from Hippocrates to modern times. (3 cr per qtr; prereq 1 yr biology and physical science or ‡) Graubard

DENTISTRY

For staff and courses of study offered, see the *Bulletin of Graduate Programs in Medicine, Dentistry, and Pharmacy.*

EAST AND SOUTH ASIAN LANGUAGES

Professor
Chun-Jo Liu
Richard B. Mather

Associate Professor
Edward M. Copeland, *chairman*

Assistant Professor
Owen R. Loveless
Paul W. Staneslow
Stephen Wang

Instructor
Amy T. Matsumoto

Graduate Majors

Prerequisites—To be accepted as a graduate major in Chinese or Japanese, the applicant must present a satisfactory undergraduate record including 18 Upper Division credit hours in Chinese or Japanese and the completion of Chinese (Japanese) 103 with a grade average of B or above. In special cases provisional registration may be arranged.

Subfields of Specialization—

Chinese	Japanese
1. Literature of the Ancient Period (pre-Ch'in to Han, to 221 A.D.)	1. Literature of the Court (Nara-Hsian, 712-1185)
2. Early Medieval Literature (the Six Dynasties, 221-589)	2. Medieval Literature (Kamakura-Ashikaga, 1195-1600)
3. Late Medieval Literature (T'ang-Sung, 589-1280)	3. Early Modern Literature (Tokugawa, 1600-1868)
4. Early Modern Literature (Yüan-Ming-Ch'ing, 1280-1911)	4. Modern Literature (Meiji, 1868-1911)
5. Modern Literature (1911——)	5. Contemporary Literature (1911——)
6. Linguistics and Philology	6. Linguistics and Philology

Language Requirement—A candidate for the Master's degree must have a reading knowledge of at least one other modern or classical language.

Master's Degree—Offered under Plan B.

Major Requirement—A minimum of 27 graduate credits in Chinese (Japanese) 3 of which must be in Chinese (Japanese) bibliography, 3 of which must be in Chinese (Japanese) linguistics; a minimum of 6 graduate credits in another related field. To satisfy the written examination requirement of the Graduate School, the student will write one in cultural history plus two in subfields chosen from those listed above.

Graduate Minor

Prerequisites—Registration as a graduate minor in Chinese (Japanese) is permitted only upon consultation with a graduate adviser in the fields.

Chinese

Chin 101f-102w-103s. Beginning Literary Chinese. Introduction to the language of classical and traditional texts. (3 cr per qtr; prereq 3, may be ¶51-52-53) Staff

Chin 105f-106w-107s. Introduction to Chinese Linguistics. (3 cr per qtr; prereq 103 or Clas 56 or ‡) S Wang

Chin 110-111-112. Chinese Literature in Translation. (3 cr per qtr; prereq 9 cr in literature or ‡; Chinese required only of majors, who will read assigned portions in original; offered 1966-67 and alt yrs) Staff

Chin 121f-122w-123s. Vernacular Texts. (3 cr per qtr; prereq Chin 53 and 103; with ‡ may be ¶ with 101-102-103) Liu

Chin 125, 126, 127. Chinese Documents. (3 cr per qtr; prereq 103 or ‡)

Chin 135-136-137. Advanced Conversation and Composition in Chinese. (3 cr per qtr; prereq 103)

Chin 161f-162w-163s. Six Dynasties Literary Texts. Reading of representative prose and poetical works by major writers 200-600 A.D. (2 cr per qtr; prereq 103; offered 1967-68 and alt yrs) Mather

Chin 171f-172w-173s. Poetry of the T'ang and Sung Periods. Reading of the poetical works of Li Po, Tu Fu, Wang Wei, Po Chu-i, Li Yu, Ou-yang, Hsiu, Su Tung-p'o, and others. (2 cr per qtr; prereq 103; offered 1967-68 and alt yrs) Mather

Chin 175, 176, 177. Chinese Literature of Yuan, Ming, and Ch'ing Periods. (3 cr per qtr; prereq Chin 103, 123, or ‡) Liu

Chin 181-182-183. Twentieth-Century Chinese Literature. (2 cr per qtr; prereq 123) Staff

Chin 185, 186, 187. History of Chinese Literary Criticism. (3 cr per qtr; prereq 173 or ‡; offered when feasible)

Chin 191Hf-192Hw-193Hs. Honors Course: Research. (1-3 cr per qtr; prereq 103 and 123 or ‡) Mather and staff

Chin 200A,B,C. Bibliography and Research Methods. (3 cr per qtr; prereq 103 and 123, ‡)

Chin 205s. Seminar: Chinese Linguistics. (3 cr; prereq 105, 106, 107 or ‡) Wang

Chin 221. Seminar: Vernacular Chinese Literature. (3 cr; prereq 123 and 200C) Liu

Chin 248A, 249A, 250A. Ming and Ch'ing History. (Same as Hist 248A, 249A, 250A) (3 cr per qtr; prereq reading knowledge of Chinese) Taylor

Indic

Indn 101-102-103. Advanced Hindi. (3 cr per qtr; prereq 53 or ‡; offered when feasible) Staff

Indn 105. Structure of Hindi. (3 cr per qtr; prereq reading knowledge of Hindi) Staneslow

Indn 106-107. Hindi Linguistics. (3 cr per qtr; prereq ‡) Staneslow

Indn 110. Survey of Indian Literature. From the Vedas to present. Taught in English. (3 cr; prereq 6 cr in literature or 3 cr in courses pertaining to India or ‡) Staff

Indn 121-122-123. Readings in Hindi Literature (Twentieth Century). (3 cr per qtr; prereq 103) Staff

Indn 125-126-127. Hindi Composition. (3 cr per qtr; prereq 103) Staff

Japanese

Jpn 101-102-103. Advanced Japanese. Readings in modern prose and poetry; introduction to the classical language. (3 cr per qtr; prereq 53) Staff

Jpn 105-106-107. Introduction to Japanese Linguistics. (3 cr per qtr; prereq 103 or Clas 56 or ‡)

Jpn 110-111-112. Literature in Translation. Survey of Japanese literature 8th century A.D. to present. (3 cr per qtr; prereq 9 cr in literature, knowledge of Japanese required only of majors, who will read assigned portions in the original) Copeland

Jpn 121-122-123. Readings in Contemporary Japanese Texts. (3 cr per qtr; prereq 103)

Jpn 148Fw, 149Fs. History of Japan. (Same as Hist 148F-149F) (3 cr per qtr) Marshall

Jpn 161-162-163. Classical Japanese Prose. Reading of representative prose works by major writers of the classical period. (2 cr per qtr; prereq 103) Copeland

Jpn 171-172-173. Poetry of the Nara and Heian Periods. Readings in the major anthologies of the classical period. (2 cr per qtr; prereq 103; offered 1966-67 and alt yrs) Copeland

Jpn 191H-192H-193H. Honors Course: Research. (1-3 cr per qtr; prereq 103 or 123 or ‡) Staff

Jpn 193Af-194Aw. Proseminar: History of Japan. (Same as Hist 193A-194A) (3 cr per qtr; prereq ‡) Marshall

Jpn 200A,B,C. Bibliography and Research Methods. (3 cr per qtr; prereq 103, 123, ‡) Staff

Sanskrit

Skt 151, 152, 153. Directed Readings. (3 cr per qtr; prereq ‡) Staff

Tibetan

Tib 101-102-103. Beginning Tibetan. (3 cr per qtr) Wang

ECONOMICS

Professor

Francis M. Boddy
O. H. Brownlee, *chairman*
John A. Buttrick
John S. Chipman
Walter W. Heller
James M. Henderson
Clifford Hildreth
Leonid Hurwicz
John H. Kareken
Anne O. Krueger
Jacob Schmookler
Norman J. Simler, *director of graduate study*
John G. Turnbull

Associate Professor

Edward Coen
Carlos F. Diaz Alejandro
Edward M. Foster
Peter Gregory
John C. Hause
E. Scott Maynes
Herbert Mohring
George L. Perry
Marcel K. Richter
Harlan M. Smith

Assistant Professor

George D. Green
Ralph H. Hofmeister
Thomas J. Muench
Hugo F. Sonnenschein
Morris F. D. Teubal
Neil Wallace

Prerequisites—Courses in economics are open to all regularly enrolled graduate students who can meet course prerequisites as listed in the *Class Schedule* or who obtain permission of instructor. A student who desires to major or minor in economics shall satisfy the director of graduate studies in economics that he is prepared to undertake graduate work in economics. Normally he shall have had work in economics and some courses in mathematics or statistics as an undergraduate. An undergraduate grade average of B or better is usually required. Detailed information may be obtained from the department office.

Language Requirement—For the Master's degree, none. For the Ph.D. degree, reading knowledge of two foreign languages or of one foreign language and either a collateral field or research technique that meets the approval of the major adviser and the director of graduate studies.

Master's Degree—Work leading to the M.A. degree is offered under Plan A or Plan B. By arrangement with the instructor, a Plan B paper may be written in most of the courses listed below.

Doctor's Degree—Work leading to the Ph.D. degree in economics is offered. Credit in economics may be granted for some courses offered in business administration, agricultural economics, statistics, and history. Consult the director of graduate studies.

General

101A. Foundations of Mathematics for Social Scientists. Sets. Relations. Partially ordered systems. Functional relations. Elements of logical calculus. Groups. Matrices. Applications mostly in economics, decision and game theory, some in statistics. (3 cr; prereq Math 10 or equiv or ‡) Staff

101B. Introduction to Decision Theory. Elements of probability. Basic concepts in statistical decision theory. Relationship to game theory and other types of decision problems. Prediction and inference. Models underlying statistical analysis in economics and certain other fields. (Same as Stat 101) (3 cr; prereq 101A, or Math 40 or 42, or ‡)

120. Economics of Consumption. Theories and research relating to saving and consumption; concept of saving; consumption function literature; forecasting of consumer spending; role of buying plans. (3 cr; prereq 65 or 165, 66 or 166 or ‡) Maynes

140. Economics of Location. Analysis of location of economic activity in relation to resources and markets. Effects of changes in transport costs. Problems of regulating urban growth. (3 cr; prereq 65 or 165, 66 or 166 or ‡) Mohring

150A-B-C. Current Economic Issues. Current controversies over economic policy and problems that underlie controversies. Selected topics. (3 cr per qtr; prereq 65, 66 or equiv or ‡; offered when feasible)

160. Comparative Economic Systems. (Old 160B) Functions of all economic systems—the market economy, liberal socialism, the centrally planned economy. Analysis of American and Soviet economies. (3 cr, §160A; prereq 2 or equiv; not available to economics majors) Maynes, Schmookler

160A. Advanced Comparative Economic Systems. Functions of all economic systems—the market economy, liberal socialism, the centrally planned economy. Analysis of American and Soviet economies. (3 cr, §160; prereq 65, 66 or equiv or ‡) Maynes, Schmookler

170. Economics, Ethics, and Economic Philosophy. The literature and the issues it raises; relation of ethics to economic organization, practice, and policy. Different economic philosophies; elements involved in formulation of an economic philosophy. (3 cr; prereq 2 or equiv) Smith

190. Readings in Economics. Areas useful to individual programs and objectives not available in regular course offerings. (Cr ar; prereq consent of adviser and ‡) Staff

200. Advanced Topics in General Economics. Topics to be announced. This course may be offered in several sections at the same time and with different topics and may be taken more than once. (Cr ar; prereq ‡) Staff

200A-B. Advanced Topics in Consumer Behavior. (3 cr per qtr; prereq ‡) Staff

290. Individual Graduate Research. (Cr ar) Staff

300. Seminar: Economics. Topics to be announced. This course may be offered in several sections at the same time and with different topics and may be taken more than once. (Cr ar; prereq ‡) Staff

390A-B-C. Workshop in Economics. Topics to be announced. The workshop may be offered in several sections at the same time and with different topics. (Cr ar; prereq completion of written preliminary exam in field of workshop topic or ‡) Staff

Economic Theory

135A-B-C. Foundations of Economic Analysis. Essentially a substitute for 176A-B, 185A-B, 215A for students with mathematics. (3 cr per qtr; prereq 165, 166, Math 44 or equiv and ‡) Chipman, Richter, Sonnenschein

165. Elements of Economic Analysis: Firm and Household. Individual decision making by households and by firms under conditions of monopoly, competition, and monopolistic competition. (3 cr, §65; prereq 2 or equiv or ‡) Staff

166. Elements of Economic Analysis: Income and Employment. Determinants of national income, employment and price level; aggregate consumption, investment, and asset holding. (3 cr, §66; prereq 2 or equiv or ‡) Staff

175. Economic Analysis III: Welfare Theory and Policy. Decision problems faced by the household and development of elementary welfare economics; application of evaluative techniques to various market phenomena and government policies. (3 cr; prereq 185A) Buttrick, Foster, Hause

176A. Economic Analysis II: Income Theory. General equilibrium models from which may be determined the real output, employment, price level, and rate of interest. Effects of government fiscal and monetary policies on these equilibrium values. (3 cr; prereq 166 or equiv or ‡) Brownlee, Kareken

176B. Dynamic Macroeconomics. Theories of pattern of movements over time of employment, incomes, and prices. Effects of various economic policies upon magnitude of fluctuations; stability of the economy. (3 cr; prereq 176A or equiv or ‡) Brownlee, Perry

180A-B. History of Economic Thought. Principal economic writings of the past so that contemporary theory may be seen in perspective. Particular theories are related to problems and policies of the times and to contemporary theories. A: Classical economists, Marx, and beginnings of neoclassical economics. B: Development of neoclassical economics through the 1930's. Origins of macrotheory. (3 cr per qtr; prereq 176A, 175 or ‡) Buttrick, Krueger

185A. Economic Analysis I: Price Theory. Theories of choice as applied to consumers, firms, and resource owners, economic behavior in competitive and monopoly market situations. (3 cr; prereq 165 or equiv or ‡) Boddy, Henderson

185B. Advanced Microeconomics. Price and output policies under conditions of imperfect competition. Problems of choice under conditions of uncertainty. (3 cr; prereq 185A or equiv or ‡) Boddy, Henderson

186. Income Distribution. Statistics of personal and functional income distribution. Wages, rent, interest, and profit under pure and imperfect competition. Aggregative theories of distribution as a whole. "Exploitation" and "maldistribution" problems. (3 cr; prereq 165, 166 or equiv) Boddy, Simler

195A-B-C. Decision Making and Operations Analysis. Applications of various mathematical techniques of maximization and minimization to business problems. Calculus, linear programming, nonlinear programming, and dynamic programming methods are applied to production, inventory, transportation, selling, and financial problems. Electronic computer programs used where feasible. (3 cr per qtr; prereq 65 or 165, Math 43 or equiv or ‡) Brownlee, Chipman, Henderson

215A-B. Welfare Economics. Basic concepts and propositions; Pareto optimality, social welfare functions; economic efficiency of alternative market structures. Decentralization of resource allocation processes. Applications of concepts for analysis of typical policy issues with emphasis on development of student's skills. (3 cr per qtr; prereq 185B or equiv or ‡) Brownlee, Hurwicz

225A-B. Advanced Topics in Microeconomics. (3 cr per qtr; prereq ‡) Staff

226A-B. Advanced Topics in Macroeconomics. (3 cr per qtr; prereq ‡) Staff

245A-B-C. Mathematical Economics. Mathematical models underlying contemporary economic theory. (3 cr per qtr; prereq 135C or ‡) Chipman, Hurwicz

335. Seminar: Mathematical Economics. (Cr ar; prereq ‡) Hurwicz and others

Econometrics and Statistics

111. Elements of Statistics. Acquaints the nonspecialist with some basic concepts and methods of classical statistics. Problems of hypothesis testing and estimation. (3 cr; prereq Math 10 or ‡) Staff

121A-B-C. Theory of Statistics. (Same as Stat 121, 122, 123) Normal and related univariate and multivariate distributions. Some large sample theory, including the law of large numbers. Likelihood methods in hypothesis testing and estimation; applications to regression and analysis of variance and covariance. Confidence intervals. Distribution-free methods. (3 cr per qtr; prereq Math 42 or ¶Math 42 for 121A, Math 43 for 121B, Math 44 for 121C, or ♯)

131. Elements of Econometrics. Statistical inference in models arising in economics and certain other fields. Least squares method, regression theory; relationship to simultaneous equation and factor analysis problems. Specification error. Identification. Time series. Problems of aggregation. Examples: production functions, demand functions, factor analysis. (3 cr; prereq 121C or ¶121C or ♯) Chipman, Hildreth, Hurwicz

181A-B-C. Topics in Statistics. (Same as Stat 181A, B, C)

201A-B-C. Econometrics. A: Multiple regression analysis. Markov theorem on least squares. Linear restrictions. Specification and aggregation problems. B: Multivariate normal regression and simultaneous equation models. Identification. Limited information, full information, and two-stage least squares methods of estimation. Serial correlation. Time series and cross-section analysis. C: Applications to demand and supply production, business cycles, and forecasting. Computational methods. (3 cr per qtr; prereq 165, 166, 121C or equiv...some background in matrix theory highly desirable) Chipman, Hildreth, Hurwicz

221A-B. Advanced Topics in Econometrics. (3 cr per qtr; prereq ♯) Staff

301. Seminar: Econometrics and Statistical Inference. (3 cr; prereq ♯) Hurwicz and others

Labor Economics

102. Contemporary Labor Issues. Analysis of important labor problem areas. Current issues will be examined in light of their broader economic, legal, political, and social implications. (3 cr; prereq 62 or equiv or ♯) Gregory, Simler, Turnbull

152. Economic History of Labor. Historical analysis of role of labor in industrial society; origin and growth of labor organizations and other labor market institutions. Economic and social consequences of these developments. Labor's progress and problems. (3 cr; prereq 62 or equiv or ♯) Gregory

172. Labor Market Behavior and Regulation. Public and private rules and policies directed at regulation of employer-employee-union relations and labor market behavior. Settlement of disputes. Control of employer and union self-help techniques. Emphasis on economics of control, rather than upon legal or administrative aspects of policy. (3 cr; prereq 62 or equiv or ♯) Simler

182. Economic Security. Public and private approaches to problems of economic insecurity. Nature and causes of economic insecurity. Details of and economic and social implications of private and public programs. Emphasis on economics of income and employment maintenance and stabilization rather than upon legal or administrative aspects of policy. (3 cr; prereq 62 or equiv or ♯) Turnbull

192. Economics of Collective Bargaining. Economic analysis of labor markets and their operation under conditions of both individual and collective bargaining. Implications of labor market operations for resource allocation, wage and price stability, income and employment growth. Wage structures and wage levels. Wage and employment theories and practices. Economic impacts of the union. (3 cr; prereq 62, 65, 66 or equiv or ♯) Gregory, Simler, Turnbull

222A-B. Advanced Topics in Labor Economics. (3 cr per qtr; prereq ♯) Staff

Economic Development and Area Studies

103. Economic Development. Conditions necessary for increasing income, capital formation, measurement of economic growth, and problems of "underdeveloped" areas. (3 cr, §103A; prereq 2 or equiv; not available to economics majors) Staff

103A. Economic Development. (Old 103T) Conditions necessary for increasing income; capital formation, measurement of economic growth, and problems of "underdeveloped" areas. (3 cr, §103; prereq 65, 66 or equiv or ‡) Diaz and others

133. Development of American Industry. Relations between long-run changes in technology, output, price, location, and market structure in major American industries, against background of American institutions, changing international environment, growth of population, and per capita income. (3 cr; prereq 165 or equiv) Schmookler

143A,B. Development of the American Economy. Application of economic theory and empirical methods to topics in American economic development, particularly during the 19th century period of accelerated growth and industrialization. (3 cr per qtr; prereq 65, 66 or ‡) Green

154. The Economy of Western Europe. Current internal and external economic problems and policies. Recent developments in production, public finance, income levels, and income distribution. Will emphasize one country of western Europe, not necessarily the same from year to year. (3 cr; prereq 2 or equiv) Boddy, Heller

164. Economy of the U.S.S.R. Development of economic organization of the state, planning and control of use of resources, and distribution of product. Performance of the economy in agriculture and industry under 5-year plans. Internal and external economic policy. Public finance, income distribution, and economic incentives under Soviet system. (3 cr; prereq 2 or equiv) Boddy

174. The Economy of Latin America. Current economic problems: exchange controls, land reform, inflation and fluctuation in prices of basic commodities. Evaluation of foreign aid proposals. (3 cr, §174A; prereq 2 or equiv; not available to economics majors) Chipman, Diaz, Gregory

174A. The Economy of Latin America. (Old 174T) Analysis of current economic problems: exchange controls, land reform, inflation, and fluctuation in prices of basic commodities. Evaluation of foreign aid proposals. (3 cr, §174; prereq 65, 66 or equiv or ‡) Diaz and others

184. Economics of the Far East. Economic development of the Far East following contact with Western civilization. Some present problems: population, growth, capital formation, international economic relations, choice between types of economic organization. (3 cr; prereq 2 or equiv) Buttrick

213A-B. Economic Growth and National Planning. Models of the process of economic growth; exogenous factors to which growth is attributed. Techniques useful in planning, e.g., input-output, national income accounting, programming. Questions of policy. (3 cr per qtr; prereq 175, 176A, plus a course in this section) Buttrick, Krueger

223A-B. Advanced Topics in Economic Development. (3 cr per qtr; prereq ‡) **Staff**

International Economics

104. International Economics. Significance of foreign trade and investment. International payments and foreign exchange. Gold standard. International Monetary Fund and Bank. Arguments over tariffs and foreign aid policies. (3 cr, §104A; prereq 2 or equiv; not available to economics majors) Staff

104A. International Economics. (Old 104T) Significance of foreign trade and investment. International payments and foreign exchange. Gold standard. International Monetary Fund and Bank. Arguments over tariffs and foreign aid policies. (3 cr, §104 and 114A; prereq 65, 66 or equiv or ‡) Diaz and others

114A-B-C. International Trade and Payments Theory. A: Gains from trade, tariffs, customs unions, impact of trade on wages. B: Balance of payments disequilibrium, exchange rates, capital movements. C: Relation of trade theory to growth and development, general equilibrium analysis. (3 cr per qtr; prereq 65 for 114A...66, 67, 114A for 114B...114B for 114C...or ‡) Krueger

134. International Economic Problems. Current issues of international economic policy and development of U.S. foreign economic policy in 20th century. (3 cr; prereq 104 or equiv) Coen, Smith

224A-B. Advanced Topics in International Trade Theory. (3 cr per qtr; prereq 176A, 185A, 114C or equiv or ‡) Chipman

Monetary Economics and Public Finance

157. Business Cycles. Ups and downs of business: explanations of causes, statistical data on such fluctuations. Relationship of cycles to economic growth. Methods of forecasting. Examination of proposals for economic stabilization. (3 cr; prereq 66, 67 or equiv) Perry, Smith

177A-B. Intermediate Monetary Economics. Economic role of principal financial institutions. Determinants of value of money. Principal problems of monetary policy. (3 cr per qtr; prereq 66 or equiv) Kareken, Smith

178A-B. Public Finance. Government expenditures and budgeting, fiscal policy, debt management, and taxation in terms of economic effects, fiscal process, and social policy. Expenditure theory; budgetary process, alternative budgetary policies; debt burden; taxing process; taxation, incentives, and markets; tax incidence; technical problems of income, profits, and sales taxation; defense finance. (3 cr per qtr; prereq 65 and 66 or equiv for 178A) Brownlee, Heller, Perry

188. State and Local Taxation. Main problems of state and local finance and proposed solutions; interstate comparisons and co-ordination of practices and policies. (3 cr; prereq 68 or equiv) Staff

227A-B. Advanced Topics in Monetary Economics. (3 cr per qtr; prereq ‡) Staff

228A-B. Advanced Topics in Public Finance. (3 cr per qtr; prereq ‡) Staff

268A-B. Advanced Public Finance and Fiscal Policy. (3 cr per qtr; prereq 178A, 176A, 175 or equiv or ‡) Brownlee, Heller

277A-B. Development of Monetary Theory and Policy. Principal issues in monetary theory. Contributions to the literature of importance in development of monetary theory. (3 cr per qtr; prereq 177A, 176A, or equiv or ‡) Henderson, Kareken, Smith

377. Seminar: Monetary Policy. (3 cr; prereq ‡) Henderson, Kareken, Smith

Industrial Organization

179A-B. Industrial Organization. Structure of American industry, past and present; factors influencing industry structure. Theories of the firm and competition; their quantitative implications, scale economies, and barriers to entry. Relation of industry structure to industry behavior; the firm and its rivals, the firm and its customers and suppliers. (3 cr per qtr; prereq 165 or equiv) Mohring

189A-B. Government Regulation of Market Behavior. General restraints of trade, monopoly, standards of fair competition and regulation of entry into trades and professions. Regulation of public utility rates and services. Economic and legal analysis of federal regulation; state and local regulation. (3 cr per qtr; prereq 165 or equiv or ‡; offered 1967-68 and alt yrs) Boddy, Hause

229A-B. Advanced Topics in Industrial Organization. (3 cr per qtr; prereq ‡) Staff

309A-B. Seminar: Industrial Organization. Research in applied topics in industrial organization and government regulation of market behavior. (3 cr per qtr; prereq 175, 179B or 189B or equiv or ‡) Boddy, Mohring

EDUCATION**

Professor

Bruce E. Balow
Robert H. Beck
Emma M. Birkmaier
Clarence H. Boeck
Henry Borow
Marjorie M. Brown
Arnold F. Caswell
Theodore W. Clymer
Raymond O. Collier
James R. Curtin
Otto E. Domian
Richard L. Donnelly
Ruth E. Eckert
William H. Edson
Marcia Edwards
Roxana R. Ford
Clifton A. Gayne
Carl V. Goossen
Ruth E. Grout
Theda Hagenah
W. Reid Hastie
Vivian H. Hewer
Clifford P. Hooker
Cyril J. Hoyt
Eloise M. Jaeger
Donovan A. Johnson
William A. Kavanaugh
Stanley B. Kegler
Robert J. Keller
Theodore E. Kellogg
Harry W. Kitts
Robert E. McAdam
George H. McCune
Keith N. McFarland
Jack C. Merwin
Warren G. Meyer
Gordon M. A. Mork
Jerome Moss, Jr.
Howard F. Nelson
Gerhard Neubeck
Paul M. Oberg
Clyde A. Parker
Milo J. Peterson
Ralph A. Piper
Raymond G. Price
Alton L. Raygor
Maynard C. Reynolds
Deane E. Richardson
Vincent R. Rogers
Helen M. Slocum
Timothy L. Smith
John E. Stecklein
Louise A. Stedman
Gordon I. Swanson
Edith West
Roger E. Wilk
Marjorie U. Wilson

Associate Professor

John F. Alexander
Ayers L. Bagley
W. Forrest Bear
Donald H. Blocher
Robert L. Borg
Russell W. Burris
Frederick M. Chapman
Naomi C. Chase
Mary E. Corcoran
Donald E. Davis
Jan D. Duker
Robert Dykstra
Gerald F. Firth
Dewey G. Force
William E. Gardner
Charles J. Glotzbach
Marian D. Hall
Vernon L. Hendrix
Richard N. Hey
Wells Hively II
Alan H. Humphreys
Robert L. Jackson
Bjorn Karlsen
Everett T. Keach
Ronald T. Lambert
John C. Manning
R. Paul Marvin
Daniel C. Neale
R. Norine Odland
Neville P. Pearson
Samuel H. Popper
Martin Snoke
James E. Stochl
W. Wesley Tennyson
Frank B. Wilderson
Arnold S. Woestehoff

Assistant Professor

Alan R. Anderson
Douglas H. Anderson
Eugene S. Gennaro
Lorraine D. Hansen
David C. Johnson
David W. Johnson
Paul E. Johnson
Donald G. MacEachern
Van Dyck Mueller
Frank B. Murphy
Neal C. Nickerson
Douglas R. Pierce
Robert R. Randleman
S. Jay Samuels
James S. Terwilliger
Frank H. Wood

Prerequisites—For major work in education, at least 6 quarter credits in psychology and also a total of not less than 18 quarter credits of undergraduate work in education including introduction to secondary or elementary school teaching. For minor work, at least 6 quarter credits in psychology and also a total of not less than 18 credits of undergraduate work in education. Ordinarily, applicants should already hold a teaching certificate, and for some fields, such as school administration or counseling, teaching experience is strongly advised.

Language Requirement—For the Master's degree, none. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge.

** Advanced work leading to the professional degree of master of education (M.Ed.) is offered by the College of Education in art education, mathematics education, music education, nursing education, physical education for men, physical education for women, and recreational leadership. Additional programs are planned, and interested teachers should inquire about them at the College of Education.

Master's Degree—PLAN A majors may be chosen as follows:

The student, with the approval of his adviser, may select a group of courses in one of the following fields, excluding the field of his minor, centering about his special interest in education:

Agricultural education
Art Education
Curriculum and instruction**
Education**
Educational administration**
Educational psychology**
History and philosophy of education
Home economics education
Industrial education
Music education
Physical education

Minors may be chosen as follows:

1. From any of the foregoing groups of courses when such grouping is not included in the major.

2. From any other field of study offered at the University of Minnesota in which satisfactory courses of graduate character are available and which is obviously related to the major field.

3. Students majoring in fields other than education may choose education or any of its subdivisions enumerated above as a minor when it appears that such a minor is appropriately related to the major field.

Under PLAN B the student will select a field of concentration in which he will attain from 21 to 27 credit hours. The field of concentration differs from a major in that it encourages the choice of a somewhat wider range of courses related to the student's interest. As in the case of the major, however, the student will indicate his field of concentration according to the general arrangement of courses required for a major. This arrangement is as follows:

Agricultural education
Art education
Curriculum and instruction**
Education (in special cases)**
Educational administration**
Educational psychology**
History and philosophy of education
Home economics education
Industrial education
Music education
Physical education

Additional Courses—The student may elect the additional courses required to complete the total of 45 credits from areas of education not included in the field of concentration and from any other fields of study offered at the University of Minnesota in which satisfactory courses of graduate character are available and which are obviously related to the student's interest. Teachers should include advanced study in their teaching fields.

Notes to Applicants for Admission to Graduate School—Be sure to indicate the exact major field in which you are interested. Where necessary, state also the main emphasis within the major field, as in the following examples:

Educational administration (specify whether elementary school principal, secondary school principal, or school superintendent)

** See Notes to Applicants for Admission to Graduate School, on this page.

Educational psychology (specify whether college or high school guidance and counseling, measurement, research, school psychology, special education, learning, or another main interest)

Curriculum and instruction (specify whether your general interest is at the elementary or secondary level, or in a principal teaching field such as business and distributive education, English education, etc.)

Education (at M.A. level this major is planned only for those secondary school teachers who desire a combination of education fields for their area of concentration, with the related work taken in specific teaching fields, such as English, mathematics, or science, and programs which emphasize special fields [Special Education] involving courses from an unusually broad combination of departments. At the Ph.D. level this major includes programs with varying emphases, as indicated under "Doctor's Degree," and the applicant should specify the area of his main concern.)

Doctor's Degree—A major may be chosen, with the adviser's approval, from the following:

Education
Educational administration
Educational psychology

Under the first of these majors, education, the student's program may emphasize any one of several areas, such as industrial education, history and philosophy of education, agricultural education, art education, home economics education, physical education and health, business and distributive education, as well as the elementary and secondary education fields shown under the curriculum and instruction department. Under this general major, the student works with a doctoral adviser from the area of his own particular interest, he includes in his major program a core of courses from that area, and he plans his research in relation to that special interest.

A minor may be selected from any field of graduate study related to the field of major interest, including any one of the following areas of education not represented in the major:

Agricultural education
Curriculum and instruction
Education
Educational administration
Educational psychology
History and philosophy of education
Home economics education
Industrial education
Physical education

If the student's major is education and the minor is one of the above areas not represented in the major, the minor field is ancillary to the student's principal emphasis in his graduate study, the latter always being included under the major.

Prospective college teachers of communication may apply for a doctoral program with a major in education and a minor in English literature. The major, individually planned, combines pertinent courses from education, journalism, speech, psychology, linguistics, and other areas.

Specialist Certificate Programs

The Graduate School offers 2-year programs in the fields of general educational administration (for superintendents and central office personnel), secondary school administration, elementary school administration, special education, and school psychological services, which lead to the certificate Specialist in Education. These programs require the completion of a minimum of 90 credits. Students will ordinarily complete the requirements for the Master's degree with a major in the field of the specialty as the first year of the program. All first-year students must meet regular admission, candidacy, and examination requirements for the master of arts degree and should specify as their degree objective the Master's degree on the application form. Any decision regarding continuation beyond the Master's degree in a specialist program will be dependent on an evaluation of performance in meeting the master of arts degree requirements. The specialist certificate programs now available are the following:**

General Educational Administration (for Superintendents and Central Office Personnel)—In the first year, the student completes the requirements for the M.A., majoring in educational administration. The second year's program includes seminars in educational administration; workshops on the improvement of instruction in the elementary and secondary schools, school building planning, and state school administrative problems; advanced courses in educational psychology; field research; and graduate courses dealing with school-community problems and educational philosophy.

School Business Administration—This program includes many of the elements of the general educational administration program. Special emphasis is given to those aspects of administration which relate to the business operation of the school. The program is designed for the school business manager, the assistant superintendent in charge of business affairs, and persons in similar positions.

Intermediate Unit in Educational Administration—This administrative unit provides a supervisory, administrative, or co-ordinating function for local school districts within a geographic area larger than a school district and smaller than a state. Students in this program will follow the same common program as for other areas of school administration with the addition of a differentiated group of courses designed to prepare them for service in the Intermediate Unit in Educational Administration. Persons who have taken Master's level work in other areas of school administration can move to this program.

Secondary School Administration—This program is planned to prepare students to serve as high school principals, assistant principals, directors, or supervisors of secondary education and related positions. Students are admitted to the second year of the program after completion of a

**For detailed information, write to the department concerned.

related program for the Master's degree in secondary school administration and supervision. The program emphasizes secondary school curriculum and instruction with support in educational psychology and child psychology as well as educational administration. Students who wish to work on this program are urged to plan early on an individual basis with graduate advisers. It is possible to emphasize the junior high school level or curriculum development.

Elementary School Administration—Requirements are arranged by areas of study, including emphasis on curriculum and instruction, as well as on administration in the elementary school. Students admitted to the second year of the program will plan individually with advisers for meeting the 2-year area requirements through supplementation of work presented for the Master's degree.

Counseling—This program is designed for preparation of counselors, supervisors, and directors or co-ordinators of guidance and counseling programs in school systems. Students must satisfy all requirements for the Master's degree either at the University of Minnesota or elsewhere before being admitted to the program. Breadth of liberal studies is expected in the undergraduate background of candidates for this certificate. Persons who lack such foundation courses will be expected to add to their program work in the social, behavioral, and biological sciences.

School Psychological Services—In the first year, the student completes requirements for the M.A. The second year includes additional work in educational psychology, psychology, child psychology, diagnostic and remedial procedures, and special education as well as appropriate practicum experiences.

Special Education—The program is designed for students preparing for administrative, supervisory, and consultant positions in special education. Flexibility allows concentration in a particular field (such as education of the gifted, the mentally retarded, or the blind), but generally students will be expected to develop competencies in several special education areas. Applicants should have had basic preparation and experience in at least one special education area, with certification for public school work.

Admission to the Specialist in Education Program—Approval of the Graduate School upon recommendation of the graduate faculty in the field of specialty is required. A prospective student must complete an application form for admission to the Graduate School to be submitted with official duplicate copies of transcripts of all college work completed to date. As an attachment to the application form the prospective student should indicate the names and addresses of three persons who are able to comment in detail on his qualifications for undertaking this sixth-year program. He will also be asked to take a graduate form of the Miller Analogies Test before his admission request will be reviewed. Students who have taken or contemplate the completion of the M.A. degree at Minnesota will request consideration for admission to the

specialist program by filing a Graduate School Change of Status Form, available in the Graduate School office.

After admission to the Graduate School for the specialist program and satisfactory completion of at least 9 credits beyond the Master's degree, the student must file a program for the certificate on the appropriate form available in the Graduate School office. This program form will list all courses completed beyond the Bachelor's degree which will be presented for the Specialist Certificate, as well as those courses which he proposes to complete in fulfillment of the requirements for the award of the certificate.

Qualifying examinations in specified areas may be required by the major adviser and the departmental faculty of students who bring credits from other institutions. Such examinations are designed to aid students and their advisers in planning the programs for the Specialist in Education Certificate, and will be taken preceding the date that the students apply for candidacy and file their approved programs.

All students in the specialist program must earn in residence at the University of Minnesota a minimum of 45 credits distributed as approved by the adviser and the graduate faculty in the area of specialization. At least 30 credits of the second year of the program must be earned at the University of Minnesota.

The 2-year specialist program must be completed within a period of 12 years. Graduate credits earned previous to the 12-year span will be evaluated by the graduate faculty in the area of specialization and may be recommended to the Graduate School for acceptance on a full or partial basis. Persons who have completed a Master's degree prior to September 1, 1956, are exempt from the 12-year completion time, but must complete requirements for the Specialist Certificate (beyond the Master's degree) within 7 years after being admitted to the program.

Agricultural Education

Prerequisites—Preparation in agricultural subjects satisfactory to the Department of Agricultural Education.

101. Young Farmer Education in Agriculture. Developing and organizing a continuing program of educational activities for farm youth not in school and not established in an occupation. Co-ordinating community resources, determining needs, deriving goals and individual plans of procedure for establishment in farming and related occupations. Observation of young farmer programs. (4 cr) Peterson, Marvin

103. Adult Education in Agriculture. Systematic instruction for established farmers; analysis of the agricultural situation; adoption of appropriate management practices; determining needs in production, marketing, credit, conservation; developing a continuing program; observation of adult education programs. (4 cr) Peterson, Marvin

104x. Planning Programs. Agricultural education program development in a community school; integration with total school program; administrative relationships and professional improvement. (3 cr; prereq ‡) Peterson

120.* Rural Education and Community Leadership. Role of school in rural community; co-ordination of school with nonschool educational agencies; responsibility for community leadership. (3 cr, §20; prereq ‡) Swanson

121. Enterprise Analysis. Analyzing the farm business as a basis for identifying problems. Planning learning experiences to improve farm management at the high school, young farmer, and adult levels. (3 cr; prereq ‡) Staff

141. Supervised Farm Practice in Vocational Agriculture. Selection, planning, supervising, and summarizing of individual farming programs. Adaptation to meet needs of high school F.F.A. students, young farmers, and adults. (3 cr per qtr, total 9 cr; prereq 10 cr in education or ‡) Staff

145. High School Curriculum in Agriculture. Philosophy, organization, and administration of instruction in agriculture departments in the secondary schools. (3 cr; prereq 10 cr in education) Kitts, Peterson

151. Organization and Management. Administrative structure and function of subcollegiate programs of agricultural education. (3 cr; prereq ‡) Staff

156.* Rural Education Through Extension Methods. Role of Agricultural Extension Service in rural education; methods and techniques of instruction in nonschool educational programs. Special problem required. (3 cr, §56; prereq ‡)

166. Techniques of Instruction in Rural Electrification. Developing a program of instruction in electricity and rural electrification. Teaching aids, units of instruction, job sheets and demonstrations, facilities and materials for adult, young farmer, and high school classes. (3 cr; prereq MeAg 130 or equiv) Kitts

171. Procedures in Teaching Agriculture. New developments in methodology; assessment of innovations and procedures; consideration of various levels of instruction. (3 cr; prereq ‡) Peterson, Marvin

221x. Field Problems. Making investigations, gathering data, and formulating plans regarding agricultural education. (3 cr) Staff

232x.* Research in Agricultural Education. Selecting problems, preparation of bibliographies, analyzing and interpreting data, and preparing manuscripts. (Cr ar; prereq 15 cr in education) Staff

250x. Supervision of Vocational Agriculture. Objectives, functions, responsibilities of state and local supervision at the secondary level; role in teaching-learning process; supervisory activities. (1-3 cr; prereq ‡) Peterson, Kitts

283x. Organization and Administration of Educational Programs in Agriculture. Philosophy, purposes, and objectives at national, state, and local levels. (3 cr per qtr, maximum 9; prereq grad student in field of agriculture other than agricultural education) Staff

286. Current Issues in Agricultural Education. Problems related to local school programs. (Cr ar; prereq ‡) Staff

291x. Seminar: Agricultural Education. (Cr ar) Staff

Art Education

151-152-153. Curriculum Building in Art Education. Selection, evaluation, and organization of material for teaching units and projects. 151: Critical survey; 152: Innovations; 153: Programs for exceptional children. (3 cr per qtr) Gayne, Hastie

156. Intercultural Education Through Art. Approaches to international understanding and co-operation through recognition of aesthetic contributions of diverse peoples to American life. (3 cr) Gayne

158. Art Education in Europe. Current practices, problems, and achievements in art education in western Europe compared with practices in American art education. (3 cr) Gayne

184. Improving Art Programs in the Elementary School. Evaluating research findings and introducing new materials; developing closer co-operation between classroom teachers and art education specialists. (3 cr; prereq tchg exper or ‡) Gayne

185. Improving Art Programs in the Secondary School. For experienced teachers of art and advanced students; critical examination of art programs. (3 cr; prereq tchg exper or ‡) Hastie

189. Application of Aesthetic Theory in Education. Contemporary theories of art, their psychological and philosophical foundations. Open to teachers, supervisors, and administrators concerned with art in general education at all levels. (3 cr) Hastie

284. Research in Art Education. Research techniques. (3 cr) Gayne

295x.• Problems: Art Education. Independent projects under staff guidance may include advanced studio practice or technical problems requiring experimental or library research. (Cr ar; prereq ‡) Gayne, Hastie

296x. Seminar: Art Education. Reports, evaluation of problems, recent literature. (1 cr) Gayne and staff

Curriculum and Instruction

GENERAL COURSES

104. Adult Education. Agencies, programs, philosophies, history, and trends. Each student will devote some time to a field of special interest. (3 cr) Woods

105x. Audio-Visual Materials in Education. Characteristics, advantages, limitations, and practical classroom use of audio-visual materials of nonprojected and projected types. Practice in operation of audio-visual equipment. (3 cr) Pearson

106. Co-ordinating an Audio-Visual Education Program. Criteria for equipment, facilities, and materials; in-service training of teachers; problems in schools or industry. (3 cr; prereq 105 or ‡) Pearson

107x. Radio and Television in Education. Production, techniques of classroom use, selection of equipment, teaching appreciation, and administration of radio and television in the schools. (3 cr; prereq 9 cr in education) Pearson

108. Nonprojected Audio-Visual Materials and Equipment Laboratory. Planning and making nonprojected materials for audio-visual education; use of materials and equipment. (3 cr; prereq 105 or ¶105) Pearson

109x. Projected Audio-Visual Materials and Equipment Laboratory. Planning and making materials for audio-visual education; use of machines and equipment. (3 cr; prereq 105 or ¶105) Pearson

115. Introduction to Education of Visually Handicapped Children. Educational programs, services, and resources for blind and partially seeing children; historical background, philosophy, related sociological and psychological problems. (3 cr; prereq ‡)

116. Braille I. Mastery of literary Braille code and introduction to use of mathematics and music codes; analysis of specialized equipment; use of Braille writers and slates. (3 cr; prereq 115 or ‡)

117. Braille II. Development of classroom materials involving literary Braille code; mastery of Nemeth Code of Mathematics; opportunity for mastery of music code; consideration of newer approaches in setting up text and reference materials. (3 cr; prereq 116)

126. Orientation and Mobility for Blind Children. Provides basic techniques to help blind children gain skill in orientation and mobility. Lectures and demonstrations; practice in basic techniques; conferences on psychological and physical factors in mobility; discussions of cane, dog guide, and related methods of travel. (3 cr; prereq ‡)

127. Methods of Teaching School Subjects to the Hearing Impaired. Adaptation of material and teaching methods for hearing impaired children in reading, mathematics, social studies, and science. (3 cr; prereq SSPA 127 or equiv or ‡)

128. Introduction to the Education of Hearing Impaired Children. Educational programs, services, and resources; historical background; philosophy; sociological and psychological problems. (3 cr; prereq ‡)

133. Consumer Education in the Schools. Objectives, content, and curriculum organization at elementary and secondary levels. (3 cr) Price

145. Reading Difficulties. Causes, prevention, and correction. Remedial practices useful to classroom teacher, school counselor, and reading specialist. (3 cr; prereq 143A or 144 or equiv) Clymer

151. Diagnosis and Treatment of Learning Difficulties. Evaluation of results of teaching; diagnosis of pupil difficulty; development and prevention; tests as aids to teaching; following up a testing program. (3 cr) Clymer, Manning

155. Materials Laboratory for Social Studies Teachers. Printed and audio-visual materials useful in social studies classes. (3 cr; prereq ‡) Gardner

170. Programs and Procedures of Curriculum Development. Leadership in procedures, operational processes, major considerations in planning and organizing, interpersonal relationships, and evaluation of improvement programs. (3 cr, §170A-B; prereq 113 or 119) Curtin, Firth, Goossen

171x. Curriculum Laboratory Practice. Workshop: Analysis and construction of units, courses of study, and curriculums according to needs, interests, level, and specialization. (0-3 cr per qtr; prereq 113 or 119, ‡) Birkmaier, Firth

173. Preparation of Curriculum Materials. Selecting and organizing units, courses of study, curriculum guides and writing materials individually and in groups. (3 cr, §173A-B; prereq 113 or 119) Firth, Goossen

174x-175x-176x. Clinical Methods and Practice in Speech Pathology. Case history and analysis; testing and diagnosis of speech defects; techniques and work programs for treatment; practical clinical work. (3 cr per qtr; prereq SSPA 141, 142, or ‡) Starr

174A. Clinical Practicum in Speech Correction: Cleft Palate. (1 cr; prereq SSPA 146, ‡) Starr

178. Structure and Function of the Eye—Educational Implications. An ophthalmologist discusses anatomy and physiology of the eye. An educator presents the educational implications. Vision screening, visual efficiency, aids. Field trips, films, observations. (3 cr; prereq ‡)

182. Education of Partially Seeing Children. Principles of preparation, selection, and effective use of instructional materials for the partially seeing child; adaptation of school environment. (3 cr; prereq EdCI 115, 118, and ‡)

185. Advanced Course in the Teaching of Modern Languages. New curriculums, classroom procedures; use of language laboratory and other media and evaluation techniques. Open to teachers of modern languages and registrants in language institutes. (3 cr) Birkmaier

189. Materials and Curriculum Construction in Modern Languages. Curriculum development, preparation of units, testing techniques; materials for classroom, language laboratory, televised instruction, and programmed learning. (3 cr; prereq 185 and ‡) Birkmaier

201x.° Problems: Teaching Social Studies. Individual research. (Cr ar; prereq 102 or 155 or 168, 204 or ‡) Morse, McCune, West, Rogers, Gardner, Keach, Warmke

203. Supervision and Administration of Special Education. Procedures in establishing and improving educational programs for exceptional children. (3 cr; prereq ‡) Force

205x.° Problems: Audio-Visual Education. (Cr ar; prereq ‡) Pearson

207x.° Problems: Radio-Television Education. For students whose work in 107 has indicated an aptitude and interest in the field. (1-3 cr per qtr; prereq 107) Pearson

215x.° Problems: School Health Education Program. Independent study and experimentation in school health education. (Cr ar; prereq ‡) Grout

217. Seminar: School Health Education Program. Discussion and reports on current problems in school health education. (Cr ar; prereq ‡) Grout

227x.° Problems: Rural Education. (Cr ar; prereq EdAd 117)

230. Theory and Classical Research in Mathematics Education. Critical review of classical research and relevant theoretical formulations; criteria for appraising research methods, educational implications. (3 cr; prereq 149A or 191 or ‡) Stochl, Jackson

232x.° Problems: Teaching Mathematics. Surveying the most recent literature, designing and preparing research reports on special problems. (Cr ar; prereq 230 or 231 or 291) Stochl, Jackson

233. Seminar: Mathematics Education. Problems of mathematics instruction at levels kindergarten through junior college; provides an opportunity to develop proposals and design models for empirical research. (0-3 cr; prereq ‡) Donovan Johnson, Stochl, Jackson, David Johnson

240. Workshop: Improvement of Instruction. For school principals, superintendents, and supervisors responsible for instructional programs to develop understanding of problems from kindergarten through secondary school; programs for gifted and handicapped, courses of study, planning. (1-4 cr)

241. Seminar: Advanced Study in Supervision and Curriculum Development. Theory, models, and research design. Fall: Effects of social policies on curriculum; Winter: Theory and research in curriculum; Spring: Strategy of change and supervision theory. (1 cr per qtr, total 3 cr; prereq 113, 170 or 172 or equiv) Firth

242. Field Practicum in Supervision and Curriculum Development. Experience through internships and field service. (1 cr per qtr, total 3 cr; prereq 113 and 170) Firth

243A. Research Foundations for Reading Instruction. Critical review and analysis of classical research studies in psychology, pedagogy, and sociology of reading; criteria for appraising research findings; educational implications. (3 cr; prereq 143A and ‡) Clymer

243B. Recent Research in Reading. Critical analysis of methodology and findings of current research. Appraising research methods, population limitations, and educational implications. (3 cr; prereq ‡) Clymer

243C. Seminar: Reading Instruction. Provides graduate students with opportunity to present their research designs and to criticize those of their peers. Faculty members will present designs for studies in progress. Study of problems at all levels. (0-3 cr; prereq ‡) Clymer and staff

271x.° Problems: Curriculum Construction. Individual research. (Cr ar; prereq ‡) Birkmaier, Boeck, Clymer, Curtin, Donovan Johnson, Rogers, Chase, Dykstra, Firth, Gardner, Keach, Lambert, Manning, Odland, Stochl, Humphreys

273x.° Problems: Reading. Recent issues, studies, and findings. For those with previous training in reading who have a special problem or who wish to survey the most recent literature. (Cr ar; prereq 143 or 144 or ‡) Clymer, Kegler, Raygor, Balow, Chase, Dykstra, Manning, Odland

288.° Seminar: Research in Modern Language Learning. Criteria for evaluating major studies with implications for language teachers; needed research, planning and design of individual study. (3 cr; prereq 185 and ‡) Birkmaier

291.° Research in Mathematics Education. Recent issues, problems, and findings; criteria for evaluating research; design and preparation of reports on special problems. (Cr ar; prereq 191) Donovan Johnson

296x.° Problems: Teaching English. For those qualified to undertake individual research. (Cr ar) Kegler, Chase, Dykstra

297. Research in English and Speech Education. Analysis and evaluation of research. (1-3 cr per qtr, max 6)

ELEMENTARY EDUCATION

102. Teaching and Supervision of Social Studies in the Elementary School. Content and organization of social studies programs; programs of understanding, improving the learning situation, and effective use of materials. (3 cr; prereq Ed 75B or equiv) Rogers, Keach

103. Teaching Science in Elementary School. Resources, materials and their application in elementary grades. (3 cr; prereq Ed 75B or tchg exper) Goossen, Humphreys

118. Education of Blind Children in the Elementary Grades. Adaptation of curriculum for blind children; procedures in teaching specialized curriculum: Braille reading, typing, orientation, and mobility; utilization of family, school, and community resources. (3 cr; prereq 115, 116 and ‡)

119. Elementary School Curriculum. Selection and organization of subject matter for courses; methods, problems, and findings of research by subjects. (3 cr; prereq Ed 75B or equiv) Goossen

121. Literature for the Elementary School. Evaluative survey of books for children; research related to children's reading interests; selection of literature. (3 cr) Odland

143A. Teaching and Supervision of Reading in the Elementary School. Objectives, materials, and teaching procedures; current practices and curriculums; class and individual projects; observation of reading techniques and materials in the demonstration school. (3 cr; prereq 9 cr in education) Clymer

143B. Materials and Instructional Techniques of Elementary Reading. Analysis and evaluation of materials for reading instruction; consideration of programmed, basal, linguistic, and other types of materials. Laboratory projects and demonstrations of techniques of instruction; criteria for selection of materials and techniques for students with special needs. (3 cr; prereq 60 or 143A or ‡) Manning

143C. Instructional Leadership in Elementary Reading. Survey of formal and informal procedures for evaluating reading instruction; demonstration teaching as instructional leadership; grouping procedures in improvement of reading programs. Intended for supervisors and principals. (3 cr; prereq 143A or ‡) Manning

149A. Teaching and Supervision of Mathematics in the Elementary School. Present practices and trends in methods, evaluation, and diagnosis; objectives, psychology, and philosophy related to improvement of instruction. (3 cr, §149; prereq 62 or ‡) Stochl, Jackson

149B. Materials Laboratory for Elementary School Mathematics Instruction. Printed and programmed materials, audio-visual aids, community resources; laboratory projects and techniques of using mathematical devices and instruments. (3 cr; prereq 62 or 149A or ‡) Stochl, Jackson

149C. Current Developments in Elementary School Mathematics Instruction. Contemporary literature, trends and experimentation with content; criteria for program evaluation. (3 cr; prereq 62 or 149A or ‡) Stochl, Jackson

150. Supervision and Improvement of Instruction. Functions and duties of a supervisor; techniques; analysis of classroom activities. (3 cr; prereq 9 cr in education) Curtin, Lambert

153A. Materials Laboratory for Teaching English in Elementary Schools. Examination and evaluation of textbooks, programmed materials, and audio-visual resources for language arts instruction. (3 cr; prereq 64 or elementary tchg exper) Chase, Dykstra

154. Elementary Social Studies and the Social Science Disciplines. Relationship of sociology, political science, economics, geography, anthropology, and history to social studies education. Scope, meaning, goals, and significance as they relate to elementary school programs. (3 cr; prereq 61 or 102 or ‡) Rogers

155A. Materials Laboratory for Elementary Social Studies Teachers. Printed, audio-visual, and other materials; investigation and evaluation of teaching materials and devices. (3 cr; prereq 61 or 102 or ‡) Rogers, Keach

165A. Mathematics for Gifted Children. Curriculum and methods of instruction for academically talented children; development of enrichment units; source material for teachers. (3 cr; prereq 62 or 149A or ‡) Stochl, Jackson

165B. Mathematics for Slow Learning Children. Units of instruction emphasizing mathematical concepts essential for vocational competence; experimental materials and methods designed to improve performance of low achievers. (3 cr; prereq 62 or 149A or ‡) Stochl, Jackson

166. Current Trends, Kindergarten Education. Continuing needs of children in our changing culture; current kindergarten practices and recent research. (3 cr; prereq tchg exper primary, kindergarten, or nursery school or ‡) Headley

179. Education of Mentally Retarded Children in the Elementary School. Curriculum content, materials, and methods of instruction for educable mentally retarded children. Preparation of units and development of teaching aids. (3 cr; prereq EPsy 184)

181. Foundations of Elementary School Methods. Psychology and philosophy related to improvement of elementary school instruction; utilization of research findings. (3 cr; prereq 9 cr in education)

206. Curriculum Construction in Elementary Social Studies. Detailed analysis of curriculum building goals, selection of content, grade level placement, development of teaching procedures, and evaluation. (3 cr; prereq 61 or 102, and 154 or ‡)

208. Research in Elementary Social Studies. Critical review of research findings and relevant theoretical formulations of major studies; criteria for appraising research methods, educational implications. (3 cr; prereq 61 or 102, and 154 or ‡)

209. Seminar: Elementary Social Studies Education. Development of proposals and design models for empirical research; problems of social studies instruction for grade levels K-6. (3 cr; prereq 61 or 102, 154, and 208 or ‡)

226x. Seminar: Elementary School Problems. (No cr) Clymer, Curtin, Goossen, Lambert

231. Recent Research in Elementary School Mathematics Instruction. Current issues, problems, and findings in curriculum, gradation of subject matter, methods, and materials of instruction; criteria for evaluating research. (3 cr; prereq 230 or ‡) Stochl, Jackson

257. Research in English Composition in Elementary Schools. Review of research in oral and written language of children; needed research indicated by current classroom procedures. (3 cr; prereq 153 or equiv) Chase, Dykstra

258. Research in Skill Development in Spelling, Handwriting, and Listening. Review of findings with implications for the classroom teacher; evaluation criteria and needed research. (3 cr; prereq 153 or equiv) Chase, Dykstra

261x.* Problems: Improvement of Instruction. Primarily for students qualified to make intensive studies of problems related to school supervision. (Cr ar; prereq ‡) Boeck, Clymer, Curtin, Goossen, Rogers, Chase, Dykstra, Lambert, Manning, Odland, Stochl, Humphreys, Jackson

264. Research in Educational Diagnosis. Recent research in methods of diagnosis in education; techniques of preventive and remedial teaching. (3 cr) Clymer

SECONDARY EDUCATION

113. Principles of Secondary School Curriculum. Fundamental principles; curricular concepts, special services, student activity programs, instructional instruments, administrative systems and future trends. (3 cr; prereq Ed 55B or equiv) Firth

114. Interdisciplinary Approaches to Curriculum. Unified studies and other approaches to rationale, status and trends, design, operation and evaluation of the core curriculum. (3 cr) Firth

120. Education of Blind Students in the Secondary Schools. Adaptation of curriculum for junior-senior high school; preparation of educational materials; reader service, orientation and mobility, specialized equipment; utilization of guidance and counseling services, local, state, and national resources. (3 cr; prereq EdCI 118, and ‡)

122. Literature for Adolescents. Background for pupil guidance in extensive reading in junior and senior high schools. (3 cr; prereq Ed 55B or junior-senior high school tchg exper) Kegler, Kemp

124. Foundations of Career Development. Evaluation of vocational theory and career development research; occupational analysis and industrial structure; methods of classifying the world of work; analysis of labor force and employment trends; basic concepts and principles for effective work in educational and vocational planning and development. (3 cr) Tennyson

125. Occupational Information Laboratory. Using, reviewing, and evaluating occupational information; sources and types of material, occupational filing plans, and practical techniques at secondary school level. (3 cr; prereq ‡) Tennyson, Hansen

129. Trends and Issues in Secondary Curriculum. Research findings and analysis of current proposals at national, state, and local levels. (3 cr; prereq 113 or equiv) Firth

131. Advanced Teaching of Technical Business Subjects. Recent research and trends. (3 cr) Price

132. Teaching the Basic Business Subjects. Recent trends and developments in teaching general business training, economic geography, marketing, business law, and consumer education. (3 cr) Price

135. Group Procedures in Guidance. Content and materials for home room groups, occupations units, and other guidance courses in junior and senior high school. (3 cr; prereq 9 cr in education, EPsy 133 or ‡) Hansen

136. Organization and Administration of Distributive Education. Principles, practices, and legislation followed in developing co-operative part-time and adult programs under federal vocational acts. Basic course for teacher-coordinators and vocational administrators. (3 cr) Meyer

137A. Materials and Methods in Co-operative Part-Time Classes. For co-operative part-time distributive, office, miscellaneous trades, and diversified occupations classes. (3 cr) Meyer

137B. Advanced Materials and Methods in Co-operative Part-Time Classes. Individual and group work on related vocational materials. New methods of teaching co-operative part-time distributive, office, miscellaneous trades, and diversified occupations classes. (3 cr; prereq ‡) Meyer

138. Training Store and Office Supervisors. Conducting short unit courses for store and office supervisors and improving on-the-job training in co-operative part-time programs. (3 cr) Meyer

139. Co-ordination Technique. Problems of co-ordinators in the co-operative part-time program; guidance and selection; placing of students in work stations; assisting job adjustments; developing the training program. (3 cr) Meyer

141. Co-operative Part-Time Work Experience Programs. Planning, organizing, curriculum building, plant and equipment, promoting and evaluating co-operative part-time distributive, office, miscellaneous trades, and diversified occupations programs. (3 cr) Meyer

142. Business and Distributive Programs for Adults. Selection and training of evening school instructors; planning and promoting evening school distributive and business education classes. (3 cr) Meyer

144. Teaching Reading in Secondary Schools. Procedures, objectives, and materials for teaching reading in subject-matter fields. (3 cr; prereq 9 cr in education) Kegler, Chase

147. Workshop Teaching Display. Materials and methods; practice in using equipment. (3 cr; prereq ‡) Meyer

148. Post-Secondary Business and Distributive Education. Determining needs, curriculum, facilities, admission practices, placement and follow-up of students, teacher qualifications, interorganizational relations in junior college and area technical school programs. (3 cr) Price, Meyer

155. Materials Laboratory for Social Studies Teachers. Printed and audio-visual materials useful in social studies classes. (3 cr; prereq ‡) West, Gardner

156. Trends in Business Education. Historical development of business education; trends in philosophy, curriculum, and teaching procedures. (3 cr) Price

158. Materials and Methods in Office and Clerical Practice. Recent research and developments in teaching office practice, clerical practice, and office machines. (3 cr) Price

159. Materials Laboratory, Secondary School Distributive Education. Development of specific related vocational materials for distributive occupations, co-operative part-time classes. (3 cr; prereq 137A or EdT 90C or ‡) Meyer

160. Materials Laboratory, Occupational Relations. Development of general related vocational materials for all types of co-operative part-time classes. (3 cr; prereq 137A, EdT 90 or ‡) Meyer

161. Curriculum Construction in Business Education. Curriculum problems; organization and preparation of teaching units. (3 cr; prereq 113) Price

167. Economic Education Problems. Conceptual framework of economic education through analyzing its research, objectives, philosophy, scope, and curricular sequence. (3 cr; prereq Econ 2 or equiv or ‡) Warmke

168. Current Developments in the Social Studies. Contemporary literature, circular trends, and developments in methods. (3 cr; prereq ‡) McCune, Gardner

169. Student Activity Programs in Secondary Schools. Values, purposes, and practices in organizing, sponsoring, and evaluating student activity programs. (3 cr; prereq Ed 55B or equiv) Firth

172. Supervision of Secondary Instruction. Achievement of appropriate teaching expectations focusing on problems of personnel responsible for their improvement. (3 cr; prereq 113) Firth

180. Education of the Mentally Retarded in the Secondary School. Curriculum, materials, and methods of instruction for educable mentally retarded students. Philosophy, administration, vocational, and personal guidance, parent consultation and work programs. Field trips when possible. (3 cr; prereq EPsy 184)

194. Current Developments in Secondary School Science Teaching. Curriculums, methods, materials of instruction, evaluation. (3 cr; prereq EdT 68B, C, or 68M, equiv undergrad courses, or exper in science tchg) Boeck, Gennaro

191. Advanced Teaching and Supervision of Secondary Mathematics. Methods, materials, and curriculum development; principles of learning; review of research; preparation and evaluation of units, tests, and materials of instruction. (3 cr) Donovan Johnson, David Johnson

192. Mathematics Laboratory. Sources and types of materials, laboratory projects and techniques of using mathematical devices and instruments, visual aids, and community resources. (3 cr; prereq grad or experienced teacher) Donovan Johnson, David Johnson

194. New Content and Methods in Mathematics. Trends and experimentation with content; special programs for the gifted and the slow learner; methods in mathematics; program evaluation. (3 cr; prereq exper in mathematics tchg) Donovan Johnson, David Johnson

195. Current Developments and Curriculum Construction in English. Analysis and evaluation of curriculums and trends; emphasis on articulation. (3 cr; prereq EdT 75C or D or equiv) Kegler, Piché

200. Organization and Supervision of Business Education. Examination of evaluative criteria for business education departments, teacher selection and supervision, and organization of business education in the United States. (3 cr; prereq ‡) Price

204. Social Studies Curriculum. History, techniques, and practices at all grade levels. (3 cr) Gardner

222x. Seminar: Secondary Curriculum and Instruction. Implications and problems reculting from innovations in staff utilization, student grouping procedures, paraprofessional personnel, flexible scheduling, and technological devices. (1 cr per qtr, total 3 cr; prereq 113) Firth, Gardner

225x.° Problems: Secondary School Supervision. An individual problems course on improvement of instruction. (Cr ar; prereq ‡) Firth

237. Seminar: Business and Distributive Education. Primarily for Master's degree candidates. Planning and evaluation of research and of individual projects. (No cr; prereq ‡) Price, Meyer, Warmke

238x.° Problems: Distributive Education. Individual research. (Cr ar; prereq ‡) Meyer

239x.° Problems: Business Education. Investigations in field of student's interest. (Cr ar; prereq ‡) Price, Warmke

280. Supervision of Counseling. Lectures, seminar discussions, review and analysis of recorded interviews, critiques of counseling practicum and observation of practicum experiences. (3 cr; prereq ‡) Dugan, Blocher, Parker

287.* Research Foundations of Secondary School Science Teaching. Implications for improvement of instruction in junior and senior high schools. (3 cr) Boeck

294x.* Advanced Materials and Methods in Secondary School English. Evaluates present content and method in light of research and recent trends in teaching. (3 cr; prereq EdT 75C or equiv) Kegler, Piché

295. Readings in English and Modern Language Education. Readings in high school English or modern language instruction. (1-3 cr; prereq MA or equiv) Birkmaier, Kegler

HIGHER EDUCATION

184. Supervision of Student Teaching. For persons planning to supervise or administer student teaching and other professional laboratory experiences in elementary and secondary education. (3 cr; prereq 15 cr in education or ‡) Mork

228x.* Problems: Higher Education and Teacher Education. Selected topics on college programs, instruction, organization, and administration. (Cr ar; prereq ‡) Eckert, Mork, Morse

250x. Higher Education in the United States. Development, present status, and outlook for American colleges; purposes; current and projected programs provided; trends in curriculum, instruction, and administration; evaluation of outcomes. (3 cr; prereq yr of grad study in any field or 18 cr in education) Eckert

251. Curriculum Trends in American Colleges. Principles in development of college programs. Examination of current curriculums in liberal arts and professional fields; general education courses and sequences. (3 cr; prereq yr of grad study in any field or 18 cr in education) Eckert

252. Effective College Teaching. Teaching-learning relationship; study and appraisal of methods employed to encourage, guide, and appraise students' learning. (3 cr; prereq yr of grad study in any field or 18 cr in education) Eckert

253x. Seminar: Improvement of College Instruction. For instructors, teaching assistants, and advanced graduate students from various departments of the University and other institutions; current problems, research, and trends. Offered with co-operating staff of various teaching departments. (Cr ar or no cr; prereq ‡) Eckert, others

253A. Seminar: Materials and Methods in Marriage Education. Content and methods employed in college marriage courses. Supervised experience in selected teaching methods and in methods of evaluation. (4 cr; may also count toward grad major in sociology) Hill

254x. Directed Experience in College Instruction. Individualized program under guidance of an instructor or department; understandings, procedures, and skills related to application of instructional theory, curriculum development, and evaluation practices. Offered with co-operating staff of various teaching departments. A special section is offered each year in family life education. (Cr ar; prereq ‡; may also count toward grad major in sociology) Eckert, Hill, others

284x. Problems: Student Teaching. Research in supervision, organization, and administration and laboratory experiences on the elementary and secondary levels. (3-9 cr; prereq ‡) Mork, Woestehoff

285-286. Professional Education of Teachers. For present and prospective instructors, administrators, and personnel workers in teacher education institutions. Both quarters are recommended in sequence, but either may be taken without the other. Current issues and problems, selection and retention, curriculum, certification, experimental programs, and research. (3 cr per qtr; prereq for 285, 15 cr in education incl 184 and 250 or HEd 182 or EPsy 250 or ‡...for 286, 285 or ‡) Mork, Woestehoff

Educational Administration

101. Public School Administration. Organization, administration, and general support of public schools in state and local school districts. (3 cr; not open to majors in educational administration; prereq 9 cr in education) Popper

118. The Community School. Philosophy, purposes, organization, and functioning of the community school; its relationship with the area it serves. (3 cr) Pierce

128. Workshop: Educational Administration. Laboratory approach provides opportunities for experienced educational administrators to concentrate their study on common administrative and supervisory problems. (1-6 cr; prereq practicing educational administrator or ‡) Pierce

167. Junior High School. Sources of the movement; purposes, functions, and limitations; fundamental problems, types, and curricular implications of reorganization. (3 cr; prereq 9 cr in education) Popper

200. Seminar: Elementary School Administration. Problems of administration and organization of instruction. (3 cr; prereq 215 or ‡) Curtin, Lambert

201. Foundations of Educational Administration. For all students preparing for administrative positions in schools. Sources, meaning, and application of administrative theory, organizational structure, human relations, and leadership roles as they relate to the conduct of school organizations. (3 cr) Mueller, Pierce

202. Foundations of Educational Administration. For all students preparing for administrative positions in school organizations. Aspects of federal, state, and local relationships as they relate to the co-ordination and operation of public elementary and secondary schools. (3 cr) Mueller, Pierce

210. Public School Finance. Current practices; sources of revenue; types of taxes; theory of taxation; and formulas used for distribution of school aids; federal, state, and local support of education. (3 cr) Mueller

211. School Business Management. Administration of school business affairs. (3 cr; prereq 210 or ‡) Domian, Mueller

215. The Elementary School Principalship. Problems in elementary school administration and the principal's role of leadership. (3 cr; prereq 201 and 202 or ‡) Curtin, Lambert

218. Seminar: Secondary School Administration. Problems in school units treated in a tri-dimensional framework of social system theory, structural-functional analysis, and institutional perspective. Focus on the interrelation of values, roles, technical functions, and goal attainment in the school organization. (3 cr; prereq 201 and 202, or ‡) Popper

224. Legal Aspects of Public School Administration. Constitutional, statutory, and common law bases of school administration; principles growing out of fundamental legal procedures. (3 cr) Hooker

226. School Plant Planning. Planning educational facilities for public and private school systems and institutions of higher education; emphasis on writing educational specifications. (3 cr) Hooker, Mueller

227. Public School Personnel Programs. Selection, assignment, evaluation, and development of school personnel; salary and conditions of service policies of administrative, instructional, and noninstructional personnel. (3 cr) Davis

228x.* Problems: Educational Administration. For superintendents and principals qualified to make intensive studies of a school system. (1-3 cr per qtr) Davis, Popper, Mueller

230. School Community Relations. Theory and practice of educational interpretation; principles; techniques of working with groups; the teacher's contacts with the community; the role of the pupil; professional and lay organization. (3 cr) Popper

231. Workshop: School Community Relations Technique. Practical experience in design and use of basic tools in a program such as: conducting community analysis; preparing copy and news releases; meeting, working with material for the press, radio, and television; planning school publications; opinion polling and personal conferences. (1-4 cr) Popper

232. Workshop: School Business Management. For school business managers and superintendents. Examples of projects: development of a complete insurance program, determination of nature and scope of machine accounting equipment and procedure, establishment of a cost accounting system. (1-4 cr; prereq course in school business management or ‡) Mueller

233. Workshop: The Junior High School. Projects such as articulation with elementary and senior high school; organizing and developing curricular materials; organizing to meet needs of the preadolescent; activity programs; guidance functions. (1-4 cr) Popper

235. Seminar: Educational Administration. Decision making through case method. Cases and concepts covering human relations, curriculum, school community relations, instructional problems; students analyze processes involved and use research and writings in the fields covered. (1-3 cr; prereq MA in educational administration or ‡) Davis

236. Field Study. Required for Specialist in Education certificate. The 10 credits will be based on a written report covering an approved field study. Students may register for the general planning and organization of their study without credit. (0-10 cr; prereq ‡) Curtin, Domian, Hooker, Davis, Firth, Hendrix, Lambert, Popper, Mueller, Nickerson, Pierce

237. Seminar: Educational Law. Legal theory as it applies to education. (1-3 cr; prereq 224 or ‡) Hooker

238. Seminar: Research and Theory. Problems of theory, models, and design in administration, developing and testing hypotheses. Consideration of designs used in behavioral sciences. Students develop proposals and models for empirical research. (1-3 cr) Pierce

239. School Principal's Workshop. Contribution of recent research and theory to effective administration; analysis of administrative behavior in realistic settings and relation of administration to human behavior. (1-4 cr) Curtin, Davis, Popper, Nickerson, Pierce

241. Seminar: Internship in Educational Administration. For interns in elementary, secondary, and general school administration. (1 cr per qtr, max 3 cr) Nickerson

242. Administrative Organization and Staffing of School Systems. Analysis of patterns and staff of public schools, emphasizing the effective achievement of purposes in learning programs. (3 cr; prereq ‡) Davis

253. Administration in Higher Education. Control, faculty and employee personnel administration, budget making and administration, financial accounting and reporting, protection of college funds, public relations. (3 cr; prereq EdCI 250) Morse

264. The Secondary School Principalship. The role of the principal: qualifications, duties and problems, including current issues, and factors of staff and student relationships. (3 cr) Nickerson

265. Administering the High School Program. Practices and procedures in scheduling, improving the curriculum, community relations, records and reports, school services, and program evaluation. (3 cr) Nickerson

270A.* Problems: Elementary School Administration. (Cr ar; prereq ‡) Curtin, Lambert

270B.* Problems: Secondary School Administration. (Cr ar; prereq ‡) Domian, Hooker, Davis, Firth, Popper, Mueller, Nickerson, Pierce

274. The Junior College. Present status, development, functions, organization, curriculum, and trends. (3 cr) Hendrix

275. Junior College Administration. Selected topics and problems associated with administration and administrative positions. (3 cr; prereq 274 or ‡) Hendrix

290. Financing Higher Education. (3 cr; prereq ‡) Hendrix

291. Public Relations for Colleges and Universities. (3 cr; prereq ‡) Hendrix

Educational Psychology

GENERAL COURSES

100. Individual Appraisal for Counseling. Analysis of techniques; use in guidance and counseling. (3 cr; prereq 9 cr in education; offered when feasible) Tennyson, Hansen

110x. Educational Measurement in the Classroom. Principles and methods for construction, evaluation, and improvement of classroom instruction. (3 cr)

116x. Introductory Statistical Methods. Basic statistical techniques; comprehension of literature using elementary statistical concepts and methods. Not equivalent to EPsy 216, 216A. (3 cr)

116Ax. Introductory Statistical Methods—Laboratory. (See EPsy 116) (2 cr; prereq ¶116)

117x. Basic Principles of Measurement. Principles underlying construction of achievement examinations; developments in educational and psychological measurement; theory and practice related to statistical methods; types and uses of derived scores; factors influencing reliability and validity. (3 cr; prereq 116 or 216 or Psy 70 or equiv)

125. Group Dynamics in Education. Review of literature; practical application of social-psychological concepts to analysis of group behavior. (3 cr)

126. Analysis of Behavior in Groups. Laboratory experimentation; individual projects with class help. (3 cr; prereq 125)

133. Introduction to Guidance. Philosophy, principles, and practices in development and operation of pupil personnel services; role of counselor, teacher, principal, and specialized personnel; guidance techniques and case studies. (3 cr; prereq 9 cr in education) Tennyson, Hansen

140. Instruments and Techniques of Measurement. Measuring intelligence, achievement, interests, attitudes, and personality traits; use in educational guidance, personnel work, administration, and supervision. (3 cr; prereq 110 or 117)

141. Computer Programming. Computer as a tool for research in the behavioral sciences. Computer systems, language, and development of specific programs that demonstrate computer characteristics. Laboratory experience. (3 cr)

148x. Clinical Diagnosis of Reading Difficulties. Relationship to psychological factors and clinical remedial correction. (3 cr; prereq EdCI 145)

150x. Clinical Practice in Remedial Teaching. Remedial tutoring of individual children who have difficulty in school learning. (3 cr; prereq EdCI 145 or 151, ‡)

152. Introduction to School Psychological Services. Relationship of the psychologist to teachers, administrators, parents, and community. Problems of normal children; diagnosis and treatment of educational and psychological disabilities. (3 cr) Duker, Hall

159. Personality Development and Mental Hygiene. *Fall:* for seniors and first-year graduate students only—elementary and secondary classroom conditions. *Spring:* for graduate students only—basic theory, group and individual procedures in treatment. (3 cr)

182. Education of Exceptional Children. Overview of field of special education for classroom teachers, counselors, supervisors, and administrators; the initial course for students working on special class certificates. (3 cr; prereq Ed 55B or 75B) Force, Karlsen

183. Education of Gifted Children. Abilities, characteristics, and education of intellectually gifted children and adults. (3 cr; prereq Ed 55B or 75B or equiv) Reynolds

184. Introduction to Education of the Mentally Retarded. Issues which relate to educational practices; community planning; educational philosophy, administration, organization, and programming. (3 cr; prereq 182)

185. Education of the Auditorially Handicapped Child. Group and individual observation of classes for auditorially handicapped children; individual and small group conferences. (3 cr)

186. Education of Emotionally Disturbed and Socially Maladjusted Children. Discussion and evaluation of curriculum, materials, and methods for instruction of disturbed and delinquent children in hospital, training school, and public school settings. (3 cr; prereq ‡) Wilderson

187. Education of Crippled Children. Characteristics and abilities; methods and materials for training; observation of teaching situations involving these groups. Personal consultation scheduled in addition to class hours. (3 cr; prereq 182 or ‡) Force

188. Education of the Culturally Disadvantaged Child. Educational needs of children handicapped by behavior related to deficiencies of physical and/or cultural environment; adaptations of educational programs for such children. (3 cr; HEd 90 and CPsy 80 or equiv) Wood

190. Educational Problems of Cerebral Palsy. Problems in development, learning, and adjustment; study and development of materials to meet special educational needs; observations of teaching and personal conferences. (3 cr; prereq 182 or ‡) Force

193. Psychological Analysis of Instruction. Use of psychological concepts and principles in analysis of instructional problems and development of teaching strategies. Consideration of behavior modification; behavioral objectives; task analysis. (3 cr, §old 193, 196-197) Neale, Hively, P Johnson, Samuels

194-195. The Experimental Analysis of Instruction. Introduction to programmed instruction and behavior modification with emphasis on methodological and theoretical foundations. (3 cr per qtr)

196-197.† Psychology of School Learning. Acquisition of skills, knowledges, and attitudes which typically form the content of the school curriculum, broadly conceived. Influence of motivational variables. (3 cr per qtr, §193) Neale, Hively, P Johnson, Samuels

200.° Seminar: Guidance. Orientation to graduate study for Master's degree candidates in counseling and school guidance services. Examination of issues and developments in youth guidance; review of literature and research. Preparation of starred paper for M.A. program optional. (1-3 cr; prereq ‡) Tennyson, Hansen

207. Research Practicum. Supervised experience in research design, data gathering and processing; assignment to an approved research station according to graduate work completed and experience. (3-6 cr per qtr, 9 cr total; prereq ‡) Wilk

208.° Methods in Educational Research. Methods and techniques employed in investigation and report of educational problems. Suggested for all candidates for degrees. (3 cr; prereq winter qtr MA students only, spring qtr PhD students only) Hoyt, Wilk

209. Seminar: Research Planning. A functional approach to planning empirical research projects appropriate for the basis of a Ph.D. thesis. Students develop outlines of projects and present these for critical review of members of the seminar. (1 cr per qtr) Hoyt

210x. Individual Mental Testing. Revised Stanford-Binet and Wechsler Adult or Wechsler Intelligence Scale for Children. Student supplies materials for at least one test. Full day or 2 mornings per week required for practice administration of tests. (3 cr, §142; prereq 110 or 117 or ¶117 with ‡) Duker

211. Advanced Individual Mental Testing. Familiarizes student with a variety of individual assessment devices, supplementing the Binet and Wechsler scales. Exploration of theoretical aspects of intelligence; administration and interpretation of specific tests; limited practicum involved. (3 cr, §143; prereq 210 and ‡) Duker

216-217-218. Statistical Methods. Foundations of statistical theory; practice in applying theories to solution of educational and psychological problems. (3 cr per qtr) Collier, MacEachern

216A-217A-218A. Statistical Methods Laboratory. For students who wish more experience in solution of problems and use of machines than is obtained in 216-217-218. (2 cr per qtr; prereq ¶216-217-218)

219. Design and Analysis of Experiments. Functional approach to principles of efficient design of experiments and other types of observational programs; improved sampling techniques; methods of analyzing observational results. (3 cr; prereq 218 or ‡) Collier, MacEachern

219A. Design and Analysis of Experiments Laboratory. Applicational extension of 219. (2 cr; prereq ¶219)

220-221. Advanced Theory of Measurement. Principles of underlying construction and use of psychological and educational measuring instruments and the limitations of tests for purposes of measurement in experimentation and evaluation of students' work. (3 cr per qtr; prereq 117 and 217 or equiv or ‡ for 220; 220 for 221) Hoyt

225. Counseling Theory and Procedure I. Definition of counseling; theoretical approaches to counseling and vocational choice theories; measurement versus appraisal; diagnostic principles utilized. (3 cr; prereq 140 or ¶140 and any one of the following: 133, 250, or Psy 130) Blocher, Parker

226.° Counseling Theory and Procedure II. Dimensions of counseling relationship; dynamics of interviewing; distinction between psychotherapy and counseling; treatment of factors; counselor attitude and personality; applications in different settings. (3 cr; prereq 225 or equiv) Blocher, Parker

233x.° Problems: Guidance and Personnel Work. Independent study. (1-9 cr) Dugan, Edson, Hagenah, Merwin, Blocher, Glotzbach, Snoke, Tennyson, Hansen, Parker

234. Seminar: Counseling Theory and Research. Examination of theoretical positions in learning and personality development related to an emerging theory of counseling; review of recent research; evaluation. (3 cr) Blocher, Parker

240x. Problems: Measurement. Intensive study and individual research. (3 cr per qtr) Hoyt

241. Seminar: Developing Computer Applications. Specific problems of utilization of the computer in research and development activities in the behavioral sciences. (3 cr; prereq 141 and ‡)

242. Computer Application to Statistical Analyses. Use of computer to analyze data from the behavioral sciences; interpretation of results; attention to large-scale problems. (3 cr; prereq 218 or equiv)

243x.° Problems: Statistics for Students in Education and Psychology. Recent developments in statistical science; application to educational and psychological problems. (3 cr per qtr) Collier, MacEachern

244x. Research in Special Education. Review of recent research in special education, consideration of needed research, and problems in design. (1 cr per qtr; prereq 116, 117 or equiv, and ‡) Karlsen

248. Seminar: School Psychology. One year of continuous enrollment required of all students in the specialist and Ph.D. programs in school psychology. (1 cr per qtr, total 3; prereq PhD or specialist candidate, ‡) Duker, Hall

253x.° Research Problems. (Cr ar; prereq ‡) Borow, Collier, Edson, Hoyt, Kellogg, Raygor, Reynolds, Stecklein, Wilk, Balow, Corcoran, Duker, Force, Houchins, Karlsen, Neale, Hall, Hively, P Johnson, MacEachern, Samuels, Wilderson, Wood

257. Clinical Practice in Educational Diagnosis. Supervised work with children referred to the Psycho-Educational Clinic for diagnosis of learning disabilities and school related problems. Parent and child interviewing, testing, and preparation of case reports. (5 cr f,w,s, 3 cr su, §151; prereq 210 or equiv, EdCI 145, ‡)

259. Personality Theory in Mental Hygiene. Major concepts of personality theories examined for mental health implications: understanding dynamics of personality development; assessment for prophylaxis and creation of healthy conditions; in groups; identification of individuals needing special help and psychotherapy; theory, research, and modern practices. Preparation of counselors, classroom teachers, administrators, supervisors, curriculum specialists, social workers, and other mental hygiene workers. (3 cr)

260x. Seminar: Educational Psychology. For all Ph.D. majors in educational psychology. Integrating course work in all areas and related fields, analyzing new developments. (Cr ar) Wilk

261. Survey of Theory and Research in Mental Retardation. Critical review of research and theories of mental retardation in the context of relevant developmental theories. Important contributions in primary sources concerning principles of behavior and applied problems. (3 cr; prereq ‡) Turnure

262. Functional Analysis of Behavior in Mental Retardates. Empirical approach to retarded development based on experimental research in perception, learning, motivation, and emotion; derived principles of behavior applied to a variety of specific problems in the development of the retarded. (3 cr; prereq 261) Turnure

263. Design and Interpretation of Behavioral Research with the Mentally Retarded. Detailed treatment of objectives, selection of problems, design, methodology, interpreta-

tion, and reporting of experimental research with the mentally retarded. Origin and implementation of researchable questions, with training and practice in actual research. (3 cr; prereq 262) Turnure

264. Asssessment of the Handicapped. Individual assessment of intelligence, achievement, personality, and vocational aptitudes and interests; limited practicum required. (3 cr; prereq 210) Karlsen

265. Theories of Educating Disturbed Children. Examination of the applications of major personality theories to education of children with behavioral disorders. (3 cr; prereq ‡) Balow

266. Research in Education of Disturbed Children. Review; critical analysis of specific designs and procedures; critique of current status of research in the area. (3 cr; prereq ‡) Balow

267. Research Designs in Education of Disturbed Children. Identification of researchable problems, design, procedures, and interpretation. (3 cr; prereq ‡) Balow

268. Seminar: The Culturally Disadvantaged. Psychological theory and research with implications for educational planning and procedures. (3 cr; prereq ‡) Wood

280. Practicum in Group Leadership. Supervised practice in leading a discussion or activity group. (3 cr; prereq ‡)

286. Advanced Course: Education of Emotionally Disturbed and Socially Maladjusted Children. Techniques of behavior modification, analysis of teacher-pupil interaction in study of classroom groups, and classroom management strategies with disturbed and delinquent children. Current literature review; individual assignments. (3 cr; prereq ‡) Wilderson

287. Practicum: School Psychological Services. Field experience under supervision; typical functions of school psychologists; assessment procedures, case studies, consultation with parents, school personnel, and community agencies. Participation in seminar required. (1-3 cr; prereq ‡) Duker, Hall

288. Practicum in Special Education. Supervised experience in special education, including supervision, administration or co-ordination, teaching and related work in schools, agencies, institutions, and other facilities for exceptional children. (3-9 cr; prereq ‡) Reynolds, Balow, Force, Karlsen, Wilderson, Wood

289. Survey of Special Education Problems. For persons working in special education or in allied fields. (3 cr; prereq 182 or exper, and ‡) Reynolds

290. Advanced Counseling Practicum. An advanced practicum in laboratory setting with emphasis on multiple supervisory reaction to interviews. (3 cr; prereq ‡)

292. Recent Literature in Educational Psychology. (3 cr; prereq ‡) Borow, Hoyt

295x. Research Practicum in Programmed Instruction and Behavior Modification. Problems of constructing, administering, revising, and experimenting with programs of instruction or behavior modification. Individual work with guidance and discussion. (1 cr per qtr; prereq 194-195 or ‡) Hively

297.° Psychology of Knowledge Acquisition. Learning, retention, transfer, and their role in acquisition of knowledge. Nature of structures that constitute curriculum content. (3 cr; prereq 196-197 or Psy 128-129 or ‡) P Johnson

298.° Psychological Theories of Teaching. Evaluation of recent research on teaching; analysis of theories; methods of research. (3 cr; prereq 196-197 or ‡) Neale, Samuels

299.° Seminar: School Learning. Research methodology and theoretically critical issues in human learning. (3 cr; prereq 196-197 or Psy 128-129 and ‡) Neale, Hively, P Johnson, Samuels

SECONDARY EDUCATION

134. Counseling Procedures. Introductory course in counseling for school and community personnel; basic theories and principles applied to the work of the classroom teacher, school principal, church and community agency personnel, counseling procedures, case studies, and role playing. (3 cr; prereq 110 or 117, 133 and ‡)

282A. Field Practice in Guidance. Laboratory experience in testing, occupational information and beginning counselor duties. (1-3 cr; prereq ‡) Tennyson, Hansen

282B. Supervised Practicum in Counseling. Individual assignments in counseling under supervision. (1-3 cr; prereq counselor in service only, ‡) Blocher, Tennyson, Parker, Hansen

HIGHER EDUCATION

250. College Student Personnel Work—Development and Administration. For potential personnel workers, in college or university; scope, administration, co-ordination, and evaluation of program. (3 cr; prereq one course in higher education or ¶one course in higher education or ‡) Parker

251x. College Student Personnel Work. Weekly seminar discussions of college student and noneducational personnel work. *Fall:* student activities. *Winter:* specific personnel services. *Spring:* co-ordination with nonacademic personnel procedures. (1-3 cr per qtr; prereq 250 or other course in higher education) Parker

252. Seminar: The College Student. Psychology and sociology of college students; research concerning diversity of college student populations, vocational development of students, student society, culture, mental health, under-achievement, drop-outs, values, and attitudes. Relevant research methods. (1-3 cr; prerq 6 cr in psychology or educational psychology) Parker

254.° Measurement and Evaluation in Higher Education. The examination program in American institutions of higher learning; principles of examination construction; design and critical evaluation of investigations. (3 cr) Stecklein, Corcoran

255. Diagnosis and Treatment of College Learning Difficulties. Introduction to principles and practice; readings in research literature with emphasis on reading and study skills. Observation of group and individual work in Reading and Study Skills Center. (3 cr; prereq one course in reading and ‡) Raygor

256. Clinical Practice in Diagnosis and Treatment of College Learning Difficulties. Supervised practice in group and individual work. (3 cr; prereq 255) Raygor

281x. Practice in Personnel Work. Supervised experience in counseling at college and adult levels. Student Counseling Bureau section, 3 consecutive quarters beginning fall; other assignments any quarter. (3 cr per qtr; prereq 226, or ‡) Hagenah, Snoke, Parker

History and Philosophy of Education

101. Historical Foundations of Modern Education. Background course for all other courses in history and philosophy of education. Analysis and interpretation of important elements in modern education derived from the Greeks, Romans, the Middle Ages, and the Renaissance. (3 cr) Beck, T Smith, Bagley

110. Intercultural Education. Racial, religious, and nationality problems; their importance for the schools. (3 cr)

131. Comparative Education. European, Asiatic, and American systems and philosophies of education. Explores possibilities of international education. (3 cr) Beck

141. Critical Issues in Contemporary Education. Introduces graduate students to ideas involved in current theory and practice. (3 cr) Beck

149-150-151. Social History of American Education. Impact of education on social and institutional developments in America from colonial period to present. Although schools, both private and public, will receive continuous attention, education will be defined broadly to include work of family, religious congregation, popular press, clubs and other private associations. (3 cr per qtr, §Hist 139E-140E-141E) T Smith

155. History of Western Educational Thought. Major educational classics of Western Civilization: Plato, Cicero, Locke, Rousseau, Dewey, and others. (3 cr) Beck, Bagley

156. History of Ideas in American Education. Readings in American political, economic, and social development; reference to the emerging system of public education. Recommended as background for 170. (3 cr) Bagley

170. American Pragmatism and Education. Analysis and interpretation of the educational philosophy of pragmatism (experimentalism). Readings from Dewey, Kilpatrick, Bode, Counts, Childs, and others. (3 cr) Bagley

182. Comparative Philosophies of Education. Examination of competing philosophies of education. (3 cr) Beck

190. Sociology of Education. Advanced studies in social aspects of education including the school as a socialization process, the social structure of education, the role of school in social change, and others. (3 cr; prereq 90)

241x.* Problems: History and Philosophy of Education. For students interested in research and original work in these areas. (Cr ar; prereq ‡) Beck, T Smith, Bagley

242. Seminar: Educational Philosophy. For advanced students; critical study and discussion of special problems. (3 cr; prereq ‡) Beck, Bagley

296-297-298. Seminar: American Social and Educational History. Source materials: historical criticism and analysis applied to study of social and educational forces in history; individual research projects. See also Hist 237E, 238E, 239E. (3 cr per qtr) T Smith

Home Economics Education

160A. Home Economics Curriculum. Examination of research and literature; development of units of study and programs at elementary and secondary level; production and evaluation of materials. (3 cr, §193A; prereq 63, ‡) Horn

160B. Home Economics Curriculum. Examination of research and literature; course and program development in higher education; analysis of current college programs; production and evaluation of curriculum materials. (3 cr, §193B; prereq ‡)

161. Method in Teaching Home Economics: Theory and Technology. Derivation of theory for educational method from relevant research; application to educational objectives of home economics; analysis of technology related to teaching method. (3 cr, §191; prereq 61, 63, or ‡) Horn

162. Evaluation: Theoretical and Technical Aspects. Collecting and interpreting evidence related to achievement of objectives emphasizing higher levels of cognition and affective behaviors. (3 cr, §292; prereq 62 and ‡) Brown

163. Practicum: Adult Education. Individual field assignments under supervision. (3 cr; prereq ‡)

164. Adult Education in Home Economics. Planning a community program; teaching procedures; special problems. For teachers and supervisors of adult education. (3 cr, §194B; prereq 64 or ‡)

165. Proseminar: Home Economics Education. Relation of processes and standards of rational thought to professional competence and goals of a graduate program of study. (2 cr; required of all new grad students) Brown

166. Trends in Home Economics Education. Current status; purposes, programs, content emphases, research, problems and issues in the field. (3 cr, §243; prereq 160A or B)

190. Readings in Home Economics Education. Independent study under tutorial guidance. (1-3 cr; prereq ‡) Brown, Ford, Horn

195. Space, Equipment, Furnishings, and Materials for Home Economics Departments. Remodeling old and planning new departments, and equipping and furnishing them. Review of research; investigation of problems. (3 cr; prereq 61, 63, HE 49) Horn

196. Home Experiences and the Extended Program. Place and procedures in directing home experiences in the high school program; effective use of the period of extended employment of home-making teachers in the vocational program. (3 cr)

200A. Research Methods. Overview of methods of inquiry appropriate for home economics education. Descriptive and causal-comparative methods with some attention to experimentation. (3 cr, §294; prereq 162, ‡) Brown

200B. Research Methods. Historical and philosophical methods applied to problems of meaning, validity, value, and conceptual structure. (3 cr, §294; prereq 200A and 9 cr in history or philosophy or history and philosophy of education, ‡) Brown

201.° Problems: Home Economics Education. Independent study of current educational problems. (1-9 cr, §293; prereq 200A, ‡) Brown, Ford, Horn

260. Seminar: Curriculum Development. Examination of philosophical, descriptive, and experimental research pertinent to development of a theory of curriculum. (2 cr; prereq 160A or B, 200A) Horn

263. Seminar: Supervision of Student Teaching. Examination of research pertinent to purposes, procedures, evaluation, and interpersonal relations. (2 cr; prereq EdCI 184)

264. Seminar: Improvement of Instruction in Adult Education. Examination of research and literature. (2 cr; prereq 164 or ‡) Ford

265. Seminar: Teacher Education. Examination of research in problems of selection and education of teachers of home economics and family life education, development of a theoretical framework. (2 cr; prereq 160A, 200A, EdCI 285) Horn

266. Seminar: History and Philosophy of Home Economics Education. Examination of primary and secondary sources of data to trace the meaning of home economics as a field of study. Relation of developments in the field of intellectual forces in society. Critical examination of conceptual foundations. Emphasis during any 1 quarter may be on any one of these three areas. (2 cr; prereq 166, 200B) Brown

267. Seminar: Administration and Supervision of Home Economics Programs. Application of research and theory of educational administration to clarify the role of educational leadership in home economics. (2 cr; prereq 164, 266 or ‡...EdAd 201 or 253 recommended) Ford

295.° Seminar: Home Economics Education. Discussion and reports. (1 cr per qtr) Brown, Ford, Horn

Industrial Education

100. Industrial Instruction. Concepts and techniques of instruction in industrial arts, trade and industrial schools and classes, and training-within-industry programs. (3 cr; prereq 40, Ed 55B, ‡) Moss

101. Tests in Industrial Subjects. Application of principles of evaluation to shop and drawing subjects. (3 cr; prereq Ed 55B) Kavanaugh

102. The General Shop. Lectures only. Purpose of general shop organization; types of shops, equipment, instructional materials and procedures, pupil personnel plans. (3 cr) Nelson

103. Instructional Aids. Planning, construction, use. (3 cr; prereq 55 or 100 or equiv) Nelson, Kavanaugh

105. Administration of Industrial Education. General and vocational phases; objectives, programs, and practices; laws, rulings, and standards for aid; significant literature. (3 cr; prereq 35 or ‡) Nelson

106. Industrial Education Workshop. Problems. Areas of concentration vary with each successive offering. (3 or 6 cr; prereq tchg exper, ‡)

107. Co-ordination. Duties and responsibilities of co-ordinators in trade schools, part-time programs, and comprehensive high schools. (3 cr; prereq 35 or 125, or ‡) Miletich

109. Conference Leading for Industry. Purposes, advantages, and limitations of method; techniques of procedure; experience in planning, leading, and evaluating conferences and in writing summaries. (3 cr; prereq ‡) Miletich

110. Vocational Guidance. History of educational and vocational guidance movement; typical public school means and methods; types and uses of occupational information; duties of the counselor; organization and relationships. (3 cr; prereq Ed 55B) Nelson

111. Instructional Materials Laboratory for Nonmajors. For students needing manipulative skills and craftwork activities in their teaching; individual and group projects. (3 cr; prereq tchg exper or ‡)

115. Supervision of Industrial Education. Principles of creative supervision; duties, organization for supervision. (3 cr; prereq 35 or 105) Miletich

125. Philosophy and Practice of Industrial Education. History, objectives, development, and current practices of the field. (3 cr, §35) Miletich

135. Industrial Course Construction. Principles and techniques; experience in planning, organizing, and building a teaching guide. (3 cr, §40) Kavanaugh

136. Instructional Materials Laboratory. Laboratory and shop experiences with new materials, processes, and equipment; development of complementary instructional materials. (3, 6, or 9 cr; prereq major, tchg exper, or ‡)

150. Vocational Education Surveys. Practices and techniques in the study of communities or areas for the establishment or improvement of vocational courses and facilities. (3 cr; prereq 105 or 125 or equiv) Moss

155. Critical Issues in Industrial Education. Identification, analysis, and discussion of major current problems. (3 cr) Moss, Randleman

200x.* Research Problems. Individual conferences. (3, 6, or 9 cr per qtr; prereq approval of candidacy) Nelson, Kavanaugh, Moss, Randleman

205x. Seminar: Industrial Education. (No cr; required of all candidates for advanced degrees) Nelson and graduate staff

250. Literature of Industrial Education. Professional literature, organizations, leaders, and movements in the field. (3 cr; prereq ‡) Nelson

251. Research in Industrial Education. Critical analysis of existing research; selection of problems; organization and presentation of projects. (3 cr; prereq ‡) Moss

Music Education

101. Philosophies of Music Education. Analysis and interpretation of philosophies in music and education; objectives, trends, curriculum, evaluation. (3 cr) Borg

102. General Music in Elementary and Junior High Schools. Open to music education and nonmusic majors. Methods, materials, and problems in teaching general music classes; emphasis on music literature. (3 cr; prereq 52 or ‡) Borg

103. Psychological Foundations. Implications of developmental and objective psychological data in music theory and acoustics. (3 cr; prereq ‡) Caswell

104. Advanced Topics: Vocal Music. Empirical research and literature on voice development in individual, class, and choral work. Individual surveys of performance practices and organization of school vocal groups; selection of vocal music. (3 cr; prereq ‡) Caswell

105. Advanced Topics: Instrumental Music. Individual selection of topics for intensive study. Bibliographical methods, library resources. (3 cr; prereq ‡)

114. Reading and Stylistic Interpretation of Choral Music. Defining means of teaching choristers to read and interpret music of representative periods and styles of compositions. (3 cr; prereq 104 or ‡) Caswell

115. Advanced String Instruments Techniques. Research reports, lecture-demonstrations; performance by class members and by school-age laboratory groups. (3 cr; prereq B.S. in music education or ‡) Sieber

118. Advanced Wind and Percussion Techniques. Research reports, practical performances, and lectures. (3 cr; prereq B.S. in music education or ‡) Bencriscutto

124. Selection, Conducting of Choral Materials. Student conducting with class as performing ensemble; criteria for selecting choral and combined choral and instrumental materials; rehearsal techniques. (3 cr) Caswell

125. Selection, Instrumental Music Materials. Sources and criteria; orchestra, band, ensemble music, and choral accompaniments; class teaching methods, books, individual projects, group activities. (3 cr)

151. Supervision and Administration of Elementary Music. Analysis and evaluation of instructional techniques; supervisory and administrative techniques; readings, new trends. (3 cr; prereq major or minor in music or music education) Borg, Caswell

152. Supervision and Administration of Junior High Music. Evaluation of instructional techniques and materials for required and elective courses; supervisory and administrative practices; readings; new trends. (3 cr; prereq major or minor in music or music education) Borg, Caswell

153. Supervision and Administration of High School Music. Materials, scheduling and teaching of performance ensembles; courses in theory and literature; individual and class lessons; extracurricular activities. (3 cr; prereq major or minor in music or music education) Borg, Caswell

170. Recent Research and Literature. Current research; evaluation of teaching materials; appraisal of research techniques. (3 cr) Caswell

194. Advanced Selection, Conducting of Choral Materials. Criteria for selecting choral music for school groups; analysis of selections of degrees of difficulty; application of advanced rehearsal and conducting techniques with the class as a performing choral group for student directors. (3 cr; prereq 124) Caswell

224x.* Research Problems. Individual projects. (3-9 cr; prereq knowledge of elementary statistics) Borg, Caswell

251-252-253. Seminar: Curriculum Development. Development and evaluation of the music curriculum; needed research; three-quarter elementary, junior high, senior high sequence. (3 cr per qtr; prereq MA in music or music education for 251)

Physical Education and School Health Education

In this section are listed courses in physical education and school health education. A student may emphasize either of these fields in selecting courses.

Physical Education (PE)

101. Foundations of Physical Education. Establishment of guidelines for individual and group professional action; examination of pertinent social forces, educational philosophies, and general ethics. (3 cr; prereq ‡) Richardson, McAdam

102. Curriculum. For students without previous experience in curriculum; objectives, content, organization, evaluation, and trends. (3 cr) Jaeger, Richardson

104. Teaching Physical Education for the Handicapped Child. Selection and organization of appropriate activities; planning of physical activity at all levels; observations, demonstrations, special lectures. (3 cr; prereq ‡) Wilson

106. Curriculum Development. Trends, issues, and problems at selected levels of interest: elementary, secondary, junior college. For experienced teachers. (3 cr; prereq 102 or equiv) Jaeger, Richardson

115. Advanced Kinesiology. Techniques of mechanics and kinesiology of movement; skills; evaluation of pertinent research methods and devices; application to individual projects. (3 cr; prereq undergrad course in kinesiology or ‡) McAdam, Wilson

123. Advanced Methods of Teaching Physical Education. Teaching procedures and method problems at all levels; research results. (3 cr; prereq ‡) Jaeger

124. Supervision of School Health and Physical Education. Functions; adaptations of accepted procedures for observation, guidance, and training of teachers. (3 cr, §Hlth 124; prereq ‡) Jaeger, Slocum

130. Contributions of Basic Sciences to Physical Education. Pertinent research in basic sciences; applications in selected areas. (3 cr; prereq ‡) Alexander, Wilson

135x. Tests and Measurements in Physical Education. Study of construction and interpretation of evaluative procedures; place and limitations of measurement. (3 cr; prereq ‡) McAdam, Wilson

136. Introduction to Research. Methods and design for research in health, physical education, and recreation. (3 cr; prereq ‡) Alexander, McAdam, Wilson

137. Readings: Physical Education. Independent study under tutorial guidance. (1-3 cr; prereq ‡) Graduate faculty

155. Instructional Aids in Health, Physical Education, and Recreation. Evaluation, construction, and use of instructional materials stressing audio-visual aids. (3 cr) Piper

171. Applied Physiology. Lectures and laboratory problems demonstrating the physiological bases for objectives and content. (3 cr; prereq PubH 92 or Phys 51 or equiv) Alexander

202. Professional Preparation of Physical Education Teachers. Current needs, issues, trends, curriculum patterns, and standards. For experienced teachers. (3 cr; prereq 102 or equiv) Jaeger, Richardson

221. Seminar: Physical Education. Discussion of individual projects and current problems. (No cr) Graduate faculty

224Ax.* Research Problems. Designing, reporting on individual problems. Required of all M.A. and Ph.D. candidates. (3 cr; prereq 136, EPsy 116 or ‡) Graduate faculty

224Bx.* Research Problems. Individual problems. (Cr ar; prereq 224A or ‡) Graduate faculty

233. Administration of the Physical Education Program in Secondary Schools. Special administrative procedures in promotion of physical education program. (3 cr; prereq 63) Donnelly, Jaeger, Richardson

236. Laboratory Research Techniques. Demonstration and student participation in laboratory procedures involving assessment of exercise parameters. (1-3 cr; prereq 136 or ¶136)

238. Administration of Physical Education in Colleges and Universities. Programs and facilities; field trips and surveys of neighboring colleges. (3 cr; prereq 63 or ‡) Donnelly, Jaeger, Richardson

261A. Seminar: Contemporary Problems in Physical Education. Individual presentation and class discussion of studies and contemporary problems selected by class members. (3 cr; prereq 136 and ‡) Graduate faculty

School Health Education (Hlth)

103. Role of the School Health Educator in Health Appraisal. Role of school medical and dental advisers, nurse, teachers, health educator, and other school personnel in health protection and maintenance phases. (3 cr; prereq ‡) Slocum

114. Administration of the School Health Education Program. Co-ordination of total program; health supervision and guidance; relationships between public schools and governmental health organizations and agencies; evaluation. Guidance in solution of individual professional problems. (3 cr; prereq 83, PubH 50 or equiv or ‡) Slocum

117B. Advanced Instruction for Secondary Schools in School Health. Instructional and individual problems. (3 cr, §117A; prereq 83 or ‡) Slocum

124. Supervision of Health and Physical Education. Functions; adaptations of accepted procedures for observation, guidance, and training of teachers. (3 cr, §PE 124; prereq ‡) Jaeger, Slocum

137. Readings: Health Education. Independent study under tutorial guidance. (1-3 cr; prereq ‡) Slocum

224Ax.* Research Problems. Designing, reporting on individual problems. Required of all M.A. and Ph.D. candidates. (3 cr; prereq PE 136, EPsy 116 or ‡) Graduate faculty

224Bx.* Research Problems. Individual problems. (Cr ar; prereq 224A or ‡) Graduate faculty

Recreation (Rec)

105. Conservation of National Resources. Their importance and relation to recreation and outdoor education. (2 cr; prereq 64A-B) Chapman

107. Camp Administration. Prepares qualified personnel for responsibilities of camp administration. (3 cr; prereq 46, ‡) Chapman, Osell, Ostrander

110. Recreation Surveys. Techniques and practice. (3 cr; prereq 57, 58)

111. Recreation Areas and Facilities. Orientation, design, planning, and standards. (3 cr; prereq 57, 58) Giles

112. Programming in Recreation. Principles of program planning for an organized offering of recreation opportunities. (3 cr; prereq 57, 58) Chapman

116. Community Recreation Resources and Organizations. Agencies and their interrelationship. (3 cr; prereq 110, 111, 112) Chapman

121. Principles of Recreation Methods. Leadership methodology in all aspects of recreation. (3 cr; prereq EdT 84) Chapman

131. Industrial Recreation. History, scope, place, and relationship of management-employee recreation. (3 cr; prereq ‡)

137. Readings: Recreation. Independent study under tutorial guidance. (1-3 cr; prereq ‡) Chapman

141. Introduction to Hospital Recreation. General field as background for the recreation leader, hospital administrator, and other personnel. (3 cr; prereq ‡) Chapman

142. Leadership in Hospital Recreation. Application of leadership methodology. (3 cr; prereq 141) Chapman

143. Programming in Hospital Recreation. Planning recreation programs for various types of hospital patients. (3 cr; prereq 141) Chapman

224Ax.* Research Problems. Designing, reporting on individual problems. Required of all M.A. and Ph.D. candidates. (3 cr; prereq PE 136, EPsy 116 or ‡) Graduate faculty

224Bx.* Research Problems. Individual problems. (Cr ar; prereq 224A or ‡) Graduate faculty

240. Legal and Financial Aspects of Recreation. Federal, state, and local recreation laws; sources of funds for public and private recreation agencies; agency liability. (3 cr)

241. Administration of Public Recreation. Basic principles of administration of recreation as a governmental service. (3 cr)

242. Community Organization for Recreation. Nature, scope, pertinent principles, and procedures. (3 cr; prereq ‡)

261Bx. Seminar: Contemporary Problems in Recreation. (Cr ar; prereq consent of adviser) Chapman

ELECTRICAL ENGINEERING**

Professor

William F. Brown, Jr.
Keith S. Champlin
Robert J. Collins, *head*
Robert F. Lambert
E. Bruce Lee
Hendrik J. Oskam
William T. Peria
William G. Shepherd
Aldert van der Ziel
Karel M. van Vliet

Associate Professor

Vernon D. Albertson
Donald E. Anderson
LeRoy T. Anderson
James A. Carruthers
Paul A. Cartwright
Lorne M. Chanin
Eugene R. Chenette
Richard P. Halvorson
Bernard V. Haxby, *associate head*
James E. Holte

** Professional degrees in engineering are administered by the Institute of Technology.

Sidney C. Larson
Shao-Chung Lee
Allen Nussbaum, *director of graduate study*
John H. Park, Jr.
Mahmoud Riaz
Belle A. Shenoi

Assistant Professor
Suhash C. Dutta Roy, *visiting*
Fredric N. Bailey
Stephen J. Kahne
K. S. Prasanna Kumar
Chiao-Yao She
Frederick M. Waltz

Special Lecturer
Richard E. Jones

Prerequisites—Graduate work leading to the M.S. in electrical engineering and the Ph.D. degree is open to students who have shown exceptional scholarship and ability in accredited undergraduate curriculums in electrical engineering or physics. Consideration will be given to students who have completed another curriculum in engineering, science, or mathematics, including sufficient pertinent subject matter that would qualify the student to carry forward a graduate program in electrical engineering. In some instances additional preparatory studies may be stipulated.

Language Requirement—For the M.S. degree, none. For the Ph.D. degree, a reading knowledge of two foreign languages. French, German, Japanese, and Russian are acceptable.

Master's Degree—Offered under Plan A or, with the approval of the Electrical Engineering Graduate Committee, under Plan B. The Plan B candidate is required to complete 45 credits of course work and three written reports representing the quality but not the range of the Master's thesis. Such reports are prepared as an additional part of the work required for advanced courses or seminars, or they may be based on independent work under faculty supervision.

Doctor's Degree—Work leading to the Ph.D. degree is offered. Research programs are established and facilities are available in areas such as circuit theory, magnetism, physical and solid state electronics, control and communications theory, quantum electronics, plasma behavior, and noise phenomena.

The general requirements for the Ph.D. are outlined at the beginning of this bulletin; candidates in this department must pass the written preliminary examination not later than 1 year after receiving the M.S. degree (or, with departmental permission to bypass the M.S. degree, not later than 1 year after initial enrollment as a graduate student).

Courses Acceptable Only in Satisfaction of the Minor Requirement

107-108. Linear System Analysis. Development of time-invariant linear models for electrical, mechanical, thermal, and acoustic systems; analysis of the models in time and frequency domains. Applications of transform techniques to linear systems. Introduction to feedback systems. Analog computer simulation. Spectral analysis, correlation, noise, and sampling. (3 cr per qtr; prereq 31, Math 60A)

110. Electromechanics. Energy considerations in electromechanical devices; linear and nonlinear analysis of electromechanical energy converters; characteristics of specific rotary converter types obtainable from a generalized rotating machine. (3 cr; prereq 76, MM 36, Math 60A or ¶Math 60A)

117-118. Electronic Circuits. Electronic functions, device limitations and biasing stability; frequency effects in single-stage, cascaded, and tuned amplifiers; power amplifiers. Introduction to design consideration. Nonregenerative switching circuits; diode and

transistor logic circuits; multivibrators, oscillators. (3 cr per qtr; prereq for EE majors, 65, 107—for others, Math 60A and ‡)

119. Electrical Engineering Materials. Electric, magnetic, and dielectric properties of materials as related to devices used in electrical engineering. (3 cr; prereq 76, Phys 51, Stat 90, ME 30)

127A-B. Network Synthesis. Description of linear networks in the time and frequency domains. Properties of two- and three-element-kind networks. Approximation and realization problems in network synthesis. Design of RC, RL, LC, and RLC networks to realize driving point and transfer functions and their applications. Special topics assigned. (4 cr per qtr; prereq 108 or ‡)

128A-B. Communications. Theoretical and laboratory study of selected topics in electric communications. Spectral analysis; modulation theory and the effect of noise in modulation systems; multiplex systems, optimum filtering. (4 cr per qtr; prereq 108, Stat 90)

129A-B. Control Systems. Analysis and applications of typical linear control elements, analysis and design of linear control systems in the frequency and time domains, using such techniques as Bode, Nyquist, and root-locus methods; analytic and graphical treatment of system stability. (4 cr per qtr; prereq Math 60A, 108, or ‡)

130A-B. Applications of Electromagnetic Theory. Maxwell's equations, Poynting vector, propagation and reflection of plane waves. Transmission lines, wave guides, and resonant cavities. Radiation, interference, and diffraction. Other selected topics. (4 cr per qtr; prereq 76 or equiv)

131A. Applied Electronics I. Multistage amplifiers; broad-band, feedback, tuned transistor amplifiers, noise in amplifiers. Analysis and design including laboratory investigation of design. (4 cr; prereq 117)

131B. Applied Electronics II. Charge-control analysis of nonregenerative and regenerative switching circuits. Tuned power amplifiers and oscillators. Parametric amplifiers. (4 cr; prereq 118)

134A-B. Direct Energy Conversion. Photoelectric, thermoelectric, thermionic, magnetohydrodynamic, and phase-change energy converters. Kinetic and transport properties of materials; interaction with electric, magnetic, thermal, and mechanical fields. Applications and limitations of typical converters. (4 cr per qtr; prereq 64, 76, ME 30)

135A-B. Principles of Computer Engineering. Analog and digital computers. Properties of computer elements and their limitations; control of computers. Basic analog, digital and hybrid computer systems design for computation, simulation, and real-time control of automated processes. (4 cr per qtr; prereq 108)

138A-B. Electric Power Systems. Modern electric power system technology; response of rotating machines; complete electric power system; generation, transmission, distribution, and utilization. Balanced and unbalanced polyphase systems. Stability analysis of power systems. Digital computer applications to power system problems. (4 cr per qtr; prereq 108, 110)

141A-B. Physical Electronics. Physical principles underlying devices used in electrical engineering; elementary quantum and statistical mechanics, semiconductor properties, electron emission from surfaces, special topics of current interest. (4 cr per qtr; prereq 64 or 104, Phys 51, or ‡)

147A-B. Applied Electromechanics. Theory and application of translational and rotational electromechanical converters; transducers, sensors, and machines. Formulation of dynamic equations and methods of solution. Properties of materials, consideration of limitations they impose on device performance. (4 cr per qtr; prereq 108, 110, or ‡)

Courses Acceptable in Satisfaction of Either Major or Minor Requirements

150. Dynamical Methods in Electrical Engineering. Lagrangian and Hamiltonian formulations of dynamics, with applications to electromagnetic systems. Lagrange's equations; dissipative forces; normal co-ordinates and small oscillations; Hamilton's equations; variational principles for discrete and continuous systems. (3 cr; prereq MM 36 or equiv, Math 147, or ‡)

151. Thermodynamic Methods in Electrical Engineering. Basic thermodynamic concepts and laws, with special application to electromagnetic systems. Energy, entropy, and thermodynamic potentials; application to electrically and magnetically polarizable materials, rigid or elastic, piezoelectricity, magnetostriction, thermoelectricity, reciprocal relations in reversible and irreversible processes. (3 cr; prereq 150 or ‡)

152. Statistical-Mechanical Methods in Electrical Engineering. Classical and quantum-statistical mechanics, with applications to materials and problems of electrical engineering. Statistical ensembles, phase space, Liouville's theorem, the canonical ensemble, the partition function. Classical and quantum statistics. Relation between statistical mechanics and thermodynamics. Classical and quantum calculations of susceptibilities. (3 cr; prereq 150 or ‡)

167-168-169. Electromagnetic Theory. Fields and waves with attention to mathematical formulation. Maxwell's equations and boundary value problems. Plane waves, transmission lines, wave guides, and resonators. Microwave networks. Inhomogeneous, anisotropic, and ionized media. Diffraction theory and optical resonators. Parametric systems. (3 cr per qtr; prereq 76)

170-171-172. Linear Network Theory. Theory of positive real functions. Properties and synthesis of two-and three-element-kind networks. Approximation theory. Design of filters and pulse networks. Network models of active devices. Synthesis of active circuits and applications. Selected topics in feedback and stability. (3 cr per qtr; prereq 108 or ‡)

173A-B-C. Semiconductor Properties and Devices. Principles and properties of semiconductor devices. Selected topics in quantum and statistical mechanics, crystal structures, semiconductor properties; transistor action and other device phenomena; influence of surfaces. Treatment of actual devices (such as bipolar and field-effect transistors). (3 cr per qtr)

178-179-180. Nonlinear Circuit Analysis. Semiconductor, ferromagnetic and ferroelectric devices as switching elements; regenerative switching circuits; digital logic circuits. Free and forced response of nonlinear circuits, amplitude and frequency of oscillatory circuits; phase-plane analysis. (3 cr per qtr; prereq 118 or ‡)

86A-B-C. Communications Theory. Theoretical aspects of the problem of communicating with electrical signals in the presence of noise, practical applications. Representation of random signals, modulation, information theory, analysis of networks with random inputs, coding, statistical decision theory. (3 cr per qtr; prereq electrical engineering major or ‡)

190A-B-C. Principles of Digital Computer Systems. Internal organization and operation of modern digital computer systems. Analysis and design of static logic and synchronous and asynchronous sequential circuits with practical logic circuits. Topics in computer systems design including arithmetic logic, memories, control logic, and input-output systems. Statistics of computer reliability. (3 cr per qtr; prereq 118 or ‡)

194-195-196. Control Theory. Analysis and synthesis of linear feedback systems by classical methods; state space formulation of continuous-time and discrete-time deterministic systems; design of optimum multivariable systems with emphasis on dynamic programming and calculus of variations; stability analysis and the direct method of Lyapunov; introduction to nonlinear control systems and statistical techniques in the design of linear control systems. (3 cr per qtr; prereq 108 or ‡)

197A-B-C. Power System Analysis. Matrix representations of large power systems. Formation and modification of network matrices. Numerical and computer methods of solution. Applications to fault calculations, load-flow studies, stability studies and loss formulas. (3 cr per qtr; prereq ‡)

200A-B. Solid State Physics. (Same as Phys 231A-B) Fundamental properties of crystals; dynamics of the lattice and of electrons in a periodic structure; effects of electric and magnetic fields on metals. (3 cr per qtr; prereq Phys 181A or ‡)

200C. Magnetic Properties of Solids. (Same as Phys 232) Properties of magnetic materials in relation to exchange interactions and elementary spin excitations. (3 cr; prereq 152, 200B, or ‡)

211-212-213. Advanced Topics in Network Theory. Analysis and synthesis of lumped constant and distributed networks, time-varying networks, and nonlinear networks. Selected topics of current interest. (3 cr per qtr; prereq 172, Math 174 or ‡)

221-222-223. Seminar: Electric Power. Current literature, individual assignments in the areas of power systems and electromechanics. (Cr ar; prereq ‡)

227-228-229. Advanced Power-System Topics. Power-system design and operation. Steady-state and transient stability limits. Economic operation of interconnected systems. Surge phenomena and ferroresonance conditions on transmission lines. Power system control. Reliability considerations. Future trends in power systems. Computer methods. (3 cr per qtr; prereq 197C or ‡)

233-234-235. Fluctuation Phenomena. Theory with applications to electrical engineering. Circuit noise, vacuum-tube noise and semiconductor noise, influence upon performance of amplifiers, mixers, solid-state devices, detectors and sensitive measuring equipment. (3 cr per qtr; prereq ‡)

242-243-244. Plasma Physics. Plasma theory: electron and ion orbits, self-consistent solutions, Maxwell-Boltzmann transport equation, introduction to magnetohydrodynamics. Collision phenomena: introduction to the theory of collision, basic collision processes, methods of measurement. Topics: theory of breakdown of gases, types of discharges, emission of radiation by free electrons in a plasma. (3 cr per qtr; prereq 152 or equiv and ‡)

245-246-247. Seminar: Plasma Physics. Current literature; individual assignments. (1-3 cr per qtr; prereq 244 or Phys 275, ‡)

250A-B-C. Quantum Electronics. Properties of quantum systems: energy levels of atoms, molecules, and magnetic ions in crystals. Interaction of radiation with matter. Stimulated emission. Ammonia masers. Paramagnetic resonance. Three-level solid-state microwave masers, cavity and traveling wave. Noise properties. Optical masers: resonator properties and pumping methods. Solid-state spectroscopy. Gas optical masers. (3 cr per qtr; prereq 152, 169, Phys 110 or ‡)

251A-B-C. Properties of Semiconductors. Application of modern solid-state theory to study of specific semiconductor materials. Influence of band structure and scattering mechanisms upon the electrical, optical, thermal, and thermoelectric properties. Plasma effects in semiconductors at low and high frequency. Mathematical treatments of generation-recombination kinetics, carrier injection, drift and diffusion. Utilization of semiconductor properties in devices, especially devices of current importance. (3 cr per qtr; prereq 200C, ‡)

252A-B-C. Ferromagnetism and Related Phenomena. Basic magnetic concepts, classical and quantum-mechanical. Statistical mechanics of magnetization; spontaneous magnetization; types of ordered magnetic structure. Behavior of fine particles. Magnetic microstructure; micromagnetics and domain theory; thin films. Magnetoelastic interactions. Dynamic phenomena. (3 cr per qtr; prereq 152 or ‡)

253A-B-C. Seminar: Quantum Electronics. Current literature, individual assignments. (Cr ar; prereq ‡)

254A-B-C. Seminar: Modern Optics. Current literature, individual assignments. (Cr ar; prereq ‡)

261A-B-C. Problems in Electromagnetism. Static electric and magnetic fields. Antennas, free-space transmission, refraction and diffraction phenomena, wave guides, and circuits. (3 cr per qtr; prereq 169 or equiv, ‡)

262A-B-C. Seminar: Communication. Current literature, individual assignments. (1-3 cr per qtr; prereq ‡)

263A-B-C. Seminar: Control Theory. Current literature, individual assignments. (Cr ar; prereq ‡)

264A-B-C. Seminar: Surface Physics. Current literature, individual assignments. (Cr ar; prereq ‡)

265A-B-C. Seminar: System Theory. Current literature, individual assignments. (Cr ar; prereq ‡)

267-268-269. Statistical Theory of Communication. An extension of topics covered in 186A-B-C. Recent advances in statistical decision theory, information theory and coding. Selected special topics. (3 cr per qtr; prereq 186C or ‡)

272-273-274. Fundamentals of Acoustics. Vibrations of system of mass-points. Extension to strings and membranes, acoustic elements, equations of elasticity and waves in solid media, plates, and rods. Motion of compressible fluids and the acoustic equations, solutions of the wave equation, acoustic radiation, transmission, diffraction, etc. Waves in inhomogeneous media, ray acoustics and nonlinear effects. Radiation pressure and shock waves. (3 cr per qtr; prereq ‡)

281-282-283. Seminar: Energy Conversion. Topics relating to physical processes involved in conversion of energy in its several forms to electrical energy and to devices which exploit these processes. (Cr ar; prereq 200C or equiv)

291-292-293. Seminar: Electronics. Current literature, individual assignments. (1-3 cr per qtr; prereq ‡)

294-295-296. Advanced Control Topics. Adaptive and learning systems, discrete systems, invariance, optimum control of deterministic and stochastic processes, modeling of physical systems, and stability of dynamical systems. (3 cr per qtr; prereq ‡)

297A-B-C. Nonlinear Systems. Nonlinear aspects of control systems: analytical and graphical methods of analysis and synthesis; stability studies via the method of Lyapunov; synthesis of dual mode and relay control systems; nonlinear systems subjected to random input; nonlinear filtering and estimation and their application to optimal control synthesis. (3 cr per qtr; prereq Math 148, ‡)

ENGLISH

Professor

Harold B. Allen
Bernard R. Bowron
John W. Clark, *chairman*
Charles H. Foster
Richard J. Foster
John D. Hurrell
Joseph J. Kwiat
Jacob C. Levenson, *director of graduate study*
Samuel H. Monk
Franz J. Montgomery
Robert E. Moore
Gordon W. O'Brien
William A. Rosenthal
G. Robert Stange
Martin Steinmann, Jr.
Allen Tate
Leonard H. Unger

Associate Professor

James L. Scoggins
Mary C. Turpie
Sarah H. Youngblood

Assistant Professor

David B. Haley
Charles S. Levy
Toni A. McNaron
Arthur W. Plumstead

Prerequisites—For major work, not less than 27 quarter credits in English literature, 12 of which must be of Upper Division grade, including satisfactory courses in Chaucer, Shakespeare, and Milton. A student who has a good record in his 27 quarter credits in English literature but has not had courses in all three of the authors named may be allowed to make up some of those courses concurrently with his graduate program.

For minor work, not less than 18 quarter credits in English literature including a course in Shakespeare.

Candidates will ordinarily find it necessary to supplement their undergraduate work by a considerable amount of independent reading.

Before registering for their first quarter of graduate work, students should consult with the director of graduate work for the department.

Special Regulation Regarding Examinations for the M.A. and the Ph.D. During the Summer Session—Written examinations for both the M.A. and the Ph.D. are given, during the Summer Session, in the first term only. Oral examinations are given in neither term except for students who are certain that

they will be neither in residence nor in the nearby area during the following fall quarter.

Requirements for the Degree of Master of Arts

Work for the Master's degree is offered under Plan A and Plan B, but the graduate faculty in English recommends Plan B in almost all cases. (The additional course work under Plan B provides not only a better preparation for the comprehensive M.A. examination, but also a better basis for continuation into independent study and Ph.D. candidacy.)

Major—The minimum requirement of 18 quarter credits in the major under Plan A and 21-27 credits under Plan B is interpreted to mean credits in courses in English listed under Language and Literature; that is, composition may be counted only as the minor (Plan A) or as a related field (Plan B).

Candidates under either plan who have not previously had an elementary course in Old English (Anglo-Saxon) must take Engl 100, Old English; and candidates under Plan B must also take Engl 213, Bibliography and Methods of Research.

Candidates who are active schoolteachers or who hold the teaching certificate may, if they plan to take the M.A. as a terminal degree, substitute Engl 166 for Engl 100 and omit Engl 213.

Under both plans, the candidate will be given a 6-hour written examination (see Special Regulation above) which calls for some acquaintance with all periods of the language and literature of the British Isles and the United States from the beginnings to the present. The examination is given in the fall and spring quarters and in the first term of Summer Session. A specimen examination may be consulted in 127 Vincent Hall.

All candidates under Plan A must pass an oral examination.

Minor (Plan A)—As an alternative to electing work in some related field for a minor for the M.A., the candidate may select courses from one of the following groups as a minor:

Old and Middle English Literature

American Literature

Composition

The English Language

Foreign Literature in Translation, including 184, 185, 186 (Form and Idea in Dramatic Literature), and courses in foreign literature in translation offered by the foreign language departments.

Related Fields (Plan B)—The candidate under Plan B may select courses from the groups listed under the Plan A minor, but a substantial portion of his work must be taken outside the Department of English.

Language Requirement—The candidate must pass an examination in a foreign language before taking the M.A. written examination, or satisfy the language requirement by completing at least 15 credits in the language with a

grade of A or 20 credits with an average grade of B, at this University, and no longer than 5 years before applying for foreign language certification. There are special programs of course work satisfying the language requirement in French and German. For details consult the director of graduate work in English. Unless special exception is made upon petition the candidate is required to have reading knowledge of one of the following: French, German, Latin, Greek, Italian. No candidate may satisfy this requirement either with English or with his native language.

Requirements for the Degree of Doctor of Philosophy

The program of course work for the Doctor's degree should be filled out by the candidate in consultation with the director of graduate work for the department during the first or second term after he has passed the M.A. written examination at a standard qualifying him to proceed toward the Ph.D. This examination requirement applies not only to students taking the Minnesota M.A. degree, but also to students holding M.A. degrees from other institutions, for the examination also serves as the preliminary written examination for the Ph.D. For information concerning the M.A. written examination, see above.

The department divides the study of English and American language and literature into seven subfields, as follows:

1. Old and Middle English Literature
2. The Renaissance to the Restoration
3. The Restoration and the Eighteenth Century
4. British Literature of the Nineteenth Century
5. American Literature through the Nineteenth Century
6. British and American Literature of the Twentieth Century
7. The English Language

A candidate shall "write off" three of the seven subfields with at least 12 credits of course work in each, except for subfield 7, where the requirement for "writing off" is Engl 100 plus 6 credits in other courses in the English language. Six credits in each of these three subfields must be of A quality. On the subfield in which a candidate is writing his thesis, he will be examined in a 3-hour special written examination; on the three remaining subfields plus the minor (or the "supporting program"), he will be examined in a 2-hour preliminary oral examination. A final oral examination will be given to the candidate on completion of his thesis and certification by his committee that it is ready for defense. The following courses cannot be used in "writing off" any of the subfields: 120-121, 123, 124, 176, 184, 185, 186, 213, 246-247, 268-269, 290-291-292, 297,298,299.

Language Requirement—Unless special exception is made upon petition, the candidate is required to have a reading knowledge of two of the following: French, German, Latin, Greek, Italian. No candidate may satisfy either part

of this requirement either with English or with his native language. The candidate must satisfy language requirements before taking the preliminary examinations. See under M.A. for particulars.

The Graduate Minor in English

The prerequisite for minor work is not less than 18 quarter credits in English literature, including a course in Shakespeare.

The candidate for the Master's degree (Plan A) taking a minor in English is expected to present a minimum of 9 credits in one of the seven subfields listed above or in 184, 185, 186.

A minor sequence in English for the Doctor's degree must include either 9 credits in one of the sequences of courses numbered 100 or above devoted to a historical period or 9 credits in 184, 185, 186.

Besides satisfying the general requirements established by the Graduate School, the candidate for the Ph.D. offering English as a minor must pass a preliminary oral examination on two of the seven subfields listed above, or on one of the seven and on one specific literary kind such as the drama or the novel.

Comparative Literature—For information on this program, see page 127.

Language and Literature

100x. Old English (Anglo-Saxon). Introduction to sounds and grammar with some prose reading. Relation to Modern English stressed. (4 cr; prereq §§) Allen

102. Readings in Old English Prose and Verse. Critical reading of texts, and introduction to versification. (3 cr; prereq 100) Clark

103. Beowulf. Introduction to the Old English poem, with reading of considerable portions of the text. (3 cr; prereq 100) Clark

104. Emerson and Thoreau. (3 cr; prereq §§) Turpie, Alsen

105. Hawthorne and Melville. (3 cr; prereq §§) Turpie, Plumstead

106. Whitman and Mark Twain. (3 cr; prereq §§) Kwiat

108, 109, 110. Romantic Poetry and Prose. 108: Blake, Wordsworth, Coleridge, and others. 109: Scott, Byron, Lamb, DeQuincey, and others. 110: Shelley, Keats, Hazlitt, and others. (3 cr per qtr [for 108 §109 before 1966f]; prereq §§) Scoggins

111. Henry Adams and Theodore Dreiser. (3 cr; prereq §§) Levenson

113. American Short Story. Historical examination of American short story from 18th century to present. (3 cr; prereq §§) Turpie

120-121. The Interpretation of Poetry. Certain technical aspects of poetry in relation to poetic meaning. 120: Analysis of a number of short poems. 121: Coleridge, Housman, Frost, and Eliot. (3 cr per qtr; prereq §§) Tate

123, 124. The Technique of the Novel. Special studies in novels of the late 19th and 20th centuries, with regard to structure. See also Comp 101-102-103 for the writing of fiction. (3 cr per qtr; prereq §§) Unger

126. Restoration and Eighteenth-Century English Drama. The heroic play, tragedy, comedy of manners, sentimental comedy. (3 cr; prereq 56) Moore

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§§ Five credits in literature, English or American, exclusive of freshman English.

127. Drama from c. 1880 to c. 1920. Beginnings of modern realism, naturalism, and expressionism in English and Continental drama. (3 cr; prereq 56) Moore

129. Drama Since c. 1920. Survey of the chief dramatists, English, American, and Continental. (3 cr; prereq 56) Moore

134. The Origins of American Naturalism. (3 cr; prereq §§) Bowron

136. Advanced Shakespeare. Special attention to two or three of the later plays and survey of some others. (3 cr; prereq 56) O'Brien, McNaron

137, 138, 139. Victorian Literature. Prose, poetry, and selected fiction. Critical study of particular works of major authors and their relation to recurrent themes and literary interests of the period. (3 cr per qtr; prereq §§) Stange, Joseph

140-141. Advanced Chaucer. The longer poems apart from *The Canterbury Tales.* Treatment primarily literary and historical. (3 cr per qtr; prereq 75 or equiv) Clark

147-148-149. Middle English Literature Exclusive of Chaucer. Leading genres of Middle English literature, with some attention to Continental traditions and influences. **147:** Devotional prose and lyric verse. **148:** Religious allegory and the drama. **149:** Epic and romance. (3 cr per qtr; prereq 75 and 100 or ‡) Clark

154, 155. American Novel. History of the American novel from the beginning to the present. (3 cr per qtr; prereq §§) Bowron

156. American Drama. Critical survey, primarily of period from 1914 to present, with some attention to historical and cultural background; some representative American plays of 18th, 19th, and early 20th centuries. (3 cr; prereq §§) Kwiat

157, 158. American Poetry. Critical survey of American poetry from Anne Bradstreet to present, with some attention to historical and intellectual backgrounds; emphasis upon major figures. (3 cr per qtr; prereq §§) Tate, Levenson

159, 160. Early American Literature. Critical survey with emphasis upon principal writers and major cultural themes, from the Puritans to the Transcendentalists. (3 cr per qtr; prereq §§) C Foster

162x. Milton. The minor poems, *Areopagitica, Paradise Lost,* and *Samson Agonistes.* (3 cr; prereq 21 or 56) Levy, McNaron, Steinmann, Unger

165. The Structure of Modern English. Introductory study of English phonemics, morphemics, and syntax. (3 cr; prereq §§) Allen

166. History of the English Language. Historical influences upon, and changes within, the language as both a popular and a literary medium of communication. (3 cr; prereq §§) Allen

167. Modern Rhetorical Theory. Survey of modern theory and research; discussion of relationship between modern and classical theory and between rhetorical theory and grammatical and semantic theory. Not a course in composition. (3 cr) Steinmann

169. Earlier English Drama. Interludes, moralities, the cyclic plays (selected), academic and court plays; plays of Kyd, Marlowe, Lyly, Greene, and Peele. (3 cr; prereq §§) O'Brien

170. Shakespeare's Later Contemporaries. Selected plays of Chapman, Jonson, Dekker, Marston, Webster, Heywood, Beaumont and Fletcher, Middleton, Ford, and Shirley. (3 cr; prereq 56 or 169) O'Brien

173. Dr. Johnson and His Circle. Boswell; Johnson's influence on his contemporaries. (3 cr; prereq §§ and △) Moore

174. American English. The developing distinctiveness of the English language in America; its relationships to American cultural patterns; significant regional variations in vocabulary, pronunciation, and grammar; introduction to field methods of American dialect geography; access to unpublished collections of Linguistic Atlas of the Upper Midwest. (3 cr; prereq 5 cr above freshman English) Allen

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§§ Five credits in literature, English or American, exclusive of freshman English.

175. Chaucer. Reading of *The Canterbury Tales* with introduction dealing with grammar and literary forms of 14th-century English. (4 cr, §75 or equiv; prereq 100)

176. The Structure of Verse. Technical devices, with emphasis on tropes, rhythmic patterns, stanzaic forms. Primarily descriptive, but with some attention to history and theory of various techniques. (3 cr; prereq §§) Youngblood

178. The South in Literature. (3 cr; prereq §§) Tate

180. The Influence of Poe. The French "Symboliste" school; influence of this school on modern literature, chiefly poetry, in English. (3 cr; prereq §§) Tate

181. Modern Literary Criticism. Major texts and movements in modern literary criticism; examination of a few of the more important historical documents from earlier centuries. (3 cr; prereq §§) R Foster

183. The Poetry of T. S. Eliot. (3 cr; prereq §§) Unger

184, 185, 186. Form and Idea in Dramatic Literature. Dramatic types, in chronological sequence; analytical reading of selected representative plays. 184: Tragic and religious drama (classical, medieval, Renaissance, and modern); theories of tragedy. 185: Comedy (classical, Renaissance, and modern); theories of comedy. 186: Experimental and nonrealistic drama. (3 cr per qtr; prereq §§...56 recommended) Hurrell

187, 188, 189. Eighteenth-Century Literature. Survey of English literature from 1700 to 1790. Parallel readings and critical essays. Graduate students will submit a term paper each quarter. (3 cr per qtr; prereq §§) Monk, Moore, Leyasmeyer

190, 191, 192. Twentieth-Century Writers. Each quarter, at least two such writers as the following will be studied: Conrad, James, Joyce, Woolf, Lawrence, Forster, Hemingway, Fitzgerald, Faulkner, Shaw, O'Casey, Frost, Pound, Auden. The authors chosen vary from year to year and will be annually specified in the Class Schedule. (3 cr per qtr; prereq §§) R Foster

193. The Poetry of W. B. Yeats. (3 cr; prereq §§) Unger

194, 195, 196. Elizabethan Prose and Verse. 194: From beginning of Tudor period to about 1580. Medieval origins of the drama. 195: From early work of Spenser and Sidney to the mid-nineties. 196: The decade centering in the last year of two of the Queen's reign. (3 cr per qtr; prereq §§) O'Brien

197, 198, 199. Seventeenth-Century Literature. 197-198: Prose and nondramatic poetry of the century down to 1660. 199: Dryden and his contemporaries. (3 cr per qtr; prereq §§) Unger, Monk, Hurrell, Haley

204. Studies in the English Language. Historical development of English phonemic, morphemic, and syntactic patterns. (3 cr; prereq 100) Allen

205. Studies in the English Language. Present-day structure, with attention to the theory of transformations. (3 cr, §165) Allen

206. Studies in the English Language. Research Problems. (3 cr; prereq ‡) Allen

207-208-209. Basic Research in Rhetoric. (3 cr per qtr; prereq ‡) Steinmann

210-211-212. Studies in Seventeenth-Century Literature. Selected authors to 1660 exclusive of Milton and the dramatists; style and idealogical questions. (3 cr per qtr) Unger

213x. Bibliography and Methods of Literary Research. Basic library reference works, scholarly and critical journals, bibliographies of periods and prominent literary figures; exercises and problems in methods and exposition of research. (2 cr) O'Brien, Stange, Steinmann

222-223-224. Studies in the Origins and Early Development of the American Literary Tradition. Special topics in American literature and in English literature relevant to American development prior to 1800. (3 cr per qtr)

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§§ Five credits in literature, English or American, exclusive of freshman English.

225-226-227. Elizabethan Drama. Elizabethan and Jacobean dramatists; Lyly to Shirley. Problems may involve Shakespeare. His contemporaries studied for the light they shed upon him. (3 cr per qtr) O'Brien

228-229. Studies in Eighteenth-Century Literature and Culture. (3 cr per qtr) Moore

231-232-233. Shakespeare's Tragic and Comic Art. (3 cr per qtr) O'Brien

234-235-236. Studies in Medieval English Culture. (3 cr per qtr; prereq 75 or equiv) Clark

237-238-239. Drama: History, Theory, and Criticism. (3 cr per qtr; prereq ‡) Hurrell

240-241-242. The Canterbury Tales. (3 cr per qtr; prereq 75 or equiv) Clark

243-244-245. Nondramatic Literature of the Sixteenth Century. Renaissance prose and poetry; Spenser and his contemporaries. (3 cr per qtr) O'Brien

246-247. English Literary Criticism. Basic historical texts; principles and issues which have relevance for modern criticism. (3 cr per qtr)

250-251-252. Problems in Twentieth-Century English and American Literature. (3 cr per qtr; prereq ‡) R Foster

253-254-255. American Renaissance I: Emerson, Whitman, Emily Dickinson. (3 cr per qtr) C Foster

256-257-258. Spenser and Milton. (3 cr per qtr) O'Brien

261-262-263. Studies in Renaissance Culture. The "learned poets" and essayists—e.g., Watson, Daniel, Chapman, Davies, Greville, and Donne; and Bacon, Hooker, Burton, and Browne. (3 cr per qtr) O'Brien

265-266-267. American Renaissance II: Hawthorne, Thoreau, Melville. (3 cr per qtr) C Foster

268-269. Studies in Aesthetics. Analysis and clarification of both practical and theoretical texts in aesthetics (major emphasis on literary criticism). (3 cr per qtr; prereq grad students in English and philosophy, others ‡) Steinmann

271-272. The Rise and Development of the English Novel. 271: Defoe, Richardson, Fielding, and others. 272: Smollett, Sterne, Goldsmith, and others. (3 cr per qtr) Montgomery

274-275-276. Studies in Early Eighteenth-Century Literature. Literature of first half of 18th century in the light of critical theories and currents of thought. (3 cr per qtr) Monk

277-278-279. American Realism. Howells and his contemporaries; Henry James; Mark Twain. (3 cr per qtr; prereq ‡) Bowron

281-282-283. Studies in the English Romantic Movement. (3 cr per qtr) Scoggins

284-285-286. Dryden and His Age. (3 cr per qtr) Monk

287-288-289. Studies in Victorian Literature. (3 cr per qtr) Stange

290-291-292. Studies in Critical Theory. Intensive study, from the point of view of the philosophy of criticism, of the works of certain great critics. (3 cr per qtr) Tate

297, 298, 299. Independent Reading. (3 cr per qtr; prereq MA degree or equiv) Graduate staff

Composition

Note—The student, in registering for these courses, must use the form: Comp 101-102-103, Comp 200-201-202.

101-102-103. The Writing of Fiction and Poetry. Principles of composition in these arts. (3 cr per qtr; prereq ‡) R Foster

200-201-202. Graduate Seminar: Writing. (3 cr per qtr; prereq ‡) Tate

American Studies—Students interested in major work in this program see index.

ENTOMOLOGY, FISHERIES, AND WILDLIFE

Professor

Alexander C. Hodson, *head, director of graduate study*
Huai C. Chiang
Edwin F. Cook
Laurence K. Cutkomp
William H. Marshall
Allan G. Peterson
A. Glenn Richards
Lloyd L. Smith, Jr.
Franklin G. Wallace

Associate Professor

James R. Beer
Marion A. Brooks
Albert W. Erickson
Roger D. Price
John R. Tester
James C. Underhill
Thomas F. Waters

Prerequisites—For admission of students, any B.A. or B.S. degree with a major in some zoological science is acceptable, but preference is given to students with a broad grounding in basic science courses.

Language Requirement—For the Master's degree, one foreign language. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and the option of a collateral field of knowledge or a research technique. German is required in all cases except where there is a demonstrated need for a different language which can be substituted for German with the approval of the student's adviser and the Graduate School.

Graduate Major Fields—Work leading to the Master's and Ph.D. degrees is offered in the fields of entomology and of fisheries and wildlife.

Master's Degree—Offered under Plan A. In exceptional cases Plan B may be followed by petition approved by the major advisers of the department.

Doctor's Degree—Candidates for the Ph.D. degree should earn the Master's degree under Plan A.

Course 200 is required of all majors while in residence with the exception that students who have passed their oral preliminary examination may be exempt on approval of their advisers.

Entomology

103,104,105. Basic Entomology. These courses provide a special arrangement for the making up of certain deficiencies in biological background. For use of these course numbers majors must consult major advisers; others, the department head. (Cr ar [not more than 6 cr are allowed for the Master's program, and 9 cr for the Ph.D. program])

114. Apiculture. Honeybee anatomy, physiology, nutrition, diseases, and breeding; colony development and management; processing and marketing of bee products; pollination. Lectures, laboratory, and field practice. (3 cr; prereq 9 cr entomology or biology)

116. Population Ecology. Seminars and lectures on verbal and mathematical population theories; relationship to laboratory and field data. (2 cr; prereq Zool 94 or ‡...Math 44 recommended; offered 1967-68 and alt yrs) Williams

118.* Experimental Ecology. Experimental approach to study of environmental factors affecting animal populations. (3 cr; prereq 9 cr in general biology or equiv and 3 cr in animal or plant ecology, ‡; for companion lab course, see 201) Chiang

119. Limnology. Conditions for life in the water and distribution of aquatic animals. (5 cr; prereq 15 cr in zoology incl Biol 2 or 50; offered Lake Itasca Forestry and Biological Station) Underhill

124. Biology of Immature Insects. Habits, habitats, life history, and identification of immature insects; aquatic forms. (5 cr; prereq 59 or equiv or ‡; offered Lake Itasca Forestry and Biological Station) Cook

125. Insect Morphology. Comparative studies of external and internal anatomy and histology of insects; phylogeny and function. (5 cr; prereq 74, ‡) Cook

126. Embryology and Development of Insects. Reproductive behavior, embryology, and postembryonic development of insects. (5 cr, §Zool 126; prereq 125, OrCh 42 or 62, ‡) Brooks

127.* Insect Metabolism and Co-ordination. Homeostasis, permeability, circulation, metabolic systems and products, properties of muscle and nerves, sensation, behavior. (5 cr, §Zool 127; prereq 126, ‡...BioC 106 or MdBc 101 recommended) Richards

128. Aquatic Entomology. Identification and biology of aquatic and littoral insects in all stages. (2 cr; prereq 74 or equiv; offered 1967-68 and alt yrs) Cook

129. Aquatic Entomology. Identification and biology of aquatic and littoral insects in all stages. (5 cr; prereq 59, 74 or equiv or ‡; offered in Lake Itasca Forestry and Biological Station) Cook

130. Principles of Systematic Entomology. Lectures on history of systematic entomology, the species concept and higher categories, systematic procedures and zoological nomenclature. (2 cr; prereq 15 cr in entomology or zoology, ‡; offered 1966-67 and alt yrs) Cook

131. Advanced Insect Taxonomy I. Identification of taxa within the major insect orders; use of taxonomic literature and catalogues; field trips and formation of an insect collection. (3 cr; prereq 74 or equiv) Price

132. Advanced Insect Taxonomy II. Identification of specimens collected by the student during the summer; classification within minor insect orders. (2 cr; prereq 131) Price

139. Problems in Microtechnique. Guidance for independent study of material of student's choice, with special reference to insects. (2 cr; prereq ‡) Brooks

140. Biological Microscopy. Necessary elements of optics, use and limitations of various types of microscopes, interpretation of microscopical data. Laboratory: demonstration plus project in field of student's interest. (4 cr; prereq 15 cr in zoology, entomology, or botany, ‡; offered when demand warrants) Richards

141. Insects in Relation to Plant Diseases. (Same as PlPa 141) Insect transmission and dissemination of plant pathogens; development of plant-insect relationships; habits of principal insect vectors—practical methods of control. (3 cr; prereq 5 cr in entomology, 5 cr in plant pathology or equiv, or ‡) Peterson, Wilcoxson

144. Medical Entomology. Principal arthropods noxious to man and animals. Emphasis on those that serve as vectors of pathogenic organisms of man and animals. (3 cr; prereq 15 cr incl 74 or equiv, or ‡) Price

145. Parasitic Protozoa. Structure, life histories, and economic relations of protozoal parasites of man and animals. (3 cr; prereq 15 cr in zoology incl Biol 2 or 50 and ‡) Wallace

146. Helminthology. Worm parasites of man and animals, their structure, life histories, and biological relationships. (3 cr; prereq 15 cr in zoology incl Biol 2 or 50 and ‡) Wallace

175.* Principles of Economic Entomology. Methods and principles of insect control. (4 cr; prereq 15 cr incl 50 or equiv, or ‡; offered 1966-67 and alt yrs) Cutkomp

178. Special Lectures in Entomology. Lectures in special fields of entomological research given by a visiting professor. (Cr ar; offered when feasible)

193, 194, 195.* Advanced Work in Entomology. Library and laboratory research in various lines of entomology. (1 or more cr per qtr; prereq △)

196.* Special Problems in Entomology and Vertebrate Ecology. Advanced work in entomology and ecology and ample opportunity for individual research, especially in various faunistic studies. (Cr ar; prereq ‡; offered Itasca Biology Session) Cook, Marshall, Tester

200x. Seminar. Assigned topics dealing with some special fields of work of the department. (1 cr per qtr)

201.° Experimental Ecology Laboratory. Companion course of 118. (2 cr; prereq 118 or ¶118) Chiang

202.° Insect Ecology. Dispersal, distribution, abundance, natural control, and related problems. (3 cr; prereq 118 or ‡) Chiang

204.° Insect Microbiology. Relationships between insects and microorganisms; physiological, anatomical, and pathological aspects. (5 cr; prereq 127, ‡) Brooks

205.° Insecticides and Their Action. Chemistry, physiological action, toxicology of insecticides. (3 cr; prereq 15 cr incl 50 or equiv or ‡, inorganic and organic chemistry; offered 1967-68 and alt yrs) Cutkomp

206.° Insecticides Laboratory. Research training in field of study discussed in 205. (2 cr; prereq 205 or equiv or ¶205; offered 1967-68 and alt yrs) Cutkomp

208.° Integrated Control. Suppression of insect, mite, and weed populations by integration of biotic agents; host plant resistance, artificial pest control measures and cultural practices. Principles of ecological approach to pest control. (3 cr; prereq 74 or equiv, ‡) Radcliffe

214. Field Ecology. Field work in major and minor communities in Minnesota; extended field trips to neighboring states. (3 cr; prereq Zool 65 or ‡...Bot 50 or 130 or equiv recommended; offered 1966-67 and alt yrs) Underhill

240, 241, 242, 243.° Research in Entomology. (Cr ar) Chiang, Cook, Cutkomp, Hodson, Peterson, Richards, Brooks, Price

Fisheries and Wildlife

103, 104, 105. Basic Fishery Biology or Basic Wildlife Biology. These courses provide a special arrangement for the making up of certain deficiencies in biological background. For use of these course numbers majors must consult major advisers; others, the department head. (Cr ar [not more than 6 cr are allowed for the Master's program, and 9 cr for the Ph.D. program])

118.° Experimental Ecology. Experimental approach to study of environmental factors affecting animal populations. (3 cr; prereq 9 cr in general biology or equiv and 3 cr in animal or plant ecology, ‡; for companion lab course, see 201) Chiang

119. Limnology. Conditions for life in the water and distribution of aquatic animals. (6 cr; prereq 15 cr in zoology incl Biol 2 or equiv; offered Itasca Biology Session only) Underhill

121. Ichthyology. Taxonomy and habits of North American fishes, especially those of upper Mississippi drainage. (3 cr; prereq 15 cr in zoology incl Biol 2 or 50) Underhill

128. Aquatic Entomology. Identification and biology of aquatic and littoral insects in all stages. (2 cr; prereq 74 or equiv; offered 1967-68 and alt yrs) Cook

162.° Vertebrate Ecology. Field work on populations and their relationships to local environments; habitat analysis and ecological research methods. Individual and team research projects, field trips, and lectures. (5 cr; prereq Bot 50 and Zool 94; offered Itasca Biology Session) Marshall, Tester

165.° Techniques of Fishery Biology. Basic methods used in fishery research and management; lake and stream survey methods, mapping, chemical and biological sampling; methods of fish collection, use of nets and traps, fish toxicants, electro-fishing; tagging and marking; methods of creel census. (3 cr; prereq 65, 119, 121 or ‡) Waters

166.° Techniques of Wildlife Biology. Lectures, laboratory, and field work on wildlife research and management techniques. (3 cr; prereq 65, 77, Zool 76, Bot 50, or ‡) Beer

179. Special Lectures in Fisheries and Wildlife. Lectures in special fields of research given by a visiting professor. (Cr ar; offered when feasible)

193, 194, 195.* Advanced Work in Fishery Biology or Advanced Work in Wildlife Biology. Library and laboratory research in various lines of fishery biology or wildlife biology. (1 or more cr per qtr; prereq ‡) Marshall, Smith, Beer, Tester, Waters

196.* Special Problems in Entomology and Vertebrate Ecology. Advanced work in entomology and ecology and ample opportunity for individual research, especially in various faunistic studies. (Cr ar; prereq ‡; offered Itasca Biology Session) Cook, Marshall, Tester

201.* Experimental Ecology Laboratory. Companion course of 118. (2 cr; prereq 118 or ¶118) Chiang

248-249.*† Fishery Biology and Management. Methods and theory of fishery biology; age and rate of growth, populations, mortality and harvest, indices of productivity. (5 cr per qtr; prereq 65, 165, Zool 53, 118, 119, 121, Biom 100, or equiv, or ‡; offered 1967-68 and alt yrs) Smith

250.* Fisheries Resources of the United States. Products; methods and description of commercial fisheries; state, federal, and international administration and regulation; significant laws and current legislation. Organization of fishery programs. (3 cr; prereq 249, or ‡; offered 1967-68 and alt yrs) Smith

251.* Fishery Habitats and Development. Theory, analysis, and evaluation of habitat modification; physical and chemical factors of production in lakes and streams; theory and methods of aquatic community dynamics. (3 cr; prereq 118, 165, Biom 100 or equiv, or ‡; offered 1966-67 and alt yrs) Waters

264, 265, 266, 267.* Research in Fishery Biology. (Cr ar) Smith, Waters

273.* Wildlife Management: Fur Bearers. Problems of, and methods used in managing fur bearers in North America. (3 cr; prereq 65, 77, Zool 116 and Bot 50 or ‡; offered 1966-67 and alt yrs) Beer

274.* Wildlife Management: Upland Game. Survey of upland game bird management problems in North America. (3 cr; prereq 65, Zool 75, 116, and Bot 50 or ‡; offered 1967-68 and alt yrs) Beer

275.* Wildlife Management: Waterfowl. Life histories, ecology, and management of North American waterfowl. (3 cr; prereq 65, Zool 75, 116 and Bot 50 or ‡; offered 1966-67 and alt yrs) Tester

276.* Wildlife Management: Big Game. Background basic to and methods used in managing big game herds in North America. (3 cr; prereq 65, 77, Zool 116 and Bot 50 or ‡; offered 1967-68 and alt yrs)

277, 278, 279, 280.* Research in Wildlife Biology. (Cr ar) Marshall, Beer, Tester

ENVIRONMENTAL HEALTH

Professor

Richard G. Bond, M.S., M.P.H., *director of graduate study*
George S. Michaelsen, M.S.
Theodore A. Olson, M.A., Ph.D.
Harold J. Paulus, M.S., Ph.D.
Conrad P. Straub, Ph.D.

Associate Professor

John O. Buxell, M.S., M.P.H.
Harry Foreman, M.D., Ph.D.
Velvl W. Greene, M.S., Ph.D.

Language Requirement—For the Master's degree, knowledge of a foreign language may be waived on recommendation of the adviser. For the Ph.D. degree, reading knowledge of two foreign languages or one foreign language and option of a special research technique or a collateral field of knowledge. Acceptable languages are Finnish, French, German, Japanese, Norwegian, Russion, Spanish, or Swedish.

Minor—For the Master's degree, 9 credits selected by the minor adviser on the basis of the candidate's field of study.

For the Ph.D. degree, PubH 100A, B, and C and 20 additional credits selected on the basis of the candidate's field of major study.

Master's Degree—Offered under both Plan A and Plan B. All candidates for this degree must take PubH 100A, B, and C, PubH 104, and PubH 106.

Doctor's Degree—Applicants for the degree in environmental health will present a Bachelor's degree in a physical or biological science or some field of engineering and will minor in a fundamental discipline appropriate to their previous training.

For descriptions of the following courses, see under Public Health.

102.° Environmental Sanitation. (3 cr; prereq ‡) Bond, Buxell, Olson

112.° Public Health Engineering—Plan Examinations. (1 cr per qtr, §114; prereq engineering degree and 102, and ‡) Bond, Buxell

113.° Public Health Engineering—Field Investigations. (2 cr per qtr, §114; prereq engineering degree and ‡ and 102) Bond, Buxell

115.° Food Sanitation. (3 cr; prereq 100A and ‡) Olson

115A. Institutional Food Protection Programs. (2 cr; prereq ‡) Bond

116.° Public Health Engineering Administration. (2 cr, §114; prereq ‡) Bond

117A, B, C.° Sanitary Biology. (3 cr per qtr; prereq 100A or ¶100A or ‡) Olson

123.° Topics in Public Health. (Cr ar; prereq ‡) Staff

138. Hospital Engineering Problems. (Cr ar; prereq ‡) Staff and visiting lecturers

145. Low Level Radioactivity and Radiation Measurements. (3 cr; prereq ‡) Foreman

146. Radiological Health II. (3 cr; prereq ‡) Foreman

147.° Environmental Radioactivity. (3 cr; prereq ‡) Foreman

149. Public Health Aspects of Housing and the Residential Environment. (3 cr; prereq ‡) Buxell

151. Health Aspects of Air Control in Hospitals. (2 cr; prereq ‡) Michaelsen

152.° Industrial Hygiene Engineering. (3 cr; prereq ‡) Michaelsen

154.° Radiological Health I. (Cr ar; prereq ‡) Foreman

155.° Introduction to Air Pollution Problems. (3 cr; prereq ‡) Paulus

156.° Air Pollution Surveys. (2 cr; prereq 155 and ‡) Paulus

157. Radiation Protection Criteria for Hospital Design and Operation. (2 cr; prereq ‡) Michaelsen

158. Hospital Safety. (3 cr; prereq ‡) Michaelsen, Scheffler

159. Chemical Laboratory Safety. (1 cr; prereq ‡) Scheffler

185. Air Analysis. (3 cr; prereq 152 or 155, ‡) Paulus

186. Problems of Air Pollution Control. (Cr ar; prereq 155, ‡) Paulus

200. Research. (Cr ar) Staff

210. Seminar: Public Health. (Cr ar)

212.° Seminar: Public Health Engineering and Sanitation. (Cr ar; prereq ‡) Olson

230. Field Practice in Environmental Sanitation. (Cr ar; prereq ‡) Bond

231.° Ground Water Development. (Cr ar; prereq graduate engineer and ‡) Bond, Singer, staff, and visiting lecturers

232.* Field Work in Ground Water Development. (Cr ar; prereq graduate engineer, 231) Bond, Singer, staff, and visiting lecturers

233. Water Quality Investigation and Research Techniques. (6 cr; prereq ‡) Olson, Odlaug

EPIDEMIOLOGY

Professor

Gaylord W. Anderson, M.D., Dr.P.H.
Leonard M. Schuman, M.D., M.S., *director of graduate study*

Language Requirement—For the Master's degree, knowledge of a foreign language may be waived on recommendation of the adviser. For the Ph.D. degree, reading knowledge of two foreign languages or of one foreign language and option of a special research technique or a collateral field of knowledge. Acceptable languages are: Danish, French, German, Japanese, Norwegian, Russian, Spanish or Swedish.

Minor—For the Master's degree, 9 credits selected by the minor adviser on the basis of the candidate's field of study.

For the Ph.D. degree, PubH 100A, B, and C, and 20 additional credits selected by the minor adviser on the basis of the candidate's field of major study.

Master's Degree—Offered under both Plan A and Plan B. All candidates for this degree must take PubH 100A, B, and C.

Doctor's Degree—Applicants for the degree in epidemiology will usually present a degree in medicine, dentistry, or veterinary medicine; others with adequate background in the biological or physical sciences or with demonstrated competence in investigative work may be accepted. Students majoring in epidemiology will offer a minor in a related field.

For descriptions of the following courses, see under Public Health.

100A. Elements of Public Health I. (3 cr; prereq 3, 3A or 50 and a course in bacteriology) G Anderson, Thomson, Schuman

100B. Elements of Public Health II. (1 cr; prereq 100A) Staff

100C. Elements of Public Health III. (1 cr; prereq 100B) Staff

103. Public Health Bacteriology. (Cr ar; prereq MicB 102, 116, ‡) Bauer

104.* Epidemiology I. (3 cr; prereq 100A, 140 or 110A-111A) Schuman

105.* Epidemiology II. (3 cr; prereq 104) Schuman

110A. Biometrics I. (3 cr; prereq ¶111A, Math 10 or ‡) Brown

111A. Biometrics Laboratory I. (2 cr per qtr; prereq ¶110A)

123.* Topics in Public Health. (Cr ar; prereq ‡) Staff

140. Vital Statistics I. (3 cr) Bearman, Thornton

191.* Science of Human Nutrition. (3 cr; prereq ‡) J Anderson, Keys

195. Public Health Aspects of Cardiovascular Disease. (3 cr; prereq ‡) Keys, Grande, and staff

200. Research. (Cr ar)

213. Seminar: Epidemiology. (Cr ar; prereq ‡) Schuman

241.* Epidemiology of Noncommunicable Diseases. (3 cr; prereq 104) Schuman

FLUID MECHANICS

Subcommittee:

Professor

Ernst R. G. Eckert (Mechanical Engineering), *chairman, director of graduate study*
William C. Meecham (Aeronautical Engineering)
James B. Serrin, Jr. (Mathematics)
Edward Silberman (Civil Engineering)
Ephraim M. Sparrow (Mechanical Engineering)
Hans F. Weinberger (Mathematics)

Associate Professor

Arnold G. Fredrickson (Chemical Engineering)

This group, together with the following, may serve as graduate advisers for this area:

Professor

Neal R. Amundson (Chemical Engineering)
Rutherford Aris (Chemical Engineering)
Richard J. Goldstein (Mechanical Engineering)
Edward L. Hill (Physics)
Herbert S. Isbin (Chemical Engineering)
Stephen Prager (Physical Chemistry)
William E. Ranz (Chemical Engineering)

Associate Professor

Thomas S. Lundgren (Aeronautical Engineering)
L. Edward Scriven (Chemical Engineering)

Degrees—The program in fluid mechanics leads to the Master's and Ph.D. degrees. Work in fluid mechanics can also be taken for a minor in a Ph.D. program.

Master's Degree—Offered under Plan A and Plan B.

Doctor's Degree—The program in fluid mechanics leads to the Ph.D. degree.

Prerequisites—Candidates for the M.S. or Ph.D. programs in fluid mechanics will normally have completed undergraduate work in one of the related fields of: aeronautical engineering, chemical engineering, civil engineering, mathematics, mechanical engineering, or physics. Admission to the program must be approved by the Graduate School on recommendation of the Fluid Mechanics Subcommittee, which will consider any applicant whose scientific and engineering training is adequate to carry on this program.

Approval of Program—The candidate's tentative program will be planned with the aid of an adviser selected from those listed who will supervise the thesis investigation. The Fluid Mechanics Subcommittee will consider the program and transmit it to the Physical Sciences Group Committee with recommendations. Approval and appointment of a thesis committee will be handled as usual.

Major Program—The course work in the major should normally be selected from those courses in science and engineering that are particularly relevant

to the special field of interest in fluid mechanics. As it is the intent of this program to provide opportunity for broad training, it is desirable that at least 9 credits of 200-series courses be selected from not less than three of the several graduate majors listed.

Minor Program—The minor should ordinarily be taken in mathematics. However, under special circumstances the subcommittee may consider the substitution of a basic science such as physics or chemistry. The minor must be planned so that it effectively brings in a related but distinct area and does not merely supplement the major.

Language Requirement—All candidates must satisfactorily meet the requirements for one or two foreign languages for the M.S. or Ph.D. degree. One of these must be German. The second should normally be selected from French, Russian, or Italian. It is recommended that the German requirement be met before the end of the first year of graduate study.

For course descriptions, see Aeronautical, Chemical, Civil, and Mechanical Engineering, and Mathematics.

Aero 175. Random Processes. (3 cr; prereq Math 149 or equiv or ‡) Meecham

Aero 184. Intermediate Gas Dynamics. (3 cr; prereq 102A or ‡) Lundgren

Aero 185. Rarefied Gas Dynamics. (3 cr; prereq 102A or ‡) Lundgren

Aero 190. Introduction to Magnetohydrodynamics. (3 cr; prereq 102A, Math 147 or ‡) Meecham

Aero 201. Foundations of Fluid Mechanics. (3 cr; prereq 102A, ¶Math 149 or ‡) Joseph, Lundgren, Meecham

Aero 202. Finite Waves in Compressible Fluids. (3 cr; prereq 201 or ‡) Joseph, Lundgren, Meecham

Aero 203. Linearized Compressible Flow. (3 cr; prereq 201 or ‡) Joseph, Lundgren, Meecham

Aero 205. Incompressible Boundary Layer Theory. (3 cr; prereq Math 149, ¶201 or equiv or ‡) Meecham

Aero 206. Compressible Boundary Layer Theory. (3 cr; prereq Math 149, ¶201 or equiv or ‡) Meecham

Aero 207. Fluid Dynamic Stability. (3 cr; prereq Math 149, ¶201 or equiv or ‡) Meecham

Aero 216. Theory of Turbulence. (3 cr; prereq 175, Math 149 or equiv or ‡) Meecham

Aero 217. Applications of Turbulence Theory. (3 cr; prereq 216 or equiv or ‡) Meecham

Aero 250-251-252. Magnetofluiddynamics. (3 cr per qtr; prereq 203 or Phys 104 or Math 234, or ‡)

ChEn 102. Principles of Chemical Engineering. (5 cr; prereq 101) Ranz

ChEn 211-212-213. Molecular Theory of Transport Processes. (3 cr per qtr; prereq ‡) Dahler, Davis

ChEn 218. Advanced Topics in Chemical Engineering. (3 cr) Fredrickson

ChEn 225-226-227. Fluid Mechanics and Related Topics. (3 cr per qtr; prereq ‡) Aris, Scriven

Hydr 101. Fluid Mechanics. (3 cr; prereq MM 27 [103 may be substituted for 101]) Staff

Hydr 103. Fluid Mechanics. (5 cr; prereq MM 27 [103 may be substituted for 101]) Staff

Hydr 104. Fluid Mechanics Laboratory. (1 cr; prereq 101 or 103 or ChEn 101 or ¶ or 103 or ChEn 101) Staff

Hydr 161. Open Channel Flow. (3 cr; prereq 101 or 103 and 104) A G Anderson

Hydr 162. Natural and Artificial Waterways (Including Sediment Transport). (3 cr; prereq 161 or ‡) A G Anderson

Hydr 163. Ground Water Hydraulics. (3 cr; prereq 101) Hayden

Hydr 167. Hydraulic Measurements. (3 cr; prereq 187 or ‡) Ripken

Hydr 168. Hydraulic Pumps and Turbines. (3 cr; prereq 187 or ‡) Ripken

Hydr 187. Intermediate Fluid Mechanics—The First Graduate Course in Fluid Mechanics. (3 cr; prereq 101 or 103 and 104) Ripken, Silberman, Song

Hydr 188. Incompressible Potential Flow. (3 cr; prereq 187) Silberman, Song

Hydr 189. Incompressible Boundary Layer Flow. (3 cr; prereq 187) Silberman

Hydr 190. Dynamics of Hydraulic Structures. (3 cr; prereq 187) Bowers, Song

Hydr 191. Similitude and Dimensional Analysis. (3 cr; prereq 101 or 103 or ‡) A G Anderson

Hydr 194-195-196. Advanced Hydraulics Laboratory. (2 cr per qtr; prereq 101 or 103 and 104; offered when demand warrants) Staff

Hydr 287. Fluid Turbulence. (3 cr; prereq 187 or ‡; offered when demand warrants) Silberman, Song

Hydr 290, 291, 292. Advanced Fluid Mechanics. (3 cr per qtr; prereq 190 or ‡; offered when demand warrants) Silberman, A G Anderson

Hydr 293-294-295. Hydrodynamics of the Boundary Layer. (3 cr per qtr; prereq 187 and Math 151 or ‡) Silberman, Song

Hydr 296-297-298. Hydrodynamics: Special Topics in Potential Flow Theory Such as Linearization Methods, Wave Motion, and Cavity Flows. (3 cr per qtr; prereq 295) Silberman, Song

Math 169. Mathematical Theory of Fluid Flow. (3 cr; prereq 147, 174, or 174, 168A or ‡) Meyers

Math 290A-B-C. Mathematical Theory of Fluid Dynamics. (3 cr; prereq 153 or 175 or ‡) Serrin

ME 134. Thermodynamics of Fluid Flow. (3 cr; prereq 32, Hydr 103) Staff

ME 143. Turbomachinery. (3 cr; prereq 134 or ¶134) Murphy

ME 232. Advanced Fluid Thermodynamics. (3 cr; prereq 134, 230 or ‡) Ibele

ME 270-271-272. Magnetohydrodynamics. (3 cr per qtr; prereq 134 or AE 102A, Math 147 or ‡) J E Anderson

See also courses on heat, mass and momentum transfer under Chemical and Mechanical Engineering.

FOOD SCIENCE AND INDUSTRIES

Professor

Samuel T. Coulter, *head, director of graduate study*
James J. Jezeski
Howard A. Morris
Joseph C. Olson, Jr.
Elmer L. Thomas

Prerequisites—Superior students having a B.S. or B.A. degree from an accredited college or university with a major in any physical or biological science oriented field may be considered as having the necessary prerequisites. However, if preparation appears to be inadequate, certain additional courses may be required.

Major and Minor—Students working toward the M.S. or Ph.D. degrees may emphasize chemistry, engineering, physics, or microbiology of the processing of milk or other food products. It is suggested that students present a minor in one of the following fields: biochemistry, chemical engineering, public health, economics, or business administration.

Language Requirement—Reading knowledge of one foreign language (French, German, Russian, Danish, Swedish) is advised but not required for the Master's degree. For the Ph.D. degree, this requirement may be met by (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge. When two foreign languages are offered, any combination of those listed above may be approved except Danish and Swedish.

Master's Degree—Offered under Plan A. Plan B may be followed with adviser's approval.

Doctor's Degree—Work leading to the Ph.D. degree is offered.

100. Seminar: Food Industries Literature. Selected topics. Food literature. Preparation of bibliographies. Student presents papers and reports on assigned subjects and reviews scientific investigations in food industries. (2 cr; prereq three courses in food science and industries)

101.* Principles of Dairy Processing I. Manufacture of market milk, condensed milks, ice cream, and frozen foods; application of chemical, microbiological, and physical principles. (3 or 5 cr [3 cr for lect, 2 cr for lab]; prereq 50, 51, 52; offered 1966-67 and alt yrs)

102.* Principles of Dairy Processing II. Manufacture of butter and cheese; application of chemical, microbiological, and physical principles. (5 cr; prereq 50, 51, 52; offered 1967-68 and alt yrs)

103.* Principles of Food Dehydration. Lectures and laboratory. Manufacture of dry food products; physical and chemical processes and engineering problems involved. (3 cr; prereq 101)

105.* Sensory Testing of Foods: Theory and Methodology. Fundamentals of flavor perception; sensory evaluation of properties of food products; methodology and interpretation of test results. (2 cr; prereq 51)

106. Supervised Industry Practice. Practical training and experience in some operational phase of the dairy and food industries. Includes a minimum of 2 months' employment in an approved position and written reports. (3 cr; prereq 15 cr in food science and industries courses)

107.* Quality Control Procedures. Chemical and bacteriological laboratory methods used in technical control of milk and other food products. Lectures and laboratory. (3 cr; prereq 50 and 51)

110.* Sanitation Microbiology. Factors influencing destruction of microorganisms by physical and chemical agents. Chemical and microbiological principles in cleaning and sanitizing of dairy and other food processing equipment. Thermal process evaluation. (3 cr; prereq BioC 2, two courses in microbiology or ‡)

150.* Dairy and Food Microbiology. See 50. (3 or 5 cr [3 cr for lect, 2 cr for lab]; prereq MicB 53)

151.* Food Process Chemistry. See 51. (3 cr; prereq ‡)

152.* Food Physics and Process Engineering. See 52. (5 cr; prereq ‡)

154.* Poultry Products. Technology involved in grading, processing, packaging, storage, and merchandising of poultry and eggs. (3 cr; prereq 50, 51, 52, and Poul 1 [formerly Poul 154])

161. Food Process Chemistry Laboratory. See 61. (2 cr; prereq ‡)

170.* Special Problems in Food Manufacturing. Individual laboratory or library research on chemical, physical, and engineering problems involved in processing and utilization of food products. (1-3 cr)

180.* Special Problems in Dairy and Food Microbiology. Laboratory or library research on problems related to the microbiology of dairy and food products. (1-3 cr)

181.* Advanced Dairy and Food Microbiology. Investigations of specific problems on the bacteriology and mycology of dairy and other food products. (3 cr; prereq 50 or equiv, 101 or 102)

205x.* General Seminar. Review of literature and discussion of research problems and developments related to dairy and food chemistry, microbiology, and physics. (1 cr) Staff

FORESTRY

Professor

Henry L. Hansen
John G. Haygreen
Ralph L. Hossfeld
Frank D. Irving
Frank H. Kaufert, *chairman, director of graduate study*
Lawrence C. Merriam
Merle P. Meyer
Scott S. Pauley
Richard A. Skok

Associate Professor

Egolfs V. Bakuzis
Bruce A. Brown
Jay M. Hughes
Hugo H. John
Edward I. Sucoff
Kenneth E. Winsness

Assistant Professor

Roland O. Gertjejansen
Robert D. Thompson

Prerequisites—The prerequisites for entering on the master of forestry program may be either an undergraduate degree program in forestry or completion of a 4-year undergraduate college degree including college level courses in algebra, inorganic chemistry, physics, and two college courses in biology. Applicants for admission to study for the master of science degree or the Ph.D. degree are expected to have completed Bachelor's or advanced degrees in forestry or in related sciences as dictated by the major field of specialization. Consideration will be given to students who have included in their undergraduate college curriculum sufficient pertinent subject matter to qualify them to undertake graduate work with specialization in the forest sciences or in forest products engineering.

Language Requirement—For the master of forestry degree and the master of science Plan B—none. One language is required for the master of science, Plan A. This may be waived by petition in individual cases. For the Ph.D. degree, either (a) two foreign languages selected in consultation with the student's adviser and the director of the school or (b) one foreign language and the option of a special research technique or a collateral field of knowledge—selection to be made in consultation with the student's adviser and the director of the school.

Master of Forestry Degree—Students will fulfill the general requirements for the master of science degree under Plan B. This program is designed to meet the needs for professional study by qualified students primarily interested in administration and technical work in forest resources development. For completion of the M.F. degree, the following courses or their equivalents must have been completed in the undergraduate program or during the student's graduate training.

For 49—Dendrology (4)
For 54—Forest Ecology (4)
(or) Bot 130 and 130A—Plant Ecology (5)
Ent 56—Forest Entomology (4)
Ent 64—Wildlife Management (3)
PlPa 51—Forest Pathology (4)
For 52—Forest Mensuration (3)
For 77—Forest Products (2)
For 100—Forest Fire (2)
For 109—Forest Aerial Photography (3)
For 111—Statistical Methods in Forestry (4)
For 123—Forest Economics (5)
For 129—Regional Silviculture (3)
For 131—Forest Policy (3)
For 139—Timber Management (3)
For 143—Management of Recreational Lands (3)
For 147—Forest Administration (3)
For 148—Forest Hydrology (2)
1 quarter of forestry field camp experience
Graduate seminar (1 qtr) (1)

Doctor's Degree—Work leading to the Ph.D. degree is offered under the general requirements for that degree. A program of study may be developed to include either a specific minor subject or a coherent supporting subject program.

Research Facilities—The Cloquet Forest Research Center, the Forestry and Biological Station at Lake Itasca, and the Forest Products and Forest Science laboratories on the St. Paul Campus are available to students for the development of requisite problem and thesis research.

100. Forest Fire. Fire behavior, effects, control and use. (2 cr; prereq 4, 53) Irving

105.* Range Management. Range management for sustained production of livestock forage. (2 cr, §104; prereq 53 or ‡ for nonforestry majors, Biol 2) Meyer

109. Forest Aerial Photogrammetry. Use of aerial photographs, preparation of planimetric and vegetative type maps. Photo interpretation and application to resource management. Lectures and laboratory. (3 cr; prereq 52 or ‡) Meyer

111. Statistical Methods in Forestry. Sampling, decision making using statistical tests, application of statistics to forest survey, inventory, and volume table selection. Lectures and laboratory. (4 cr; prereq 52, ¶109, Math 10, or ‡) John

122. Forest Business Practices. Survey of timber sales procedures, forest tax procedures, forest finance, and government regulations and business analysis techniques applied to forestry operations. Lectures, reports, and problems. (3 cr; prereq AgEc 3 or ¶AgEc 3) Skok

123. Forest Economics. United States and world forest resource supply and consumption relationships; forest products industries and wood products users' characteristics; aggregate and firm capital use theory for long period production processes; market systems for principal forest products; macro problems of forest economy; and decision making in micro forest economic situations. Lectures and problems. (5 cr; prereq 77, 122, and Cloquet or ‡) Skok, Hughes

125. Silviculture I. Introduction to silvicultural systems, intermediate cuttings, and related practices. Forest regeneration problems and techniques. (2 cr; prereq 49 and 54; given at Cloquet) Brown

128. Silviculture II. Lectures and field work in relation to timber stand improvement projects, stand examinations and prescriptions, seeding and planting, and related silvicultural practices. (4 cr; prereq ¶125; given at Cloquet) Brown

129. Regional Silviculture. Forest geography and classification in the U.S. and Canada as related to the silviculture of selected representative forest types. Lectures and reports. (3 cr; prereq 128 or ‡) Hansen

131.* Forest Policy. Public and private forest policies in the U.S. Forest policies of other nations. Analysis of current policy issues. Lectures and reports. (3 cr) Irving, Skok, Hughes

133. Forest Management and Utilization. Observation and analysis of state, federal, and private forestry operations with field trips and assigned reading; techniques of fire control and use; timber utilization and processing including trips through selected forest products processing plants. (4 cr; prereq 100, AgEc 3; given at Cloquet) Brown

134. Forest Inventory and Photographic Interpretation. Type delineation, area measurement, map construction, cruise design, and timber measurement using aerial photos. (4 cr; prereq 111; given at Cloquet) John, Meyer

136.° Advanced Forest Economics. Economics of forest resource development and forest products. (3 cr; prereq 123 or ‡) Skok, Hughes

139. Timber Management. Inventory, regulation, and continuous production of timber crops. Economic analysis of specific production problems. Lectures and problems. (3 cr; prereq 111, 123, 125, 133, or ‡) Hughes

141.° Principles of Forest Ecology. Review and discussion of modern ecological concepts and principles. Their application to forest ecosystems and to silvicultural manipulation. (3 cr; prereq 54, 128, or ‡) Hansen

143. Management of Recreational Lands. Recreational use of the forest and associated land and water. Policy problems arising from recreational demands. (3 cr) Merriam

145.° Advanced Silviculture. Synthesis of silviculture knowledge through review of classical as well as recent contributions to silvicultural literature. Topical presentations, reports. (3 cr; prereq 129 or ‡) Hansen

146.° Advanced Forest Aerial Photogrammetry. Photogrammetric systems, flight planning, contracting, contract inspection; advanced photo interpretation, mapping, and measurement problems. Laboratory. (3 cr; prereq 109 or ‡) Meyer

147. Forest Administration. Organization and administration of forestry enterprises. (3 cr; prereq 123, 133, or ‡) Irving

148. Forest Hydrology. Principles of managing forested watershed including effects of woody vegetation upon soil moisture, stream flow, and erosion. (2 cr, §104; prereq 53, 54, or ‡ for nonforestry majors, Soil 18, Geo 1 or ‡)

149.° Advanced Forest Mensuration. Applications of statistical and advanced mensurational methods in analysis and interpretation of forestry data and forest survey sampling methods. Lectures and laboratory. (3 cr; prereq 111 or ‡) John

150.° Forest Genetics. Heredity and variation of important forest-tree species; applications of genetic principles in tree improvement. (3 cr; prereq Gen 66 or 101, or ‡) Pauley

152.° Forest-Tree Physiology. Behavior of trees including energy balance, mineral nutrition, water relations, and growth regulation. Application to practical forestry problems emphasized. (3 cr; prereq Biol 2, Phys 3, BioC 1A or OrCh 42) Sucoff

153.° Advanced Forest Management. Advanced economic, administrative, and biologic problems of forest land management. Current techniques. Problems of increasing intensity of management. (3 cr; prereq 139, 147, or ‡) Irving

154.° Advanced Forest Hydrology. Recent literature relating to management of the forested watershed. Methods of analyzing research data. (3 cr; prereq 148 or ‡; offered when feasible)

156. Introduction to Research. Research philosophy, objectives, problem development, analytical principles, and presentation, illustrated by situations in forestry. (3 cr; prereq ‡) Hossfeld, John, Merriam

157. Recreation Land Policy. Issues affecting use and management of lands devoted entirely or in part to recreational objectives. (3 cr; prereq 143 or ‡) Merriam

158. Theory and Practices in Environmental Measurement. (Same as Bot 158) Physical factors of environment—energy budget, water budget, and microclimatic variation. Modern field instrumentation. (5 cr; prereq college physics, ecology, or physiology; offered at Itasca) Sucoff

175. Wood Pulp and Paper. Production of wood pulp and paper products. Lectures, reading, and reports. (3 cr; prereq 74 and organic chemistry) Gertjejansen

176. Design of Wood Structures. Fabrication and use of the timber truss and laminated arches and beams in building construction. Timber connector, nailed, bolted, and nail-glued joints. (4 cr; prereq 79, Math 44, Phys 9 or ‡) Haygreen

177. Wood Chemistry. Chemical composition, reaction, and analyses of wood components and derivatives. Chemical technology of wood and wood products. (3 cr; prereq 74 or ‡, organic chemistry) Hossfeld

178. Woody Tissue Microtechnique. Sliding and rotary microtomes, maceration; differential staining, and special techniques in preparation of woody tissue for microscopic study. (2 cr; prereq 74 or ‡) Hossfeld

181.° Moisture Relations in Wood. Moisture movement in wood related to the microphysical and chemical structure and its influence on development of stress during drying and subsequent use. (3 cr; prereq 81, 177; offered when feasible) Hossfeld

182.° Advanced Wood Preservation. Factors governing toxicity, permanence, and effectiveness of wood preservatives to fungi, insects, and marine borers. Fire retardant treatments. Permeability of wood, penetration of preservatives and heat transfer. (3 cr; prereq 82) Kaufert

183. Wood Finishing. Laboratory. Industrial applications of wood finishes. (2 cr) Hossfeld

184. Advanced Wood Chemistry. Laboratory problems in analysis of wood constituents and in the technique for their isolation and purification. (2 cr; prereq 177, AnCh 57 or equiv) Hossfeld

185. Principles of Adhesion in Manufactured Wood Products. Theory of adhesion as applied to wood and to combinations of wood with other materials. (3 cr; prereq 86, 177) Staff

186.° Mechanical Behavior of Wood. Orthotropic nature of wood; elastic and inelastic behavior; effect of moisture, temperature, and time. Some consideration of plywood, particleboard, and fiberboard properties. (3 cr; prereq 79 or ‡) Haygreen

187. Advanced Building Materials Merchandising. Lecture and seminar presentations in the areas of retailing, wholesaling, market analysis, and research. (3 cr; prereq 87, Mktg 197; offered when feasible) Thompson

195. Advanced Wood Pulp and Paper. Laboratory problems in the properties of wood pulp and paper products. (2 cr; prereq 175, AnCh 57 or equiv) Gertjejansen

200x.° Research Problems: Silviculture. (Cr ar) Hansen, Brown, Bakuzis

203x.° Research Problems: Forest Management. (Cr ar) Irving, Brown, Winsness, Hughes

205x.° Research Problems: Forest Economics. (Cr ar) Skok, Hughes

207x.° Research Problems: Forest Products Engineering. (Cr ar) Hossfeld, Haygreen, Kaufert, Gertjejansen

213x.° Research Problems: Forest Utilization. (Cr ar) Hossfeld, Haygreen, Kaufert, Gertjejansen

215x.° Research Problems: Forest-Tree Physiology. (Cr ar) Sucoff

218x.° Research Problems: Forest Measurements and Photogrammetry. (Cr ar) Meyer, John

219x.° Research Problems: Forest Recreation. (Cr ar) Merriam, Hughes, Hansen, Skok

220x.° Research Problems: Forest-Tree Genetics. (Cr ar) Pauley

221x.° Research Problems: Forest Influences. (Cr ar)

222x.° Research Problems: Forest Policy. (Cr ar) Skok, Irving, Winsness, Hughes, Merriam

223x.° Seminar. Current forestry research problems and current forestry literature. (1 cr) Graduate Staff

224Ax. Seminar: Forest Biology. Topics in forest biology. (1 cr) Graduate staff

224Bx. Seminar: Forest Management. Topics in forest management. (1 cr) Graduate staff

224Cx. Seminar: Forest Products. Topics in forest products engineering and technology. (1 cr) Graduate staff

225x. Seminar. Current forestry research problems and current forestry literature. (1 cr) Graduate staff

230.* **Forest Synecology.** Structure, dynamics, and productivity of forest ecosystems. Models and classification of ecosystems, theory and application. (3 cr) Bakuzis

GENETICS

Professor

S. Gaylen Bradley (Microbiology)
Charles R. Burnham (Agronomy and Plant Genetics)
Richard S. Caldecott (Genetics)
Ralph E. Comstock (Genetics)
A. Orville Dahl (Botany)
Herbert W. Johnson (Agronomy and Plant Genetics)
Jean W. Lambert (Agronomy and Plant Genetics)
David J. Merrell (Genetics)
Scott S. Pauley (Forestry)
Sheldon C. Reed (Genetics)
William E. Rempel (Animal Husbandry), *director of graduate study*
Robert N. Shoffner (Poultry Science)
Leon A. Snyder (Genetics), *chairman*
Francis A. Spurrell (Veterinary Medicine)

Associate Professor

V. Elving Anderson (Genetics)
Verne E. Comstock (Agronomy and Plant Genetics)
Laddie J. Elling (Agronomy and Plant Genetics)
Frank D. Enfield (Genetics)
Donald C. Rasmusson (Agronomy and Plant Genetics)
James C. Sentz (Agronomy and Plant Genetics)
Horace L. Thomas (Agronomy and Plant Genetics)
Charles W. Young (Animal Science)
Jorge J. Yunis (Laboratory Medicine)

Assistant Professor

William R. Andersen (Horticultural Science)
William A. Compton (Agronomy and Plant Genetics)
Robert E. Heiner (Agronomy and Plant Genetics)
Roger A. Kleese (Agronomy and Plant Genetics)
Florian I. Lauer (Horticultural Science)
Peter D. Snustad (Genetics)
Robert E. Stucker (Agronomy and Plant Genetics)

Research Associate

Richard L. Cooper (Agronomy and Plant Genetics)

A program of study in genetics, leading to the Master's and Ph.D. degrees, may be elected as a major. The major adviser may be selected from among qualified members of the graduate faculty in this field. All programs of students electing genetics as a major must be approved by the Subcommittee on Genetics of the Graduate School. Genetics may also be selected as a minor area by students with majors in other appropriate areas. Approval of minor programs in genetics will also be the responsibility of the Subcommittee of Genetics.

Prerequisites—A strong foundation in biological sciences; 3 credits in genetics; mathematics through college algebra (in some areas, mathematics through calculus); chemistry through OrCh 62 or equivalent; college physics or equivalent. Deficiencies must be removed before the student can become a candidate for a degree. Students who are preparing for graduate study in genetics are urged to become proficient in at least one foreign language prior to entering the Graduate School.

Master's Degree—Offered under Plan A or Plan B.

Doctor's Degree—For major study, the student will develop a general competence in genetics and will conduct thesis research which may be in special subfields of genetics such as (a) cytogenetics, (b) quantitative and population genetics, (c) biochemical and physiological genetics, (d) plant breeding,

(e) animal breeding, (f) human genetics, (g) radiation genetics, (h) microbial genetics, (i) evolution and speciation, and (j) developmental genetics. The student will develop a particularly thorough knowledge of at least two of the special subfields of genetics. All major students will be expected to attain competence in statistics including the design of experiments and the statistical analysis of the data. Dependent upon the subfields of genetics in which the student has special interest, he will be expected to have suitable competence in one or more related areas of science such as chemistry, biology, or mathematics. For students with a genetics minor, general competence in genetics will be required.

Language Requirements—For the Master's degree, none. For the Ph.D. degree, (a) two foreign languages or (b) one foreign language plus a special research technique or collateral field.

Agro 132. Introduction to Plant Breeding. (3 cr; prereq Gen 66 or equiv) Staff

Agro 233. Principles of Plant Breeding I. (3 cr; prereq Gen 141, Agro 132 or equiv) Rasmusson

Agro 234. Principles of Plant Breeding II. (3 cr; prereq Agro 233 or ‡) Kleese

Agro 241. Research in Plant Genetics. (Cr ar) Staff

Agro 242. Seminar: Plant Breeding. (1 cr per qtr) Staff

Agro 244. Laboratory Methods in Plant Breeding. (1 cr; prereq Agro 132 or ‡) Lambert

Agro 245. Current Topics in Plant Breeding. (2 cr; prereq Agro 234 or ‡) Rasmusson

Agro 253. Methods in Plant Genetics. (2 cr; prereq Gen 140; offered 1966-67 and alt yrs) Burnham

Agro 255. Current Topics in Plant Genetics. (2 cr; prereq 140 or ‡) Kleese

Agro 263. Application of Quantitative Genetics to Plant Breeding. (3 cr; prereq Agro 234 and 262) Staff

AnHu 160. Animal Breeding II. (3 cr; prereq Gen 66 or equiv) Rempel

AnHu 201. Advanced Animal Breeding. (3 cr; prereq Gen 66 and Biom 101) Rempel

AnHu 205. Quantitative Inheritance. (3 cr; prereq Gen 262)

Bot 118. General Cytology. (5 cr; prereq 10 cr in biology, botany, or zoology, elementary genetics or ‡) Dahl

DyHu 122. Dairy Production II. (4 cr; prereq DyHu 49, Gen 66 or equiv) Young

DyHu 217. Dairy Cattle Inheritance. (3 cr; prereq ‡) Young

For 150. Forest Genetics. (3 cr; prereq Gen 66 or ‡) Pauley

Gen 101. Basic Genetics. For correction of deficiencies in background course work. (Cr ar)

Gen 140. Intermediate Genetics I. Structure and function of genetic elements at the molecular and cellular levels. Organization and replication of genetic material, mutogenesis, recombination, the genetic code and protein synthesis, episomes, suppression, complementation and regulation. (3 cr; prereq Gen 66 and Biol 60 or equiv)

Gen 141. Intermediate Genetics II. Selected topics in population and quantitative genetics, cytogenetics, immunogenetics, and developmental and physiological genetics. (3 cr; prereq Gen 66 and Biol 60 or equiv)

Gen 171. Genetics and Speciation. (Former Zool 171) Application of genetic principles to problems of speciation and evolution. (3 cr; prereq 15 cr biology, Gen 66 and Gen 71 or ¶71)

Gen 175. Human Genetics. Inherited characters in man, particularly in relation to medicine, with some reference to the relation of genetics to marriage and to social conditions. (3 cr; prereq Gen 66 or ‡; replaces Zool 175) Reed

Gen 176. Problems and Methods in Human Genetics. (Formerly Zool 176) Methods for research in human genetics. Importance of appropriate statistical techniques. Use of genetic concepts in exploring new problems. Individual study of current problems and group discussion. (3 cr; prereq 175 and PubH 110 or equiv and ‡) Anderson

Gen 230. Biochemical Genetics. Survey of current knowledge of the molecular bases of the homo- and heterocatalytic expression of genetic material, recombination, mutation, complementation and suppression. The genetic code, protein synthesis and regulatory mechanisms. (3 cr; prereq Gen 140 and 141 or equiv or ‡...MicB 110 highly recommended)

Gen 246. Genetics Seminar. (Formerly Agro 246) Current contributions to genetic theory. (1 cr per qtr, repeated enrollment for credit permitted) Genetics Center staff

Gen 252. Cytogenetics. (Same as Agro 252) Cytogenetic behavior of chromosomal changes. Experimental methods and possible applications. (4 cr; prereq Bot 118, Gen 140 or ‡) Burnham

Gen 260. Population and Quantitative Genetics I. (Formerly Agro 261) Genetic variation in quantitative traits with special attention to fitness. Causes of change and equilibria in gene frequencies, heterosis and inbreeding depression, consequences of natural and artificial selection. (3 cr; prereq Gen 141 and Biom 101 or equiv) Enfield

Gen 262. Population and Quantitative Genetics II. (Same as AnHu 204 and Agro 262) Selection with reference to population changes in quantitative characters. Information required for predicting effects of selection and related research. Emphasis on logical analysis. (3 cr; prereq Gen 260...Biom 181 or equiv recommended) Comstock

Gen 297. Current Topics in Genetics. (Cr ar; repeated enrollment permitted) Staff

Gen 298. Seminars in Genetics. (1 cr per qtr; repeated enrollment permitted) Staff

Gen 299. Research in Genetics. (Cr ar; repeated enrollment permitted) Staff

Hort 110. Horticultural Crop Breeding. (3 cr; prereq Gen 66) Mullin

Hort 248. Truck Crop Breeding. (3 cr; prereq 110 or Agro 132) Davis

Hort 249. Research in Horticultural Crop Breeding. (Cr ar) Andersen, Davis, Lauer

MdBc 211. Nucleic Acid and Protein Metabolism. (3 cr; prereq 100-101; minimum 8 students; offered 1966-67 and alt yrs)

MicB 110. Microbial Genetics. (3 cr; prereq 53 or ‡; offered 1966-67 and alt yrs) Bradley

MicB 111. Advanced Laboratory. (3 cr; prereq 53 or ‡) Bradley

PlPa 215. Genetics of Plant Pathogens. (3 cr; prereq 1 or 51, 156 or equiv, and Gen 66) Anderson

Poul 102x. Avian Genetics and Cytogenetics. (3 cr; prereq Gen 66 or ‡) Shoffner

Poul 216x. Research in Avian Genetics and Cytogenetics. (Cr ar; prereq 9 cr in genetics) Shoffner

VSR 131. Heredity in Animal Disease. (3 cr; prereq VMC 104, ‡) Spurrell

GEOGRAPHY

Professor
John R. Borchert
Jan O. M. Broek
Fred E. Lukermann
Eugene C. Mather
Philip W. Porter

Associate Professor
Ward J. Barrett
Joseph E. Schwartzberg
John W. Webb, *chairman*

Assistant Professor
Mei Ling Hsu

Lecturer
Russell B. Adams
Robert C. Lucas

Prerequisites—Geography majors are expected to have taken introductory courses in physical, human, and economic geography, similar to courses 1, 4, and 41, and at least seven upper division courses in systematic and regional geography and also to have minor course work in the humanities or the biological, physical, or social sciences. For *minor work,* 12 credits in geography.

Language Requirement—For the Master's degree, knowledge and use of one foreign language as demonstrated by examination and a graduate paper. For the Doctor's degree either (a) knowledge of two foreign languages (as demonstrated by examination and use in graduate papers or thesis) or (b) one foreign language and a research technique. Proficiency in the latter will be certified by completion of course work, and demonstrated use in graduate papers or thesis will be required. Adequate reading knowledge of one of the two languages must be demonstrated not later than the close of the second quarter in which the student is registered for an advanced degree.

Master's Degree—Offered under both Plan A and Plan B.

Doctor's Degree—Consult the chairman of the department for suggested program of work leading to the Ph.D. degree.

Regional Studies

101w.* Western Europe. Physical and human geography of western Europe considered as a whole, followed by a more intensive discussion of selected topics on the British Isles, France, the Low Countries, the Rhine basin. (3 cr; prereq 5 cr or ‡) Webb

102w.* Central Europe. Physical and human geography of Central Europe followed by a more intensive discussion of population patterns, resources, and industries in the individual countries. (3 cr; prereq 5 cr or ‡) Rice

103f. Norden. Cultural and political development of Scandinavia, Finland, and Iceland; analysis of effects of changing resource appraisal upon patterns of economic activity and human occupancy. (3 cr; prereq 5 cr or ‡) Rice

106s. Regions of the USSR. Regionalization, production specialization and interchange within the USSR; cultural variations among regions; effects of policies of centralization and regional autonomy; present trends, prognosis, and comparisons with the U.S. Periodical readings and research paper required. (3 cr; prereq 63 or ‡) Adams

115w.* Mediterranean Region. Physical and human geography of lands adjacent to the Mediterranean Sea: Greece, Italy, Spain, Portugal, and southern France. (3 cr, §old 105; prereq 5 cr or ‡) Webb

117w.* The Middle East. A historical-geographical description of land and people in the changing environment of the Afro-Eurasian bridgelands with an analysis of the location and pattern of its present cultural and physical resources. (3 cr) Lukermann

118f.* Africa. Regional differentiation of human groups and environments in Africa with special emphasis on culture contact and problems of underdeveloped countries south of the Sahara. (3 cr; prereq 5 cr or ‡) Porter

120w.* South Asia. Physical and human geography of India, Pakistan, Ceylon, Afghanistan, and the Himalayan kingdoms; geographic aspects of social structure, population pressure, economic development, and international relations. (3 cr; prereq 5 cr or ‡) Schwartzberg

121w.* Southeast Asia. Physical and human geography of Burma, Thailand, Indochina, Malaya, Indonesia, and the Philippines; geographic aspects of population pressure, development of resources, and international relations. (3 cr; prereq 10 cr or ‡) Broek

122s. East Asia. Physical and human geography of China, Korea, and Japan; geographic aspects of population pressure, development of resources and international relations. (3 cr; prereq 5 cr or ‡) Hsu

126w.° Australia-New Zealand-Oceania. Physical and human geography of Australia, New Zealand, Polynesia, and Melanesia; modification of aboriginal land use after European contact, current trends in non-European societies, and use and modification of the environment by Europeans. (3 cr) Barrett

131s.° Historical Geography of North America. Sequential analysis of settlement and economy in the changing environment and resource patterns of North America. (3 cr, §old 114) Lukermann

131As.° Historical Geography of North America—Field Course. Sequential analysis of settlement and economy in the changing environment and resource patterns of Minnesota and contiguous states. (2 cr, §old 114A; prereq ¶131 or ‡) Lukermann

133s.° Western United States. Regional analysis of physical and human resources of western United States. (3 cr, §old 112) Mather

134f.° Eastern United States. Regional analysis of physical and human resources east of the Great Plains. (3 cr, §old 113) Mather

137s.° Canada and Alaska. Regional analysis of physical and human geography; examination of both internal and external areal relationships. (3 cr, §old 111; prereq 10 cr or ‡) Mather

141s.° Middle America. Physical and human geography of the West Indies and the mainland from Mexico to Colombia. (3 cr, §old 109) Barrett

143w.° South America. Regional survey of physical resources, population, agriculture, manufacturing, and transportation in South America. (3 cr, §old 110) Mather

TOPICAL STUDIES

151f.° Climatology. World distribution of climatic elements; methods of arranging climatic data; climatic classifications, and world distributions of climatic types; general circulation; climatic change and climatic fluctuations. (3 cr, §old 133; prereq 1 or ‡) Barrett

152w.° Advanced Climatology. Methods and results of study of heat and moisture balances of the earth; reception and disposal of precipitation and energy in the local environment; qualities of vegetation and soil cover and terrain that influence local and regional climates. Characteristics of ground and surface waters that reflect and influence local climate. (3 cr, §old 134; prereq 151 or ‡) Barrett

153s.° Advanced Physical Geography. Laboratory work and field observations in quantitative description and analysis of terrain and climate. Especially North Central United States. (3 cr, §old 135; prereq 152 or ‡) Barrett

160w.° Development of Geographic Thought. Objectives, subdivisions, concepts, and methods of geography; different schools of geographic thought as expressed in literature of the last century. (3 cr, §old 197; prereq 15 cr) Broek

162s.° Geographical Exploration and Discovery. Extension of the geographic horizons of Western society, by discovery of basic land-sea relationships of the earth, from Portuguese explorations along the coast of Africa down to modern times. (3 cr, §old 100; prereq 5 cr or ‡) Webb

163f.° Political Geography. Scope and methods of political geography; analysis of selected concepts, problems, and areas. (3 cr, §old 143; prereq 4 or ‡) Schwartzberg

165f.° Urban Geography. Character and distribution of cities in present-day world; analysis of their development. Internal character of cities, their associations with rural areas, and their functional differentiation. (3 cr, §old 153; prereq 4 or ‡) Webb

165Af.° Field Course. Concepts and techniques of field work. Saturdays devoted to field study in eastern Minnesota and neighboring areas. (3 cr, §old 170; prereq 15 cr) Webb

167w-168s.° American Cities—Location and Geographic Design. Changing regional and local patterns of urban growth in the United States; methods and results of projec-

tion of future geographic patterns, and their relation to urban planning. (3 cr per qtr; prereq ‡ for 167, 167 and ‡ for 168) Borchert

168As.° American Cities—Field Study. Directed field study of urban land use problem in the Twin Cities and vicinity. Excursion to another selected midwestern metropolitan area. (3 cr, §old 169; prereq 168 or ¶168) Borchert

171s.° Geography of Economic Localization. Analysis of localization of economic activity, circulation of resources, and process of industrial regionalization of the economies of the world. (3 cr, §old 152; prereq 41 or ‡) Lukermann

171Af. Geography of Economic Localization—Field Course. Analysis of localization of economic activity, circulation of resources, and process of industrial regionalization in the economy of Minnesota and contiguous states. (2 cr; prereq 171 or ‡) Lukermann

175w.° Rural Geography. Geographic components and assemblages of rural settlement. World regional occupance and production patterns and the geographic problems of rural settlement and agricultural production on the American scene. (3 cr, §old 150) Mather

177w.° Geography of Outdoor Recreation. Changing perception, use and management of amenities of landscape, particularly rural landscape of North America since European settlement. (3 cr, §old 130) Lucas

GEOGRAPHICAL TECHNIQUES

181w.° Statistical Cartography. Principles of and practice in representing quantitative data on maps. Analysis of dot, line, isogram, chorogram, and central tendency techniques. Representation of terrain. (3 cr, §old 138; prereq 81, QA 5 or equiv or ‡) Porter, Hsu

182f.° Advanced Cartography. Advanced statistical mapping techniques; mapping of population and settlement. Measures of distribution. History of cartography. (3 cr, §old 140; prereq 181) Porter

184s.° Air Photo Interpretation. Extraction of quantitative and qualitative information from air photos. Analysis and interpretation of physical and cultural phenomena. Air photo scale control, stereoscopy, and sources. (3 cr, §old 139; prereq 81 or ‡) Porter

184As. Air Photo Interpretation—Field Course. Directed study in use of air photos in the field. Field identification, mapping and interpretation; development of photo logic and photo keys. Field study in rural, urban, and industrial landscapes in Twin Cities and neighboring areas. (3 cr, §old 139A; prereq 184 or ¶184) Porter

185s. Source Materials for Geographic Research. Bibliographic aids and archival sources of geographic material at international, national, and local levels. Methods of handling data and preparation of written reports. (3 cr, §old 165; prereq 15 cr or ‡)

187w. Quantitative Research Design. (Same as Soc 187) Formulation of quantitative problems in social sciences for hypothesis-testing and data processing; applications and use of tabulating equipment and computers for projects selected by students. (3 cr, §Soc 187; prereq 87, Soc 45, or ‡) Adams, others

188s. Area Sampling and Analysis. (Same as Soc 188) Design and selection techniques for areally sampled information in social science research; evaluation of census, field and map methods for error control; literature survey and individual student project. (3 cr, §Soc 188; prereq 87, Soc 45, or ‡) Adams

DIRECTED STUDIES

190f,w,s.° Directed Readings. (1-3 cr) Staff

191A, B, C. Institute of Geography. A general survey of major topical themes, selected regional case studies, field work, cartographic and statistical methods. Emphasis on historical and cultural approaches in study of geography and use of advanced materials in secondary school teaching. (3 cr per qtr; prereq secondary school teachers with BA and 10 cr or △) Staff

193. Topics in Geography. Course on special topics and regions offered by visiting professors in their research fields. (3 cr; prereq △)

196s.* Proseminar in East and South Asia. (Same as Anth 196, Hist 196, Ortl 196, Pol 196) Integrating course for students majoring in East and South Asia Area Studies program. (3 cr) Interdepartmental staff

197f. Proseminar: Development of Geographic Thought. Objectives, subdivisions, concepts, and methods of geography; different schools of geographic thought as expressed in the literature of the last century. (3 cr, §160; prereq 15 cr with B overall average, or ‡) Broek

210.* Seminar: Theoretical Geography. (3 cr; prereq ‡) Staff

214.* Seminar: Historical Field. (5 cr; prereq ‡) Lukermann

236, 237, 238.* Seminar: South Asia. (3 cr per qtr; prereq ‡) Schwartzberg

241, 242, 243.* Seminar: Cartography. (3 cr per qtr; prereq ‡) Porter

246, 247, 248.* Seminar: Cultural Geography. (3 cr per qtr; prereq ‡) Broek

251, 252, 253.* Seminar: Physical Geography. (3 cr per qtr; prereq ‡) Barrett

256, 257, 258.* Seminar: Land Use Planning. (3 cr per qtr; prereq ‡) Borchert

261, 262, 263.* Seminar: Development of Geographic Thought. (3 cr per qtr; prereq ‡) Broek

266, 267, 268.* Seminar: Soviet Union. (3 cr per qtr; prereq ‡)

271, 272, 273.* Seminar: Historical Economic Geography. (3 cr per qtr; prereq ‡) Lukermann

276, 277, 278.* Seminar: Agricultural Geography. (3 cr per qtr; prereq ‡) Mather

281, 282, 283.* Seminar: Africa. (3 cr per qtr; prereq ‡) Porter

286, 287, 288.* Seminar: Settlement and Population Geography. (3 cr per qtr; prereq ‡) Webb

291, 292, 293.* Seminar: Readings in Ancient and Medieval Geography. (3 cr per qtr; prereq ‡) Lukermann

296, 297, 298.* Seminar: Historical Geography of Middle America. (3 cr per qtr; prereq ‡) Barrett

301x.* Research Problems in Geography. (Cr ar) Staff

GEOLOGY AND GEOPHYSICS

(School of Earth Sciences)

Professor

Alvin G. Anderson
J. Morris Blair
Strathmore R. B. Cooke
Donald L. Graf, *director of graduate study (hydrogeology)*
Harold M. Mooney, *director of graduate study (geophysics)*
William D. Munro
Paul K. Sims
Frederick M. Swain, *director of graduate study (general geology)*
William C. Walton
Herbert E. Wright, Jr.
Tibor Zoltai, *chairman, director of graduate study (mineralogy and petrology)*

Associate Professor

Campbell Craddock
Istavros S. Papadopulos
William C. Phinney
George R. Rapp, Jr.
Joseph Shapiro
Robert E. Sloan

Assistant Professor

James A. Grant
Henry T. Hall
Roger LeB. Hooke
Paul W. Weiblen

Prerequisites—For candidates for advanced degrees, a Bachelor's degree in geology, geophysics, or related earth science, with mathematics through differential equations, 1 year of college chemistry, and at least 1 year of

college physics. A Bachelor's degree in other fields, such as chemistry, physics, mining and civil engineering, or biological sciences, is entirely acceptable, particularly for those who wish to pursue specialized studies in geochemistry, geophysics, crystallography, hydrogeology, and paleontology.

Conditions for a minor in geology and geophysics are established on an individual basis by consultation with a faculty member and approved by the chairman of the Graduate Program Committee, W. C. Phinney.

Language Requirement—For the Master's degree, reading knowledge of German, Russian, or French. For the Ph.D. degree, German and either Russian or French; other languages may be considered on petition. Candidates for advanced degrees must either complete or show substantial progress toward completion of at least one language requirement in their first year of residence.

Master's Degree—The Master's degree, which is not a necessary prerequisite for candidacy for the Ph.D. degree, is offered under Plan A and Plan B. Under Plan B, within the general Graduate School requirements, a minimum of 9 credit hours will be in one research course in which a written report will be prepared and reviewed by at least two members of the faculty. The M.S. may be earned in general geology, geophysics, hydrogeology, and mineralogy and petrology.

Doctor's Degree—Admission to candidacy for the Ph.D. degree is contingent upon completing the minor, passing qualifying written and oral examinations, and completion of both language requirements. The Ph.D. can be obtained in three major fields: general geology, hydrogeology, and mineralogy and petrology. Strong emphasis in geophysics is possible in any of these fields.

General Geology

100-101. Field Geology. Measurement of stratigraphic sections; fossils and igneous, sedimentary, and metamorphic rocks. Geological surveying on aerial photographs and topographic maps and by the plane table method. Preparation of geologic maps and cross sections. Structural and geomorphic features and geologic setting of mineral deposits. (Cr ar; by special or co-operative arrangement; prereq 120 or ‡) Staff

103.* Problems in Geology and Geophysics. Individual research in laboratory or field problems at upper division or graduate levels. (1-6 cr; prereq ‡) Staff

104.* Advanced General Geology. Considers central problems in modern and classical geology through seminar-type discussion, evaluation of professional publications, and special projects. (3 cr; open to science majors in any field with supplemental reading by nongeologists; prereq ‡; offered on demand) Staff

105. Introduction to Paleontology. Introduction to morphology and classification of major fossil groups. (5 cr; prereq 2 or 22 or ‡) Sloan

106.* Invertebrate Paleontology. Detailed studies of morphology, classification, and ecology of selected groups of invertebrate fossils. (5 cr; prereq 105; offered 1966-67 and alt yrs) Bright

107. Vertebrate Paleontology I. Morphology, evolution, and stratigraphic distribution of fossil fish, amphibians, reptiles, and birds. (5 cr; prereq 105 or Zool 53) Sloan

108.* Vertebrate Paleontology II. Morphology, evolution, and stratigraphic distribution of fossil mammals. (5 cr; prereq 107 or Zool 53) Sloan

110. Sedimentology and Stratigraphy. Sedimentary processes and products with particular reference to modern sedimentary environments; principles of physical stratigraphy,

correlation, facies, tectonic control, classification of stratigraphic units. (4 cr; prereq 62) Graf, Swain

111.° Stratigraphy. Analysis of stratigraphy of typical and unique sequences of (a) Pre-Cambrian and Paleozoic rocks or (b) Mesozoic and Cenozoic rocks; methods of presentation of stratigraphic data; term paper required. (3 cr; prereq 110) Swain

112.° Micropaleontology. Biology and paleontology of microorganisms of geologic importance including Foraminifera, Radiolaria, flagellate Protista, Diatomaceae, Characea, Ostracoda, and conodonts. (3 cr; prereq 105) Swain

115.° Geomorphology. Origin and evolution of landforms in temperate, arctic, desert, and tropical regions in different geologic settings. Effects of structural history and climatic change on landform development. Relations of geomorphic processes to soil formation and engineering problems. Field trips; term paper or field project. (4 cr; prereq 2 or 22, Math 10 or 15 or ‡...Geo 62 and Math 22A recommended) Hooke

117.° Pleistocene Geology. Problems in Pleistocene history of glaciated and nonglaciated areas, particularly North America, Europe, and the Mediterranean. Relation of Pleistocene climatic changes to soils, biogeography, and archaeology. Pollen analysis. (3 cr; prereq 116; offered 1967-68 and alt yrs) Wright

120. Structural Geology. Primary and secondary structures of rocks, mechanics and modes of deformation, and structural techniques. Laboratory exercises in three-dimensional representation and solution of selected structural problems. (4 cr; prereq 62 or 162 or ‡) Craddock

121.° Advanced Structural Geology. Fundamental problems and genesis of secondary structural features; detailed analysis of typical examples. Comprehensive term paper required for graduate credit. (3 cr; prereq 120) Craddock

126.° Sedimentary Petrology. Mineralogy, textures, and structures of sedimentary rocks. Role of the tectonic framework. Differential effects of weathering and transport. Modern classification schemes. (4 cr; prereq 110 or ‡) Graf

200.° Paleoecology. Major features of paleoecology developed through evaluation of current and classical publications and special projects. (3 cr; prereq ‡; offered 1967-68 and alt yrs)

201.° Research in Biological, Sedimentary, and Oceanographic Aspects of Geology. (Cr ar; prereq reading facility in at least one language other than English, and ‡; open to science majors in any field)

203. Advanced Invertebrate Paleontology. (Cr ar; prereq 106 and ‡...200 advisable)

205.° Research in Paleontology. (Cr ar; prereq ‡) Sloan

206.° Seminar: Paleontology. (Cr ar; prereq ‡) Sloan

210.° Research in Stratigraphy. (3 cr; prereq 111) Swain

211.° Seminar: Stratigraphy. (Cr ar; prereq ‡) Swain

215.° Research in Pleistocene Geology. (Cr ar; prereq 116, 117) Wright

216.° Seminar: Pleistocene Geology. (Cr ar; prereq 116, 117) Wright

217.° Research in Geomorphology. (Cr ar; prereq ‡) Hooke

218.° Seminar: Geomorphology. (Cr ar; prereq ‡) Hooke

220.° Geotectonics. Basic problems of structure and evolution of the earth's crust. (3 cr; prereq 120 or ‡; offered 1966-67 and alt yrs) Craddock

221.° Research in Structural Geology. (Cr ar; prereq 121) Craddock

222.° Seminar: Structural Geology. (3 cr; prereq 120 or ‡; offered 1966-67 and alt yrs) Craddock

Mineralogy and Petrology

140.° Mineral Systems I. Basic and compound symmetry elements. Derivation and study of point groups, co-ordinate systems, crystal forms, lattices, plane groups and space

groups. Introduction to X-ray diffraction. Introduction to crystal chemistry and crystal structures. (4 cr; prereq 62 or ‡, trigonometry, a yr of college physics and chemistry) Zoltai

141.° Mineral Systems II. Survey of mineral structures and crystal growth. Optical mineralogy; behavior of light and of isotropic and anisotropic media in polarized light. Correlation of geometric and electromagnetic theories of optical mineralogy. Laboratory includes study of structure models, thin and polished sections; immersion techniques. (4 cr; prereq 140) Grant, Phinney, Rapp

141A.° Mineral Systems IIA. Optical mineralogy portion of Geo 140. (3 cr; prereq 140) Grant, Phinney

142.° Mineral Systems III. Application of basic physical sciences to geologic problems. Discussion of rocks as chemical systems. Laboratory macroscopic and microscopic study of rocks and minerals. (4 cr, §145 or §150; prereq 141, PCh 102 or 108, Math 31) Phinney

143.° Topics in Petrology. Associations, sequences, and structures developed through igneous and metamorphic processes. Laboratory and term paper. (4 cr, §146, 147; prereq 120; offered 1966-67 and alt yrs) Grant

144. Principles of Petrology. Igneous and metamorphic mineral assemblages and textures discussed with reference to phase diagrams and physical processes. Summary of important petrologic problems. (4 cr, §145; prereq 62; offered 1967-68 and alt yrs) Phinney

145.° Phase Equilibrium in Mineral Systems. Graphical and mathematical treatment of 1-, 2-, 3-, and 4-component systems. Includes the phase rule, open *vs.* closed systems and effects of disequilibrium. (3 cr; prereq 141, PCh 108 or 103; offered 1966-67 and alt yrs) Phinney

146.° Igneous Petrology. Igneous processes in light of experimental data and theory. Classical studies of igneous rock associations. Term paper required. (3 cr; prereq 145; offered 1966-67 and alt yrs) Phinney, Grant

147.° Metamorphic Petrology. Metamorphic processes in light of experimental data and theory. Classical studies in metamorphism. Term paper required. (3 cr; prereq 146; offered 1966-67 and alt yrs) Grant, Phinney

150.° General Geochemistry. Basic principles and data of geochemistry, origin and cosmic abundances of elements, structure and composition of the earth and geochemistry of some major elements in the earth's crust and mantle. (3 cr; prereq PCh 102 or 108 or ‡) Murthy

151.° Nuclear Geology. Includes studies of radioactive decay schemes and nuclear properties of certain elements in geochronology and geochemical processes such as the origin of igneous rocks, continents, and early history of the earth and the solar system. (3 cr; prereq 142, 150 or ‡; offered 1966-67 and alt yrs) Murthy

152.° Problems in Geochemistry. Selected topics in geochemistry. (2 cr; prereq 151 or ‡; offered 1967-68 and alt yrs) Murthy

155-156.° Mineral Deposits. Nature and distribution of mineral deposits, and analysis of processes by which elements are concentrated in magmatic, hydrothermal, sedimentary, and surface environments. (3 cr per qtr; prereq 120, 142, or ‡) Hall

157. Mineral Fuel Deposits. Origin and distribution of petroleum and coal deposits: source materials, reservoir rocks and structures, stratigraphic distribution of important deposits. (3 cr; prereq 110, 120 or ‡) Swain

160.° X-ray Mineralogy. Physics of X rays. Diffraction of X rays by crystalline material. Description of X-ray powder instruments. Use of powder pattern for mineral identification and for mineralogical and crystallographical research. (3 cr; prereq 140 or ‡) Zoltai

161.° Single Crystal X-ray Diffraction. Introduction to principles and practice of single crystal X-ray diffraction. Lattice and space group determination. Introduction to crystal structure determination. (2 cr; prereq 160 or ‡) Zoltai

162. Soil Mineralogy. Introduction to crystallography, crystal chemistry, and mineralogy. Descriptive and determinative mineralogy. Classification of rocks. Textural, structural, and mineralogical variations of rocks and some ores. Term paper. (4 cr; not open to geology, mining, and metallurgy majors; prereq 1 or 11 or ‡, a term of college chemistry) Rapp

163.° Electron Microprobe Analysis. Theory of electron optics, review of X-ray fluorescence. Electron microprobe analysis with mineral and pure element standards. (2 cr; prereq PCh 103 or Phys 110 or Geo 160 or ‡) Weiblen

245.° Research in Petrology. (Cr ar; prereq ‡) Phinney

246.° Seminar: Petrology. (Cr ar; prereq 145; offered when feasible) Phinney

250.° Research in Geochemistry. (Cr ar; prereq ‡) Murthy

251.° Seminar: Geochemistry. (Cr ar; prereq ‡) Murthy

255.° Advanced Mineral Deposits I. Ore genesis. Ore-forming processes considered in relation to major crustal units in space and time; geothermometry; physical and chemical nature of ore-forming solutions; additional or alternative topics when appropriate. (3 cr; prereq 156; offered 1967-68 and alt yrs) Hall, Sims

256.° Advanced Mineral Deposits II. Metalliferous districts. Interpretation of paragenetic relationships of ore minerals, using mineralographic, petrographic, and X-ray methods. (3 cr; prereq 156 or ‡) Hall, Sims

257.° Research in Mineral Deposits. (Cr ar; prereq ‡) Hall

258.° Seminar: Mineral Deposits. (Cr ar; prereq ‡) Hall

260.° X-ray Crystallography. Introduction to geometrical and mathematical principles of crystal structure determination. Principles and techniques of various methods. (3 cr; prereq 161 or ‡; offered on demand) Zoltai

261.° Research in Mineralogy and Crystallography. (Cr ar; prereq ‡) Zoltai

262.° Seminar: Mineralogy and Crystallography. (Cr ar; prereq ‡) Zoltai

Hydrogeology

116.° Glacial Geology. Physics of modern glaciers. Glacial erosion and deposition. Stratigraphy and chronology of the Pleistocene in glaciated and nonglaciated areas. (3 cr; prereq 2 or 22) Wright

118.° Problems in Geomorphology. Detailed study of selected geomorphic processes. Fluvial processes and arid region geomorphology. (3 cr; prereq 115) Hooke

125.° Sedimentary Geochemistry. Properties of bulk and adsorbed water. Phase relations from electrode measurements. Thermodynamic and kinetic implications of defective crystal structures. Stable isotope studies. (4 cr; prereq PCh 103A or ‡) Graf

128. Limnology. Description and analysis of the events occurring in lakes, reservoirs, and ponds, beginning with their origins and progressing through study of their physics, chemistry, and biology. Interrelationships of these parameters, and effects of civilization on lakes. Laboratory, field trips. (4 cr, §Bot 138; prereq GeCh 26 or equiv and ‡) Shapiro

131. Ground-Water Geology. Origin, occurrence, and movements of ground water. Characteristics of major aquifers and aquitards. Exploratory investigations. Hydrogeologic units and boundaries. Principles and theoretical aspects of recharge. Quality of ground-water supplies. (3 cr; prereq 1 or 11, Math 23, 1 qtr of physics and chemistry, or ‡) Papadopulos

202. Marine Geology. (Cr ar; prereq ‡)

213.° Organic Geochemistry. Extraction and separation of organic residues from recent sediments and rocks; interpretation of origin and diagenesis of sedimentary organic compounds. (3 cr; prereq 110, OrCh 42 or 62, or ‡) Swain

214.° Seminar: Organic Geochemistry. (Cr ar; prereq ‡) Swain

225. Research in Sedimentology. (Cr ar; prereq ‡) Graf

226. Seminar: Sedimentology. (Cr ar; prereq ‡) Graf

228.* Advanced Limnology. Detailed study of selected problems in limnology using current and classical literature. Term paper required. (3 cr; prereq 128 or Bot 138 and ‡; offered 1967-68 and alt yrs) Shapiro

229.* Research in Limnology. (Cr ar; prereq 128 or Bot 138 and ‡) Shapiro

230.* Methods for Analysis of Natural Waters. Analysis and significance of the ecologically important constituents and parameters of surface and ground waters with appreciation of different approaches. Term paper. (3 cr; prereq 128 or equiv, AnCh 46 or 47 or equiv, and ‡; two 3-hour periods per wk) Shapiro

231. Research in Ground Water Geology. (Cr ar; prereq ‡) Papadopulos, Walton

232. Seminar: Ground Water Geology. (Cr ar; prereq ‡) Papadopulos, Walton

Geophysics

170. Introduction to Earth Physics. Physics of the solid earth; evidence and data on origin, age, size and shape, internal constitution, thermal history, gravity, and magnetic fields. (3 cr; prereq 2 or 22, Phys 9 or 14 or 23)

171. Introduction to Earthquake Seismology. Physics and geology of earthquakes; causes, effects, distribution, seismic waves. (3 cr; prereq 120 or ‡)

172. Introduction to Exploration Geophysics. Principles of exploration by gravity, magnetic, seismic, and electrical measurements. (3 cr; prereq 2 or 22, Phys 9 or 14 or 23) Mooney

175. Principles of Gravity and Magnetic Exploration. Instrumentation, surveying techniques, reduction of data, interpretation, case histories. (3 cr; prereq 1 or 11, Phys 9 or 14 or 23, Math 23)

176. Principles of Seismic Exploration. Reflection and refraction seismology; theory, interpretation, instruments. (3 cr; prereq 2 or 22, Phys 9 or 14 or 23, Math 23) Mooney

177. Principles of Electrical Exploration. Resistivity, electromagnetic, and other methods; theory, interpretation, instruments. (2 cr; prereq 2 or 22, Phys 9 or 14 or 23, Math 23) Mooney

270-271. Theory of Elastic Wave Propagation. Theoretical seismology, solutions of wave equations, normal mode propagation. (3 cr per qtr; prereq MM 180...Math 174 recommended but not required) Mooney

275-276-277. Seminar: Geophysics. (Cr ar; prereq ‡) Staff

GERMAN

Professor
Frank D. Hirschbach
Edwin F. Menze,
chairman, director of graduate study
Herman Ramras
Wolfgang F. Taraba
Gerhard H. Weiss
Cecil Wood
Frank H. Wood

Associate Professor
Evelyn S. Coleman

Assistant Professor
Ida M. Kimber

Prerequisites—For major work, 27 Upper Division quarter credits or equivalent of which 15 credits must be in literature courses. For minor work, 18 Upper Division quarter credits or equivalent.

Language Requirement—A candidate for the Master's degree must have a reading knowledge of at least one foreign language other than German, preferably French.

A candidate for the Doctor's degree in German must have a knowledge of Latin equivalent to at least 2 years of high school Latin; a reading knowledge of French and one other modern foreign language.

Master's Degree—Offered under both Plan A and Plan B.

Doctor's Degree—Normally candidates are expected to offer 18 credits in linguistics and philology.

A minor in linguistics and philology will require at least 27 credits. Majors in German literature may, however, offer a combined minor by offering 18 credits in linguistics and philology and 12 or more in one of the following: classics, English literature, fine arts, foreign literature, comparative literature, history, philosophy. In any case, it is strongly recommended that candidates in German literature supplement their major by courses chosen from one or more of these fields.

Comparative Literature—For information on this program see page 127.

Composition and Bibliography

103, 104, 105. German Style and Composition. Required of all graduate majors. (1 cr per qtr; prereq 66 or equiv; offered 1966-67)

133f. Bibliography and Research Methods. Required of all graduate majors. (3 cr; prereq 11 cr above 69)

Literature

Courses in literature, as well as linguistics and philology, for which no specific years are indicated are offered more flexibly to meet the needs of the students in the program and are listed in the quarterly *Class Schedule.*

116, 117, 118. The Middle High German Literature. (3 cr per qtr; prereq 112 or ‡) Coleman

140, 141, 142.* Drama in Translation. (3 cr per qtr; prereq 9 cr in theater arts or literature above 50; no knowledge of German language required; cannot be used for German major or minor) Menze

143, 144, 145.* The German Novelle: From Goethe to Kafka. (3 cr per qtr) Taraba

146, 147, 148.* Literature of the Nineteenth Century. Literature, literary movements and influences represented in drama, lyric and shorter prose forms. (3 cr per qtr) Taraba

149. Directed Reading. (2-3 cr)

150. Literature from 1350 to 1500. (3 cr) Coleman

151. Literature from 1500 to 1600. (3 cr) Weiss

153-154.* German Literature of the Seventeenth Century. (3 cr per qtr) Weiss

160, 161.* Klopstock, Wieland, Herder. (3 cr per qtr) Ramras

162A-B.* Lessing. (3 cr per qtr) Hirschbach

163, 164, 165.* Goethe. (3 cr per qtr) Ramras

166, 167, 168.* Schiller. (3 cr per qtr) Ramras

170, 171, 172.* Romanticism. (3 cr per qtr) Menze

173, 174, 175.* The Nineteenth-Century Novel. (3 cr per qtr) Menze

176, 177, 178.* The Nineteenth-Century Drama. (3 cr per qtr) Menze

179A-B-C.* German Drama from Naturalism to the Present. 179A: 1880-1910. 179B-C: 1910 to present. (3 cr per qtr) Hirschbach, Weiss

180, 181, 182.* The Twentieth-Century Novel. (3 cr per qtr) Ramras, F Wood, Hirschbach

183, 184, 185.* Studies in the Literature of the Twentieth Century. Literature movements represented in drama, lyric, and shorter prose forms. (3 cr per qtr) F Wood

186, 187, 188.* Lyric Poetry. 186: Renaissance through *Sturm and Drang*. 187: Goethe through Romanticism. 188: Heine to Rilke. (3 cr per qtr) F Wood

189.* Expressionism in German Literature. (3 cr) Hirschbach

190, 191, 192.* Studies in English-German Literary Relations. (3 cr per qtr)

190A, 191A, 192A.* Studies in French-German Literary Relations. (3 cr per qtr) F Wood

193-194-195.* Studies in Literary Theory and Criticism. (3 cr per qtr) Ramras

253.* Seminar: Eighteenth Century. (3 cr; prereq 1 yr grad work in German)

254.* Seminar: Ninteenth Century. (3 cr; prereq 1 yr grad work in German)

255.* Seminar: Twentieth Century. (3 cr; prereq 1 yr grad work in German)

Germanic Philology and Linguistics

107-108-109.† The Structure of Modern German. Linguistic approach to study of structure of present-day German. (3 cr per qtr) C Wood

110-111-112.† Middle High German Language. (3 cr per qtr; prereq 94 and 11 cr in courses 70 and above or equiv) C Wood

113. Gothic. (3 cr; prereq 80 and 11 cr in courses 70 and above or equiv) C Wood

114-115.† Methods of Comparative Germanic Linguistics. (3 cr per qtr; prereq 113) C Wood

119-120-121. Old High German. (3 cr per qtr; prereq 112 or ‡) Coleman

122-123. History of the German Language. (3 cr; prereq 112) Steinmetz

124. Philological Proseminar: Bibliography and Methods. (3 cr) Coleman

125. Runic Inscriptions. (3 cr; prereq ‡) C Wood

126. Old Saxon. (3 cr; prereq 121) C Wood

127. Manuscript Readings and Text Reconstruction. (3 cr; prereq ‡) Coleman

HISTORY

Professor

W. Donald Beatty
Clarke A. Chambers
Harold C. Deutsch
Robert S. Hoyt, *chairman*
Tom B. Jones
Philip D. Jordan
Rodney C. Loehr
David W. Noble
Otto P. Pflanze
Timothy L. Smith
David H. Willson

Associate Professor

Joseph L. Altholz, *assistant chairman*
Paul W. Bamford
Robert F. Berkhofer, Jr.
Hyman Berman
John R. Howe
Erle V. Leichty
Paul L. Murphy
Darrett B. Rutman
Theofanis G. Stavrou
Romeyn Taylor
John A. Thayer
William E. Wright

Assistant Professor

Kinley J. Brauer
Byron K. Marshall
John K. Munholland
Thomas S. Noonan
Allan H. Spear

Note—For information on work in international relations or for work in American studies, see index.

Prerequisites—Students admitted to the Graduate School for work in history will usually be expected to have taken prior to admittance (a) general survey courses in two or three of the following areas or periods: Ancient, European, English, American, and Asian; (b) a minimum of two full-year advanced or Upper Division courses (or their equivalent) in two of these areas or periods, including (c) at least one course in which intensive work has been done.

A student who minors in history must have completed approximately the same amount of work as that indicated in the preceding paragraph with the possible exception of the course involving intensive work.

Language Requirement—The graduate faculty in history attaches much importance to adequate preparation in those foreign languages which may be used by the student in the course of advanced work and research. Reading knowledge of one foreign language is required before admittance to the Master's examination and of two languages before admittance to the preliminary examinations for the Ph.D. The languages must be relevant to the degree and must be ones in which there is a substantial historical literature.

Adviser—A candidate for the M.A. or Ph.D. degree is free to choose his adviser from among the members of the graduate faculty of the department. A candidate unfamiliar with the department or uncertain of his interests should consult the member of the graduate faculty designated to advise candidates for the M.A. and the Ph.D.

Master of Arts Degree

PLAN A—The student's program of study shall be planned in consultation with a graduate adviser. In general it is expected that the student will prepare himself by taking courses or by personal study in one subfield and an associated subarea or two subareas comparable to those required for the Ph.D. (A list of subareas may be obtained from the History Department office.) He will also present a thesis. A minimum of 24 credits in the major and 9 credits in the minor are required. There shall be a final written examination covering the two subareas or subfield and subarea selected plus an oral examination covering the thesis, the major, and the minor.

PLAN B—The student's program of study shall be planned in consultation with his adviser. The student is expected to register for courses that will eventuate in a balanced training both in the general field of history and in supporting fields. One of the courses in history carrying at least 9 credits shall be a seminar or proseminar.

Doctor's Degree in History

The student working toward the Ph.D. degree in the field of history (with the exception of the student in ancient history as noted below) must be prepared to be examined in one of the following subfields:

1. Ancient history
2. Medieval and Renaissance history to 1500

3. Modern European history, 1450 to the present
4. English history since 1485
5. American history and its colonial backgrounds
6. History of Latin America
7. History of South and East Asia

The student must also be prepared for examinations in five subareas. (A list of subareas may be obtained from the History Department office.) Ordinarily three of these subareas will fall within the subfield of the student's concentration (in which he will also write his dissertation) and two subareas in two other subfields. The student's program of study and the selection and definition of his subfield and subareas must be arranged in consultation with his adviser.

A student specializing in ancient history shall present the three subareas of the Old Orient, Greece, and Rome, as well as the subfield of medieval history with one subarea.

Preliminary Examination—The preliminary examination shall cover the subfield, the subareas in history, and the minor. There is no written examination for the supporting field if a supporting field is presented instead of a minor. The written examinations may be taken the first week in November, the first week in February, and the first week in May. At the discretion of the adviser, who will consult with the appropriate members of the faculty, a student may be excused from the written examination in one subarea within the subfield of concentration. The oral examination must follow immediately after the written examination. In both the written and oral examinations the student will be required to demonstrate a general knowledge of the subfield and a detailed knowledge of the subareas for which he is responsible.

Final Examination—The final oral examination shall cover the dissertation and its relationship to the subfield of history in which it falls.

Minor in History—The candidate for the M.A. degree with a minor in history (Plan A) must take a minimum of 9 credits and be examined in one subarea of history. Preferably the 9 credits should be in a sequence numbered 160 or above.

The candidate for the Ph.D. degree with a minor in history must be prepared for written and oral examinations in either (a) one subfield of history and an associated subarea, or (b) two subareas. The number of course credits required for a minor in history is flexible (18-24) and will depend upon the needs and the previous training of the candidate.

All programs for a minor in history must be approved by a member of the graduate faculty of the department.

SPECIAL COURSES

100Bf-101Bw-102Bs. Directed Study. Qualified senior and graduate students may register for 1 or more quarters with consent of instructor for work and training on a tutorial basis. (3 cr per qtr; prereq ‡) Staff

LECTURE COURSES

103Af, 104Aw, 105As. The Ancient Near East. (3 cr per qtr) Leichty

103Bf, 104Bw, 105Bs. Greece to 200 B.C. (3 cr per qtr; offered 1967-68 and alt yrs) Jones

103Cf, 104Cw, 105Cs. History of Rome. (3 cr per qtr; offered 1966-67 and alt yrs) Jones

106Af, 107Aw, 108As. Europe in the Early Middle Ages. 106A: Reforms of Diocletian to first sack of Rome (410). 107A: Age of the Fathers to Carolingian Empire. 108A: Germanic Empire to end of Investiture Controversy. (3 cr per qtr)

106Bf, 107Bw, 108Bs. Europe in the High Middle Ages. 106B: Twelfth-century revival. 107B: Medieval civilization. 108B: Rise of Western monarchies, decline of papacy and empire. (3 cr per qtr) Hoyt

106Cf, 107Cw, 108Cs. Europe in the Late Middle Ages, Renaissance and Reformation. 106C: Later Middle Ages and early Italian Renaissance (1300-1450). 107C: High Renaissance (1450-1515). 108C: Reformation (1515-1560). (3 cr per qtr)

109Af, 110Aw, 111As. Byzantine History. 109A: Later Roman Empire from accession of Diocletian to death of Justinian in A.D. 565. 110A: Rise of Byzantium to its zenith at the accession of Basil II in 976. 111A: From reign of Basil II to fall of Constantinople in 1453. (3 cr per qtr; offered when feasible)

112Af, 113Aw, 114As. English Constitutional History to 1485. 112A: Anglo-Saxon and Anglo-Norman England. 113A: From Henry II to Edward I. 114A: England in the later Middle Ages. (3 cr per qtr) Hoyt

115Aw, 116As. Early Modern Europe. 115A: The 17th century. 116A: The 18th century. (3 cr per qtr)

115Bf, 116Bw, 117Bs. The French Revolution and Napoleon. 115B: Background and emergence of the Revolution. 116B: The Revolution and revolutionary wars. 117B: Napoleon. (3 cr per qtr) Bamford

115Cw, 116Cs. Europe in the Nineteenth Century. 115C: Reaction and Revolution (1815-1852). 116C: National unification, industrialization, and imperialism (1852-1900). (3 cr per qtr) Pflanze

115Df, 116Dw, 117Ds. Europe in the Twentieth Century. 115D: 1890-1918. 116D: 1918-1938. 117D: 1938 to the 1950's. (3 cr per qtr) Munholland

115Ef, 116Ew, 117Es. World War II. 115E: Origins and background. 116E: War period, 1939-1942. 117E: Period 1943-1945. (3 cr per qtr) Deutsch

118Af, 119Aw. Modern France. 118A: Political, social, and economic history of France from Vienna settlement to establishment of Third Republic. 119A: Struggle of Third and Fourth Republics to meet challenge of 20th century. (3 cr per qtr; prereq 9 cr, or 15 cr in social science, or major in French; offered when feasible)

118Bf, 119Bw, 120Bs. Modern History of Spain. Spain and Portugal in the modern period: politics, diplomacy, social, economic, and cultural problems. 118B: 1400-1700. 119B: 1700-1898. 120B: The 20th century. (3 cr per qtr; offered when feasible)

118Cf, 119Cw, 120Cs. History of Germany. 118C: From 911 to 1648. 119C: 1648-1871. 120C: Since 1871. (3 cr per qtr) Pflanze

118Df, 119Dw, 120Ds. Central Europe. Poland, Hungary, Czechoslovakia. 118D: Bohemia, Poland, and Hungary to the 18th century. 119D: 18th century to 1867. 120D: 1867 to the present. (3 cr per qtr; prereq 3) Wright

118Ef, 119Ew, 120Es. History of Early Russia. 118E: Origins of Russia, Kievan period. 119E: Mongol conquest of Russia, rise of Muscovite state to the mid-sixteenth century. 120E: Ivan IV, Time of Troubles, early Romanov period to Peter the Great. (3 cr per qtr) Noonan

118Ff, 119Fw, 120Fs. Modern Russia. 118F: The eighteenth-century background. 119F: The nineteenth century. 120F: The fall of the Russian monarchy; the revolutions and the Soviet regime. (3 cr per qtr) Stavrou

118Gf, 119Gw. The Modern Near East: The Ottoman Empire and the Successor States. 118G: The 19th century from the Treaty of Jassy (1792) to the Congress of Berlin. 119G: From the Congress of Berlin to the present. (3 cr per qtr) Stavrou

118Jf, 119Jw, 120Js. History of the Scandinavian Countries. (3 cr per qtr)

118Kf, 119Kw, 120Ks. History of Italy from the Era of the French Revolution to the Present. Survey of diplomatic, political, social, and intellectual history of Italy from the late 18th century to present. 118K: 1789-1860. 119K: 1860-1901. 120K: 1901 to present. (3 cr per qtr) Thayer

118Lf, 119Lw. History of Austria. 118L: From foundation of the March to the advent of nationalism (1809). 119L: From 1809 through dissolution of the Monarchy to the Second Republic. (3 cr per qtr; offered 1966-67 and alt yrs) Wright

121Bf, 122Bw. Expansion of Europe. 121B: Era of discovery, commercial empires of Asia, settlement colonies of the Western Hemisphere, 1400-1763. 122B: Later colonization, imperialism, modernization, and nationalism beyond Europe, 1763—World War II. (3 cr per qtr)

121Cf, 122Cw, 123Cs. Intellectual and Cultural History of Modern Europe. 121C: The 18th century and its background. 122C: The early 19th century, romanticism and liberalism. 123C: The late 19th and early 20th centuries, the breakdown of the intellectual unity of Europe. (3 cr per qtr; offered 1966-67 and alt yrs) Altholz

122Af, 123Aw. Economic History of Europe. 122A: Medieval and early modern economic life. 123A: Modern European economic history. (3 cr per qtr) Bamford

124Af, 125Aw, 126As. Modern England: Tudor and Stuart Periods. 124A: 1485-1588, from Henry VII to defeat of Spanish Armada. 125A: 1588-1642, from Spanish Armada to English civil wars. 126A: 1642-1714, from civil wars to death of Queen Anne. (3 cr per qtr; offered 1966-67 and alt yrs) Willson

124Cf, 125Cw, 126Cs. Modern England: 1783 to the Present. 124C: 1783-1846, triumph of the middle class. 125C: 1846-1901, Victorian era. 126C: 1901-1951, war and social change. (3 cr per qtr; offered 1967-68 and alt yrs) Altholz

127Af, 128Aw, 129As. Modern England: Social History. 127A: Age of Queen Elizabeth I. 128A: The 18th century. 129A: Age of Queen Victoria. (3 cr per qtr; offered 1967-68 and alt yrs) Willson

130Af, 131Aw, 132As. History of the British Empire and Commonwealth. 130A: First empire to 1783. 131A: Second empire, 1783-1914. 132A: Development of the Commonwealth. (3 cr per qtr; offered when feasible)

133Cf, 134Cw, 135Cs. The Early National Period in United States History. 133C: 1783-1815. 134C: 1815-1835. 135C: 1835-1850. (3 cr per qtr) Jordan

133Ef, 134Ew, 135Es. American History, 1850-1900. 133E: Compromise of 1850 to Appomattox. 134E: 1865-1880. 135E: 1880-1900. (3 cr per qtr) Loehr

136Af, 137Aw, 138As. History of the South. 136A: 1607-1840. 137A: 1840-1890. 138A: Since 1890. (3 cr per qtr) Noble

139Af. Current Interpretation and the Problem of Synthesis in American History. Designed to acquaint students with current scholarship in the field and its implications for general interpretation of American history. (3 cr; prereq ‡; offered when feasible) Berkhofer

139Bs. Puritanism in American History. Puritanism as a reality and as a concept for historical interpretation. (3 cr; prereq ‡; offered 1967-68 and alt yrs) Rutman

139Cf, 140Cw, 141Cs. Intellectual History of the United States. (3 cr per qtr) Noble

139Ef, 140Ew, 141Es. Social History of American Education. (See HEd 149-150-151) Impact of education on social and institutional developments, colonial period to present. "Education" is defined to include not only work of schools but family, community, and popular press. (3 cr per qtr; prereq 23, 24 or ‡) T Smith

139Ff, 140Fw, 141Fs. American Constitutional History. 139F: English and Colonial background through the Age of Jefferson. 140F: Slavery controversy, sectionalism, Civil

War and Reconstruction. 141F: Constitutional developments in an industrial age. (3 cr per qtr) Murphy

139Gf, 140Gw, 141Gs. History of Civil Liberties and Civil Rights in the United States. 139G: From Magna Carta through colonial and national experience. 140G: Civil liberties and the challenge of industrialism, 1865-1918. 141G: Civil liberties and civil rights issues in modern context. (3 cr per qtr) Murphy

139Jf, 140Jw, 141Js. Race and Nationality in American History. Historical role of ethnic minorities in American society. Changing attitudes of Anglo-Americans toward Negroes, Orientals, and European immigrants and the varying responses of these groups to their minority status. 139J: 1619-1865. 140J: 1865-1920. 141J: 1920 to present. (3 cr per qtr) Spear

141Ks. Great Figures in American Jurisprudence. Analysis of role of leading jurists and legal thinkers in shaping of American public law. (3 cr; offered 1967-68 and alt yrs) Murphy

142Af, 143Aw, 144As. American Economic History. 142A: Colonial life. 143A: From American Revolution to 1860. 144A: Developments since 1860. (3 cr per qtr) Loehr

142Bs. American Agricultural History. Colonial times to present. (3 cr) Loehr

142Cf, 143Cw, 144Cs. History of American Labor. Role in development of United States from colonial period to present. 142C: 1607-1873. 143C: 1873-1917. 144C: 1917 to present. (3 cr per qtr) Berman

145Af, 146Aw, 147As. Survey of Latin-American History. 145A: Colonial period. 146A: Latin-American republics. 147A: Recent Latin-American history. (3 cr per qtr)

148Af, 149Aw. History of India. 148A: Ancient India and early Muslim India, to 1526. 149A: Mughal and British Empires, modern India and the era of nationalism, 1526-1947. (3 cr per qtr)

148Bs. History of Southeast Asia. Survey of development of the societies and states in the Asian region bordered by the culture and political spheres of China and India from the period of early influence of these two civilizations through the period of European colonialism. (3 cr)

148Df, 149Dw. Chinese History to 1279 A.D. 148D: To 221 B.C. 149D: To 1279. (3 cr per qtr; offered 1967-68 and alt yrs) Taylor

148Ef, 149Ew. Chinese History, 1279 to 1949. 148E: To 1800. 149E: Since 1800. (3 cr per qtr; offered 1966-67 and alt yrs) Taylor

148Fw, 149Fs. History of Japan. (Same as Jpn 148F, 149F) 148F: To 1700. 149F: Since 1700. (3 cr per qtr) Marshall

151Af, 152Aw. Cultural History of China. 151A: Prehistoric times to A.D. 600. 152A: A.D. 600 to the present. (3 cr per qtr; prereq ¶Art 111 recommended; offered when feasible)

PROSEMINARS IN ANCIENT AND EUROPEAN HISTORY

160Af-161Aw-162As.† Ancient History. (3 cr per qtr) Jones

160Bf-161Bw-162Bs.† Ancient History. (3 cr per qtr) Leichty

163Af-164Aw-165As.† Medieval History. (3 cr per qtr) Hoyt

163Cf-164Cw-165Cs.† Renaissance History. (3 cr per qtr)

166Af-167Aw-168As.† Medieval English History. (3 cr per qtr) Hoyt

169Cf-170Cw-171Cs.† Europe in the Eighteenth Century. (3 cr per qtr) Wright

169Ef-170Ew-171Es.† Recent European History. (3 cr per qtr; prereq lect course in 20th-century Europe or World War II, or ‡) Deutsch

170Aw-171As. Expansion of Europe. (3 cr per qtr)

172Af-173Aw-174As.† Seventeenth-Century France. (3 cr per qtr; prereq reading knowledge of French)

172Cf-173Cw-174Cs.† French Revolution and Napoleon. (3 cr per qtr) Bamford

172Df-173Dw-174Ds.† Nineteenth-Century Germany. (3 cr per qtr; prereq reading knowledge of German, ‡) Pflanze

172E-173E. Modern European Intellectual History. (3 cr per qtr) Thayer

172Ff-173Fw-174Fs.† Russian History. (3 cr per qtr; prereq 120E and reading knowledge of Russian, German, or French, or ‡) Stavrou

172Gf-173Gw-174Gs. Scandinavian History. (3 cr per qtr)

175Af-176Aw-177As.† European Economic History Since 1500. (3 cr per qtr) Bamford

175Bf-176Bw-177Bs.† History of European Commerce. (3 cr per qtr) Bamford

175Cs. The Atlantic Community: Early Modern Origins. (3 cr; offered 1966-67 and alt yrs) Rutman

175Ff-176Fw-177Fs.† Religious History of Modern Europe. (3 cr per qtr; offered 1967-68 and alt yrs) Altholz

178Af-179Aw-180As.† English History: Tudor and Stuart Periods. (3 cr per qtr) Willson

178Cf-179Cw-180Cs.† Modern England: 1783 to the Present. (3 cr per qtr; offered 1966-67 and alt yrs) Altholz

PROSEMINARS IN THE HISTORY OF THE AMERICAS

181Af-182Aw-183As.† Seventeenth- and Eighteenth-Century American History. (3 cr per qtr) Rutman

181Bf-182Bw-183Bs. The Era of the American Revolution. (3 cr per qtr) Howe

181Df-182Dw-183Ds.† Nineteenth-Century American History. (3 cr per qtr) Jordan

181Ff-182Fw-183Fs.† American History, 1850-1900. (3 cr per qtr; offered 1967-68 and and alt yrs) Loehr

181Jf-182Jw-183Js.† Twentieth-Century American History. (3 cr per qtr) Chambers

184Af-185Aw-186As.† The West in American History. (3 cr per qtr; offered 1967-68 and alt yrs) Berkhofer

184Ew-185Es. The Negro in American History. (3 cr per qtr) Spear

187Af-188Aw-189As.† American Political and Constitutional History. (3 cr per qtr; prereq 139F-140F-141F or ‡) Murphy

187Bf-188Bw-189Bs.† History of American Foreign Policy. (3 cr per qtr; offered 1967-68 and alt yrs) Brauer

187Df-188Dw-189Ds.† Intellectual History of United States in Nineteenth, Twentieth Centuries. (3 cr per qtr) Noble

187Ef-188Ew-189Es. American Religious History. (3 cr per qtr) Smith

187Ff-188Fw-189Fs.† American Labor History. (3 cr per qtr) Berman

187Gf-188Gw-189Gs.† American Economic History. (3 cr per qtr; offered 1966-67 and alt yrs) Loehr

188Jw-189Js.† American Business History. (3 cr per qtr) Green

190Af-191Aw-192As.† History of Latin America. (3 cr per qtr; prereq reading knowledge of Spanish)

PROSEMINARS IN ASIAN HISTORY

193Af-194Aw.† History of Japan. (Same as Jpn 193A-194A) (3 cr per qtr; prereq ‡) Marshall

193Bf-194Bw-195Bs.† History of India. (3 cr per qtr)

193Cf-194Cw.† Chinese History to 1279 A.D. (3 cr per qtr; offered 1967-68 and alt yrs) Taylor

193Df-194Dw.† Chinese History, 1279 to 1949. (3 cr per qtr; offered 1966-67 and alt yrs) Taylor

196s. East and South Asia. (Same as Anth 196, Geog 196, Ortl 196, and Pol 196) Integrating course for students majoring in East and South Asia Area Studies Program. (3 cr) Interdepartmental staff

199As. Southeast Asian History. (3 cr; offered 1966 and alt yrs) Stein

SEMINARS

200f. Historical Bibliography and Criticism. (3 cr; required of MA Plan B candidates unless excused by adviser) Staff

203f, 204w. Readings in the Works of Great Historians. (2 cr per qtr) Staff

205. Readings in the Works of Great American Historians. (3 cr; offered when feasible) Rutman

210Af-211Aw-212As.† Ancient History. (3 cr per qtr) Jones

213Af-214Aw-215As.† Medieval History. (3 cr per qtr) Hoyt

213Cf-214Cw-215Cs.† Renaissance History. (3 cr per qtr)

216Af-217Aw-218As.† Medieval English History. (3 cr per qtr) Hoyt

219Ef-220Ew-221Es.† Recent European History. (3 cr per qtr) Deutsch

222Af-223Aw-224As.† Seventeenth-Century France. (3 cr per qtr)

222Cf-223Cs.† French Revolution and Napoleon. (3 cr per qtr) Bamford

222Df-223Dw-224Ds.† Nineteenth-Century Germany. (3 cr per qtr) Pflanze

222Ef-223Ew-224Es.† History of the Habsburg Monarchy. (3 cr per qtr; offered 1967-68 and alt yrs) Wright

222Ff-223Fw-224Fs.† Russian History. (3 cr per qtr) Stavrou

225Af-226Aw-227As.† European Economic History. (3 cr per qtr) Bamford

228Af-229Aw-230As.† English History, Tudor-Stuart Period. (3 cr per qtr) Willson

231Af-232Aw-233As.† Seventeenth-Century American History. (3 cr per qtr) Rutman

231Df-232Dw-233Ds.† Nineteenth-Century American History. (3 cr per qtr) Jordan

231Ff-232Fw-233Fs.† American History, 1850-1900. (3 cr per qtr) Loehr

231Jf-232Jw-233Js.† Twentieth-Century American History. (3 cr per qtr) Chambers

234Af-235Aw-236As.† The West in American History. (3 cr per qtr) Berkhofer

237Af-238Aw-239As.† American Political and Constitutional History. (3 cr per qtr) Murphy

237Bf-238Bw-239Bs.† History of American Foreign Policy. (3 cr per qtr) Brauer

237Df-238Dw-239Ds.† Intellectual History of the United States in the Ninteenth and Twentieth Centuries. (3 cr per qtr) Noble

237Ef-238Ew-239Es.† American Social and Educational History. (See HEd 296-297-298) (3 cr per qtr) T Smith

237Ff-238Fw-239Fs.† American Economic History. (3 cr per qtr) Loehr

237Gf-238Gw-239Gs.† American Labor History. (3 cr per qtr) Berman

240Af-241Aw-242As.† Latin-American History. (3 cr per qtr)

243Bf-244Bw-245Bs.† History of India. (3 cr per qtr)

243Cf-244Cw-245Cs.† History of Japan. (3 cr per qtr; prereq 2 qtrs of proseminar in Japanese history or ‡, reading knowledge of Japanese) Marshall

248Af-249Aw-250As. Ming and Ch'ing History. (3 cr per qtr; prereq 2 qtrs of proseminar in Chinese history and reading knowledge of Chinese) Taylor

HOME ECONOMICS

Professor
Marjorie M. Brown
Marguerite C. Burk
Suzanne Davison
Florence A. Ehrenkranz
Gertrude Esteros
Roxana R. Ford
Lura M. Morse
Isabel T. Noble
Robert J. Sirny
Louise A. Stedman, *director and director of graduate study*

Associate Professor
Margaret D. Doyle
Robert Forsyth
Irving Tallman

Assistant Professor
Donald R. Bender
Margaret P. Grindereng
Fudeko T. Maruyama

Graduate programs are planned individually with students. The major work may be in one particular field of concentration within home economics or of a more generalized nature. Minor work may be taken in any of a number of other disciplines within the University.

Prerequisites—Students desiring to major in home economics must present undergraduate credits in social sciences, physical sciences, biological sciences, art, and education as shall be satisfactory to the adviser under whose direction the major work is to be done. In addition the student must have adequate undergraduate training in that subfield of home economics in which she wishes to specialize.

Major and Minor—Students majoring in home economics for a Master's or a Doctor's degree and those minoring in this field for the Doctor's degree must include one of the following: 209, 229, 249, 279, 289, 290.

Language Requirement—Candidates for the Master's degree under Plan B are exempted from the foreign language requirement. Under Plan A, one language is recommended but not required (French or German is acceptable). Another language might be offered by petition. Candidates for the Ph.D. degree may submit (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge.

Master's Degree—Offered under both Plan A and Plan B. The M.A. as well as the M.S. may be earned in home economics.

Doctor's Degree—Work for the Ph.D. degree is offered.

100. Homes of the World. Home design in selected regions of the world. (3 cr; prereq 24 or 29 or equiv)

102. Advanced Textiles. Structural and physical properties of fibers; measurement and significance of physical characteristics of yarns and fabrics; economic problems involved in manufacture and use. (3 cr; prereq 50, BioC 1A or OrCh 42, AgEc 2 or Econ 2, or ‡) Davison

107. Textile Analysis. Application of quantitative methods in analysis of textile materials, fiber composition, and finishes. (3 cr; prereq 50, BioC 1A or OrCh 42, InCh 11, AnCh 57) Davison

115. Sociological and Economic Aspects of Clothing. Effects of clothing on the individual, society, and economy; psychological, sociological and economic aspects of fashion. (3 cr; prereq 50, AgEc 2 or Econ 2, Soc 1 or 1A, Psy 2, or ‡) Grindereng

116. Family Clothing Problems. Clothing problems and issues resulting from family characteristics, value orientation, and social mores. Interpersonal influences in clothing behavior. (3 cr; prereq 50, AgEc 2 or Econ 2, Soc 1A or 1, Psy 2, or ‡) Grindereng

118A. History of Decorative Arts I. Textiles of the world from early civilizations to 20th century. Characteristics of design, material, and technique. (3 cr; prereq 120 or equiv)

118B. History of Decorative Arts II. Glass, ceramics, metalwork, wood, and other materials from selected historical periods. Application to interior design. Lectures and field trips. (3 cr; prereq 120 or equiv)

119su. Cultural Resources of the Twin Cities. Study of the broad range of arts represented. Lectures by instructor and practicing professional artists, field trips, selected readings. Areas from which selection will be made for class discussion and individual study: architecture (including interior design—homes and public buildings), gardens, painting, sculpture, ceramics, music, theater, costume, and food. (2-3 cr)

120x.° Art History. Egyptian period to the present. Painting, sculpture, and architecture of the past studied for influences on contemporary period. Field trips. (3 cr)

120A. Senior Seminar in Related Art. Problems in the field, possible goals, and professionalism. Assigned readings and reports. (1 cr)

121. Textile Design. Printing and dyeing techniques such as silk screen, batik, block printing, tie dye. (3 cr; prereq 21, 23 or ‡...19 recommended) Esteros, Abell

122A. Interior Design Presentation. Methods of rapid rendering for interiors in various mediums. Presentation techniques for traditional and modern interior details. (3 cr; prereq 19 or equiv, 24B) Forsyth

122B. Interior Design Problems. Interiors designed and rendered in a variety of media; color schemes planned with fabrics. Intensive study of color and fabrics. Studies and reports on trends in interior design, contemporary designers and their contributions to the home furnishings field, other topics of practical and historic interest. Field trips to shops, buildings, and homes. (3 cr; prereq 122A, 121) Ludwig

123A. History of Home Interiors and Furnishings I. From ancient times through 18th century, including Oriental influences. Major emphasis on European-American furnishings of 18th century. (3 cr; prereq 120 or equiv)

123B. History of Home Interiors and Furnishings II. European-American furnishings and interiors of domestic architecture of 19th and 20th centuries. Role of reproductions and adaptations. (3 cr; prereq 120 or equiv)

124. Home Planning and Furnishings Experiences II. Studio experience in co-ordination of color, texture, scale, and pattern in designing home interiors and their furnishings. Field trips. (3 cr; prereq 24B)

125. Advanced Costume Design. Problems in draping and sketching clothing designs. Pencil, crayon, and water color techniques, studies and reports on selected topics. (3 cr; prereq 3, 22, or ‡)

126. Craft Problems II. Advanced craft design in one selected medium. Readings. (3 cr; prereq 25 or 26 or ‡)

126A. Problems in Related Art. Independent study under tutorial guidance. (3 cr; prereq △)

127. Purchasing Home Furnishings. Detailed study in terms of use, cost, and appearance. Includes furniture, dinnerware, floor and wall coverings, fabrics, and accessories. Actual materials, slides, and references used. Field trips. (3 cr; prereq 24A or equiv, 50) Ludwig, Myren

128. History of Costume. Primitive to contemporary styles. Reports. (3 cr; prereq 120 or equiv) Esteros

129. Design II. (Three dimensional) Three dimensional spatial concepts. Relationship of materials to structures, display, and decorative presentations. (3 cr; prereq 21, 23 or ‡)

131. Laboratory Problems in Household Equipment. Procedures and instruments used to determine operating characteristics of household appliances. (3 cr; prereq 49 or

equiv course in equipment and a total of 8 cr hrs in foods, textiles, and clothing or ‡) Ehrenkranz

133. Topics in Household Equipment. Assigned readings, reports, and discussions. (1-2 cr; prereq 49, total of 15 cr in physics, foods, textiles, and clothing, ‡) Ehrenkranz

134. Consumer Selection Guides for Household Equipment. Important construction and operating components of current models of selected appliances. Suitability of appliances for kitchen and laundry plans that meet research-based recommendations. (3 cr; prereq 49 or equiv, 86 or equiv, 3 cr in related art, and 1 yr exper in tchg, extension, or business or ‡)

137. Modern Food Preparation Principles and Practices. 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. (3 cr; prereq 15 cr in food and nutrition, organic chemistry)

138. Food Purchasing. Cost factors, quality standards, informative labels, food laws, economy of new trends in food processing. (3 cr; prereq 15 cr in food and nutrition, principles of economics)

139su. Advances in the Management and Preparation of Food. Recent developments; their implications in management of time, money, and energy expenditures. (3 cr; prereq 40 or equiv)

140. New Developments in Food Preparation. (3 cr; prereq 40...73 recommended) Noble

141. Current Literature in Foods. Lecture and discussion. (3 cr; prereq 40 or equiv) Lund

142x. Experimental Cookery. Intensive study of food problems and food preparation; individual laboratory problems. (3 cr; prereq 73, BioC 1A) Noble

144x. Topics in Experimental Foods. Assigned readings, reports, and discussions. (2-3 cr per qtr, max 6 cr; prereq OrCh 42 or equiv, 15 cr in food and nutrition) Noble

146. Special Food Problems. (3 cr; prereq 142)

150su. Textile Problems. Recent developments and findings. Needs of home economics teachers in secondary schools, colleges, and adult classes. (3 cr; prereq 4 cr in textiles or equiv) Davison

152. Problems in Consumer Textiles. Contemporary textiles, their physical characteristics in relation to end use performance; agencies aiding consumer through development of standards; problems students have met in the textile field. (3 cr; prereq 50 or equiv; offered when demand warrants) Davison

153. Recent Developments in Clothing Construction. (Workshop) Discussion, demonstration, and laboratory work emphasizing management of time and materials and newer construction techniques. (3 cr; prereq 53 or ‡)

154. Pattern Design and Alteration. Principles of flat pattern designing, pattern alteration, modification of commercial patterns, and principles of fitting. Course develops versatility in use of commercial patterns and gives experience in designing original garments. Development of individual master pattern. (3 cr; prereq 4 or equiv, 22 or equiv, or ‡)

155. Experimental Studies in Clothing Construction. Comparison of selected procedures in clothing construction; evaluation of suitability for use in teaching at secondary, college, and adult levels. Individual experimental problems and class reports. (3 cr; prereq 53, tchg exper, ‡)

160. School Lunch Management. Problems of the home economist who is responsible for quantity food service; menu planning, food production, purchasing of food and equipment, personnel management, and organization of special banquets. (3 cr; prereq 31 or equiv, 41 or food preparation and meal management, principles of economics) Hitchcock

164. Design and Layout of Food Services. Problems related to remodeled and new food services. (4 cr; prereq 41, 49, 63, or equiv, general physics course, ‡) Hitchcock

166. Development in Quantity Food Production. Recent trends in quantity food products and production from management viewpoints; quality, yield, and related costs. (3 cr; prereq 67, 63, ‡) Hitchcock

167. Food Service Organization and Management. Management techniques applied to food services. Methods of analysis and control. (3 cr; prereq 63, 3 cr elementary statistics, 6 cr economics) Hitchcock

169. Special Problems in Food Service Administration. Readings, discussion, field work. (3 cr; prereq 67 and ‡) Hitchcock

170x. Nutritional Principles. Application in promotion of optimal health. (3 cr; prereq 31, 40, BioC 1A, Phsl 51) Morse

171x. Maternal and Child Nutrition. Principles; formation of desirable food habits; observation of children at mealtime. (3 cr; prereq 170, HEEd 90) Doyle

172. Current Developments in Nutrition. Fundamental facts and techniques for solving current nutrition problems. (3 cr; prereq 31, 40, BioC 1A, Phsl 51 or ‡) Sirny

173. Diet Therapy. (4 cr; prereq 170...35 recommended) Verstraete

174. Nutrition Topics. (1 cr; prereq 170) Doyle, Morse, Swan

176. Advanced Nutrition. Quantitative methods applicable to investigation relating to digestion and metabolism. (4 cr; prereq 35 or ¶35, GeCh 6, OrCh 57) Swan

177. Metabolic Basis for Therapeutic Nutrition. The physiological and biochemical basis for dietary treatment, and exploration of dietary principles as related to adequate nutrition. Case study presentations and clinical experience. (4 cr; prereq ¶178 or ‡; presently available only at St. Marys Hospital, Rochester) Jones

178x. Clinical Problems in Nutrition. Application of nutrition information to health and disease. Experience in a diabetic clinic. (2-4 cr [2 cr at St. Paul and/or 2 cr at Rochester]; prereq 170, 35 or ¶35) Ross, Jones

179x.° Readings in Nutrition. Survey of literature in the field; oral and written reports. (2 cr; prereq 170) Staff

180x.° Advanced Home Planning and Furnishings II. Problems. Aesthetic, economic, social, and managerial aspects. Each student plans a house and its furnishings based on family living. Field trips. (3 cr; prereq 24B, 50, ‡) Myren, Ludwig

181. Housing Problems of the Family. Problems of urban and rural homes; evaluation of economic, art, and social aspects. Discussions, field trips, and classroom analyses. (3 cr; prereq 24B)

183. The Family in World Perspective. Comparison of family organization and modes of functioning in selected major world civilizations. Adaptation of family to urbanization and industrialization; family influences on personality formation. (3 cr; prereq HEEd 90, or ‡)

184su. Home-Management Principles. Problems in use of time, energy, and money. (3 cr; prereq 40...41 recommended)

185. Theory and Research in Family Relationships. Scientific method in study of family relationships. Current theoretical questions discussed and hypotheses derived, tested, and analyzed in laboratory sessions. (3 cr; prereq 87 or equiv)

186. Family Economics. Variations in family income, saving, spending, and decision making related to socio-economic factors. Conceptual development and research on economic problems of families. (3 cr; prereq 85 or ‡)

187. Readings in Family Relationships. Independent study in selected areas with faculty conferences. (1-3 cr, max 3 cr; prereq ‡) Tallman

188. Evaluation of Food Quality. Subjective and objective methods used in measuring quality of food products. (3 cr; prereq BioC 1A, GeCh 6, AnCh 57, HE 142, Biom 90 or 100) Noble

189A, B, C. Construction and Use Characteristics of Household Appliances. Thermal and electrical characteristics of home cooking, refrigeration and laundry equipment and other home appliances. Convenience characteristics. A: Ranges, refrigerators, and

freezers. B: Washers, dryers, water heaters, mechanical water softeners, irons, laundry area planning. C: Selected electric and nonelectric appliances such as room air conditioners, dehumidifiers, humidifiers, electric and nonelectric housewares. (3 cr per qtr; prereq 49 for 189A or B, either 189A or 189B for 189C)

197. Applications of Art Theory in Home Economics. Current theories of art with implications for home and family living. (3 cr; prereq 120 or equiv) Esteros

201. Readings in Textiles and Clothing. Independent study—survey of literature in selected areas. Written reports. (1-3 cr; prereq 102, 115, or 116, ‡) Davison

202x. Animal Fibers. Structure, composition, properties, and special problems of manufacture of wool, silk, and other protein and protein-like fibers in relation to use. (2 cr; prereq advanced textiles, ‡; offered when demand warrants) Davison

204x. Plant and Other Cellulosic Fibers. Structure, composition, properties, and special problems of manufacture of cotton, flax, rayon, and certain minor and chemically manufactured fibers in relation to use. (2 cr; prereq botany, advanced textiles, ‡; offered when demand warrants) Davison

208s. Microanalysis of Textile Fibers. Histological and microchemical methods. (Cr ar; prereq botany, zoology, advanced textiles, ‡) Davison

209x.° Seminar: Textiles and Clothing. Reviews and interpretations of the literature of this field, emphasizing recent advances. Individual oral and written reports. (1 cr; prereq ‡) Davison

220x.° Readings in Related Art. Independent study and review of books and periodicals. Written reports. (1-3 cr; prereq ‡) Esteros

221. Special Problems in Textile Design. Advanced study in textile design such as in silk screen, block printing, or batik. (1-3 cr; prereq 121 or ‡) Esteros

227x.° Special Problems in Home Planning and Furnishing. Independent study and reports. (1-3 cr; prereq 180 or ‡...122B recommended) Esteros, Ludwig

229x.° Seminar: Related Art. Review and discussion of recent literature and materials in art significant for home economics; reports on art problems in home economics. (1 cr) Related Art graduate staff, Esteros

246. Developments in Experimental Foods. Scientific basis for generally accepted principles of food preparation, contemporary interpretations of changes produced in food by household practices, food acceptance testing. (3 cr; prereq 20 cr in food and nutrition, 142, organic chemistry, microbiology, ‡) Noble

247. Special Food Problems. Review of recent research in experimental foods. (3 cr; prereq 142, BioC 1, ‡) Noble

249x.° Seminar: Foods. Review and interpretation of the literature. (1 or 2 cr; prereq ‡) Noble

270-271. Principles of Human Nutrition. Digestion, metabolism, excretion, and food requirements under various conditions. (3 cr per qtr; prereq 170, ‡) Staff

272. Human Metabolic Studies in Health and Disease. (4 cr; prereq 173 or equiv, ‡; offered at St Marys, Rochester) Sr M Victor

273. Advanced Diet Therapy. (4 cr; prereq 173 or equiv, ‡; offered at St Marys, Rochester) Sr M Victor

279x.° Seminar: Nutrition. Review and interpretation of the literature. Recent advances. Individual oral and written reports. (1 cr; prereq ‡) Staff

289. Seminar: Household Equipment. Reference sources and research reports on recent and current work in home lighting, kitchen and laundry planning, and selected electric and nonelectric appliances. Student becomes familiar with available literature in household equipment and develops judgment in interpreting it in areas not covered in 189. (2 cr; prereq 6 cr in 189) Ehrenkranz

290. Seminar: Home Management and Family Relationships. Review and interpretation of current research in the social sciences bearing on the family. (1-2 cr; prereq 185, statistics) Burk

295x-296x.* **Home Economics Problems.** Foods, nutrition, textiles and clothing, home management and family relationships, household equipment, and related art. Independent study and written reports. (1-5 cr per qtr; prereq ‡) Staff

HORTICULTURAL SCIENCE

Professor
Robert E. Nylund
Leon C. Snyder, *chairman, director of graduate study*
Conrad J. Weiser
Richard E. Widmer

Associate Professor
Emil T. Andersen
David W. Davis
Florian I. Lauer
Donald B. White

Assistant Professor
Robert Mullin

Prerequisites—For a major in horticultural science a student must have completed a sufficient amount of work in plant sciences to satisfy the adviser that graduate study in this field may be satisfactorily undertaken. In certain cases further foundation courses may be required without credit.

Major—With the approval of the adviser, courses in closely related fields may be accepted as part of the major work.

Language Requirement—For the Master's degree under Plan A, one foreign language is required (German, French, Spanish, Italian, Japanese, or one of the Scandinavian languages). The graduate committee may, in individual cases, waive the requirement by petition. Under Plan B a foreign language is not generally required. For the Doctor's degree this requirement may be fulfilled, with the approval of the adviser, by (a) two foreign languages or (b) one foreign language and either a special research technique or a collateral field of knowledge. When two languages are offered acceptable combinations are German, Scandinavian, Russian, or Japanese *with* French, Spanish, or Italian.

Master's Degree—Offered under either Plan A or Plan B.

Doctor's Degree—Work for the Ph.D. degree is offered.

104. Frozen Food Processing and Storage. Technology of food preservation by freezing. Changes occurring during handling, freezing, and storage. Application to processing, packaging, distribution, and storage. (3 cr; prereq BioC 5A, MicB 53 or ‡) Munson

105. Frozen Food Problems. Special problems based on work in 104. (2-4 cr per qtr with 9 cr total; prereq 104 or ‡) Munson

107. Orchard Management. Cultural operations in orchards and berry fields. (3 cr; prereq 6, horticultural science majors or minors, or ‡; offered 1966-67 and alt yrs) E T Andersen

111. Systematic Pomology. Fruit varieties. Classification, description, identification, and elements of judging. (3 cr; prereq 6, horticultural science majors or minors or ‡; offered 1967-68 and alt yrs) E T Andersen

112. Principles of Recreational Design. Landscape design related to recreational land use: parks, campsites, water areas, highways, golf courses, and winter recreational facilities. (2 cr) White

112A. Principles of Recreational Design Laboratory. Analysis, development, and presentation of landscape design solutions for diverse recreational land use. (3 cr; prereq 63, 112) White

113. Advanced Landscape Design. Landscape design and site planning related to complex problems. Analytic methods and procedures as well as detailed design and presentation of solutions. (5 cr; prereq 63) White

121. Small Fruit Culture. Botanical relationships, history of commercial development, and factors of environment and culture as related to small fruits. (3 cr; prereq horticulture majors or minors or ‡, 6 or 32, 9 cr in botany or equiv; offered 1967-68 and alt yrs)

135. Potatoes. Culture, handling, storage, seed maintenance, varieties, improvement, and physiology of potato plant. (2 cr; prereq 32) Lauer

136. Adaptation and Maintenance of Vegetable Varieties. Origin and development of leading varieties and their adaptation to different vegetable-producing areas. Methods of seed production and maintaining of varieties. Activities of plant breeding organizations. (3 cr; prereq 32; offered 1967-68 and alt yrs) Turnquist

137. Advanced Plant Propagation. Lecture and laboratory. Basic concepts, theory, and techniques involved in propagating plants from seeds, cuttings, grafts, buds, layers, and division. In laboratory, students design and conduct propagation experiments on plants or techniques of special interest. (3 cr, §36; prereq course in plant physiology or equiv) Weiser

138. Light and Temperature Requirements of Horticultural Plants. Lectures and assigned reading on relation of light and temperature to growth and culture of horticultural plants. (3 cr; prereq 15 cr in plant sciences incl 3 cr in plant physiology; offered 1966-67 and alt yrs) Nylund

139. Nutrition of Horticultural Plants. Lectures and assigned reading on relation of nutrients, including water, to growth and culture of horticultural plants. (3 cr; prereq 15 cr in plant sciences incl 3 cr in plant physiology; offered 1967-68 and alt yrs) Nylund

140. Plant Growth Regulators. Physiology and agricultural technology of phytohormones and synthetic growth regulators in horticulture. Practical uses of such substances in control of fruit and leaf abscission, parthenocarpy, growth rate, growth habit, plant size, apical dominance, organ initiation, dormancy, germination, flowering, callusing, and others. (3 cr; prereq 15 cr in plant science incl 3 cr in plant physiology) Weiser

142. Turf Management. Taxonomy, ecology, and culture of grasses for landscape purposes. Areas covered include basic principles, terminology, construction, maintenance, and soil-plant relationships in turf management for lawns, golf courses, athletic fields, and production operations. (3 cr; prereq Biol 2 plus 12 cr in plant sciences) White

142A. Turf Management Laboratory. Characteristics and identification of seed and turf grasses; use and handling of equipment; field trips to commercial seed, equipment, and production organizations. (2 cr; prereq 142) White

143. Nursery Management. Application of basic biological principles in development of modern management procedures for production of landscape materials; controlled environment storage, growth regulators, chemical defoliants, etc. Lecture, laboratory, field trips, advanced problems. (4 cr; prereq 21, 22, 36, 43, 76 or ‡) White

144. Professional Practices. Client-professional relationships, contracts, specifications, estimates, office and business procedures. (2 cr) White

152. Commercial Floriculture, Fall Crops. Physiological and cultural aspects of production of principal florist crops of economic importance: chrysanthemums, carnations, cut flowers, and potted plants especially adapted to Christmas sales. Lectures, reference reading, and field trips to greenhouses, wholesalers, and retail flower stores. (3 cr; prereq 16; offered 1967-68 and alt yrs) Widmer

154. Commercial Floriculture, Spring Crops. Physiological and cultural aspects of production of principal florist crops of economic importance: roses, bulbous plants, and materials adapted to spring sales. Lectures, reference reading, and field trips to greenhouses, wholesalers, and retail flower stores. (3 cr; prereq 16; offered 1967-68 and alt yrs) Widmer

160. Plant Breeding Techniques. Lectures and laboratory covering physical aspects of many plant breeding problems, e.g., pollination control and floral morphology, sex

modification, embryo culture, mutation induction, manipulation of ploidy levels, and automated data processing. (3 cr; prereq Agro 30) Mullin

187. Methods of Plant Analysis. (Same as Bot 187) Laboratory course in techniques of sample preparation, fractionation of plant material, isolation and determination of compounds occurring in plants. (1-4 cr; prereq AnCh 57, 8 cr biochemistry and ‡) Weiser and staff

190, 191, 192.° Special Problems. Written report based on library, laboratory, or field research. (2-4 cr per qtr; prereq ‡) Staff

221. Breeding of Sexually Propagated Horticultural Crops. Breeding methods and procedures, including modifications used in the seed and processing industries; theory; sex, incompatability, and sterility mechanisms; approaches and systems unique to breeding horticultural crops. (3 cr; prereq Agro 132) Davis

222. Breeding Asexually Propagated Crops. Theory and methods applied to improving asexually propagated plants. Emphasis placed on apomixis, polyploidy, chimeras, and mutations. (3 cr; prereq 110 or equiv) Lauer

223. Evolution of Crop Plants. Origin, distribution, and evolution of cultivated plants; implications of evolutionary processes on crop breeding for the needs of modern man. (3 cr; prereq 110 or equiv; offered 1966-67 and alt yrs) Davis

241. Organization of Horticultural Research. Organization and administration in agricultural experiment stations; project development and research outlines. (2 cr) Snyder and staff

242x.° Horticultural Seminar. Reports and discussions of problems and investigational work. (1 cr per qtr; prereq 9 cr in horticulture) Snyder and staff

245. Plant Hardiness. Physiological and physical bases of plant injury and survival as related to low temperature, high temperature survival. (3 cr; prereq 15 cr in plant science incl 3 cr of plant physiology) Weiser

251x.° Advanced Problems in Horticultural Crop Breeding. Written report based on library, laboratory, or field research. (3-9 cr; prereq ‡) Staff

252x.° Advanced Problems in Physiology of Horticultural Crops. Written report based on library, laboratory, or field research. (3-9 cr; prereq ‡) Staff

Agro 242x.° Seminar: Plant Breeding. (1 cr per qtr) Horticultural Science, Agronomy, and Plant Genetics staffs

Agro 246.° Seminar: Genetics. (2 cr) Horticultural Science staff and Genetics group

HOSPITAL ADMINISTRATION**

Professor	Associate Professor	Assistant Professor
James W. Stephan, M.B.A.	Vernon E. Weckwerth, Ph.D.	Theodor J. Litman, Ph.D.

Prerequisites—Ordinarily the attainment of the professional degree master of hospital administration is an initial step toward acquiring the Ph.D. Students lacking the basic public health courses will be required to complete such courses concurrently with their doctoral program. Graduate work satisfactorily completed prior to entering the doctoral program may be applied where appropriate and in accordance with the regulations of the Graduate School.

Ph.D. Degree—Each student's program of study will be arranged individually with the guidance of his advisers and in accordance with Graduate

** Inquiries concerning courses of study leading to the degree of master of hospital administration should be addressed to the School of Public Health, 1325 Mayo Memorial Building, University of Minnesota, Minneapolis, Minnesota 55455.

School requirements. Each program will cover subject matter of the major field in the following three areas: (1) Organization and Administration of Hospitals and Related Health Services; (2) Social, Psychological, Economic, and Political Aspects of Health Services; and (3) Methodology of Hospital and Related Health Services Research. In addition, the student will achieve competency in social science fields particularly related to the major field. Especially recommended are economics, political science, psychology, and sociology. With the approval of his advisers, the student will complete one of the following requirements: (1) at least 24 credits in a coherent program of courses selected from the related social science fields; (2) all of the minor field requirements in one of the related social science fields or in two fields as a split minor in social science; or (3) a second major in one of the related social science fields. All candidates also will complete a minimum of 9 credits in courses in statistics numbered 100 or higher with the approval of his advisers.

For a more complete statement of admission requirements and related information, see the special bulletin published by the Program in Hospital Administration at the School of Public Health.

Language Requirement—A reading knowledge of two foreign languages or of one foreign language with the option of a research technique or a collateral field of knowledge.

Thesis—The dissertation shall deal with a significant problem concerning health care services as they relate to the role and function of the hospital.

PubH 141. Social, Economic, and Political Aspects of Medical Care. Social, economic, and political forces affecting administration and financing of medical care; sickness insurance, group hospitalization; concern of government in provision of medical care. (3 cr; prereq ‡) Litman

PubH 160. Principles of Administration in Hospitals. Lectures, seminars, and field trips in hospital administrative principles; top management and board of trustees, policy formation, human relations. (6 cr) Stephan

PubH 161. History and Development of Hospitals. Functions; ownership and control; promoting and building new hospitals; integrated service; national associations and foundations. (3 cr; prereq ‡) Stephan

PubH 162-163. Principles of Organization and Management of Hospitals. Departmental structures and functions; organizational principles and practice. (3 cr fall, 6 cr winter) Stephan

PubH 164. Principles of Organization and Management of Hospitals. Personnel department; legal liability; fiscal management, hospital insurance, research in administration. (6 cr; prereq 162, 163) Stephan

PubH 261-262. Alternative Patterns for Meeting Health Care Needs. Future role of hospitals and related health services in light of patient needs and community services. (3 cr per qtr; prereq ‡) Stephan, Litman, and staff

PubH 264. Seminar: Medical Care Patterns Abroad. Readings, discussion, guest lecturers on relations between health services and other social institutions in different societies. (3 cr; prereq ‡) Litman

PubH 265. Seminar: Research Studies on Health Services. Appraisal of design, instruments, field work procedures, and findings of contemporary studies. (3 cr; prereq ‡) Litman, Weckwerth, and staff

PubH 266. Hospital Administration Topics. Independent study under tutorial guidance on selected problems, current issues. (Cr ar; prereq ‡) Stephan

PubH 267. Health and Human Behavior. Social ecology of health; social and personal components of illness; health and the community; social and cultural aspects of health care services. (3 cr; prereq ‡) Litman

PubH 269. Political Aspects of Health Services. Analysis of interrelationships between government, politics, and health services; the political-social bases of health legislation and community decision making in provision and modification of health services. (3 cr; prereq ‡) Litman

PubH 273. Contemporary Problems of Hospital and Related Health Services. Current concepts, problems, principles, and future developments in hospital and related health services. (Cr ar; prereq ‡) Stephan and staff

PubH 274. Readings in Theory and Principles of Hospital Administration. (Cr ar; prereq ‡) Stephan and staff

INDUSTRIAL RELATIONS

Professor

Rene V. Dawis
Marvin D. Dunnette
George W. England
Edward Gross
Herbert G. Heneman, Jr., *chairman, director of graduate study*
Lloyd Lofquist
Thomas A. Mahoney
Norman J. Simler
George Seltzer
John G. Turnbull

Associate Professor

Hyman Berman
John J. Flagler
Peter Gregory
Cyrus F. Smythe, Jr.

Assistant Professor

William F. Weitzel
Mahmood A. Zaidi

Prerequisites—Courses in industrial relations are open to all regularly enrolled graduate students who can meet course prerequisites as listed in the *Class Schedule*. Before being accepted as a candidate for a graduate degree with a major or minor in industrial relations, a student shall satisfy his adviser that he is fully prepared to undertake graduate work in the proposed fields of specialization. Students will be expected to have or obtain such course work as may be necessary to meet the prerequisites of courses selected for their graduate programs.

Master's Degree

Offered under both Plan A and Plan B

Plan A—Thesis Program

A minimum of 27 course credits and an accepted thesis are required. At least 18 of the course credits must be obtained in industrial relations as indicated below. Additional course work may be required by the adviser to insure adequate preparation in the major field of study.

The major course work consists of a *minimum* of 18 course credits which meet the following distribution.

1. One course in each of four of the following (12 credits):
   a. IR 182A
   b. IR 202 or 212B
   c. IR 222
   d. IR 232 or 282
   e. IR 172
   f. IR 210

2. IR 192 (3 credits)
3. One additional course in industrial relations (3 credits)

Total (18 credits)

A minimum of 9 credits is required in an approved minor field of study related to industrial relations. However, more than 9 credits may be required depending upon previous preparation and coverage. Commonly selected fields are business administration, psychology, sociology, or economics.

A thesis dealing with a specialized topic in the major field must be approved for the degree.

There is no language requirement.

The final examination may be both written and oral. Candidates will be admitted to the examination only after completion of the following requirements.

1. Written Examination

   Candidates may be admitted to the written examination after all course requirements have been completed. The thesis need only be in first draft form and be sufficiently satisfactory in concept and preliminary framework to meet the adviser's requirements. The student should have the adviser certify this fact in writing to the department Examining Committee. There must be no incompletes in any required course work at the time of examination. Candidates who fail the written examination may be permitted to retake it on written recommendation of the adviser.

2. Oral Examination

   Candidates may be admitted to the oral examination only after successful completion of the written examination or recommendation of the adviser, and after the required form indicating unanimous approval of the Master's thesis by the thesis committee has been filed in the Graduate School office.

Plan B—Nonthesis Program

A minimum of 45 course credits and completion of three Plan B papers are required. The major course work consists of the following minimum requirements:

1. One course in each of four of the following (12 credits):
   a. IR 182A
   b. IR 202 or 212B
   c. IR 222
   d. IR 232 or 282
   e. IR 172
   f. IR 210
2. IR 192 (3 credits)
3. IR 182B (3 credits)
4. One advanced course in industrial relations beyond the level of courses in (1) above (3 credits)

Total (21 credits)

The minor course work consists of a minimum of 18 credits earned in at least two related fields. A minimum of at least 6 credits must be earned in each of two related fields. Commonly selected fields are business administration, psychology, sociology, or economics.

Papers of the quality but not the scope of the Master's thesis shall be prepared in three advanced courses involving independent work under faculty supervision.

There is no language requirement.

The final examination may be both written and oral. Candidates will be admitted to the examination only after completion of the following requirements:

1. Written Examination

   Candidates must have completed all course requirements and all Plan B papers. Candidates should have those faculty members to whom papers were submitted certify approval of the respective papers to the Examining Committee. There must be no incompletes in any course at the time of examination. Candidates who fail the written examination may be permitted to retake it on written recommendation of the adviser.

2. Oral Examination

   Candidates may be admitted to the oral examination only after successful completion of all course work and Plan B papers and the written examination or recommendation of the adviser.

Doctor of Philosophy

A. *Admission*

Candidates seeking to major in industrial relations at the Ph.D. level must have a Bachelor's or Master's degree from a recognized college or university, show professional promise, take the Miller Analogies Examination, and offer a minimum of 30 credits of related course work in the social and behavioral sciences with the following minimums:

Economics (9 credits)
Equivalent of IR 52 and IR 72 (6 credits)
9 credits in one of the following:
anthropology, history, political science, psychology, or sociology (9 credits)
6 additional credits in social or behavioral sciences and/or statistics (6 credits)
Total (30 credits)

B. *Requirements for the Ph.D. degree*

1. Although course work and study done in industrial relations will serve as the core of a Ph.D. program, each student will be expected to have a thorough mastery of more than one of the six designated related social or behavioral science disciplines (anthropology, economics, history, political science, psychology, sociology). If a student and his adviser feel

that a student does not need a normal minor, then the Ph.D. program would be composed of the following:

Major Field:	Industrial Relations
Supporting Program:	At least 15 credits of course work in each of *two* of the six designated social or behavioral science fields.
Research Technique:	Completion of at least 9 credits in designated course sequences.
Foreign Language:	Reading knowledge of at least *one* foreign language.

a. Specific requirements in the major:

All students must pass written examinations in the following:

(1) Scope and Systems of Industrial Relations

(2) Research Methodology

(3) Choice of two of the following five subfields:

Compensation Theory and Administration
Manpower Resources and Allocation
Staffing, Training, and Development
Collective Bargaining
Organization Theory and Administration

A list of courses providing preparatory study for the examinations can be obtained from the Department of Industrial Relations. Generally one-third of the courses taken to prepare for examinations in the major field would be courses offered by other departments.

b. Supporting Program

A supporting program of study must include at least 15 credits of course work in courses numbered 100 or above in each of *two* of the six designated fields in the social and behavioral sciences (anthropology, economics, history, political science, psychology, and sociology). Course work used to satisfy a part of the major requirement or research technique cannot be used in the supporting program. The supporting program, like the normal minor, must be completed before the student is admitted to the preliminary examination.

c. Special Research Technique

Competence in a research technique is required of all candidates and is demonstrated by completion of a sequence of 9 credits of statistical analysis outside industrial relations, and must be completed before the student is admitted to the preliminary examination. A list of courses for this purpose, and for the research methodology requirement, may be obtained from the department.

d. Language Requirement

For the Ph.D. degree, reading knowledge of at least *one* foreign language is required of all students. The foreign language require-

ment must be completed before a student can be admitted to the preliminary examination. The special research technique will take the place of the second language which is normally required of Ph.D. candidates.

2. If a student wishes to use a normal or traditional minor, he must increase work in one of the designated social or behavioral science fields from 15 credits to a full minor. Another social science field, taken from the six designated, must also be completed with a minimum of 15 credits of course work.

C. *General requirements*

Course work used to satisfy requirements in either the major, supporting program, minor, or special research technique may not be used again to satisfy requirements in any other areas of the student's Ph.D. program. Minimum acceptable grades in each of the areas of the Ph.D. program will be the same as those given in the General Information section of this bulletin; the industrial relations graduate faculty may require higher performance standards than those listed there.

Ph.D. Minor—Industrial relations may be selected as a minor or as part of a supporting program for the Ph.D. where it is associated with a major in one of the following fields: agricultural economics, business administration, economics, history, hospital administration, journalism, political science, psychology, and sociology with the exception that a student writing a dissertation in (a) business administration, subfield industrial relations, or (b) economics, subfield labor economics, may not use industrial relations as the minor for the Ph.D.

The minor program is intended to be flexible and is designed to take into account the student's educational objectives, needs, and background. Courses in the minor program will be selected by the minor adviser in consultation with the student. Additional information can be obtained from the advisers listed above or the Department of Industrial Relations.

142. Settlement of Industrial Relations Disputes. The nature of industrial conflict in employment relations; stresses contributing to conflict and dispute situations; public and private approaches to the prevention, reduction, and resolution of conflicts. (3 cr; prereq 52 or 152) Flagler, Seltzer, Smythe, Turnbull, Zaidi

152. Systems of Industrial Relations: Labor Marketing. Introductory analysis of employment relationships emphasizing economic analysis. Fundamentals of application and conservation of human resources in employment with consideration of related social and economic problems. Labor marketing, collective bargaining, unions and employer associations, industrial unrest and conflict, employment and unemployment, wage problems. (3 cr, §52; prereq Econ 2 or equiv) Heneman, Mahoney, Seltzer, Smythe

152C. Industrial Relations Fundamentals. Introductory analysis of employment relationships, effective utilization, application, and conservation of human resources within the aggregate economy and individual organizations, union and nonunion. Policy and practice in manpower management—staffing, training, morale, compensation, labor relations, industrial unrest, employment, and unemployment. (3 cr, §52 or §152 or §72 or §172 or equiv; prereq Econ 2 or equiv) England, Heneman, Mahoney, Seltzer, Smythe

162. Union Government and Policies. Internal administration and government of unions; economic and social issues; hours, wages, and other conditions of employment. (3 cr; prereq 52 or 152) Berman, Flagler, Seltzer

172. Systems of Industrial Relations: Manpower Management. Introductory analysis of personnel management and labor relations in development and utilization of effective work-teams within firms and agencies. Overview of policy and practice in major manpower management functions of staffing, training, communications, motivation, compensation, and morale maintenance. (3 cr, §72; prereq Econ 2) Dawis, England, Heneman, Mahoney, Smythe, Weitzel, Zaidi

175. Interpersonal Perception: The Employment Interview. Research-oriented application of experimental methods. Includes theories of interpersonal perception, measurement of perceptual accuracy, content and process, research strategies, methodological problems, decision validation, and current research finding. (3 cr; prereq 172 or ‡) Dunnette

182A. Intermediate Labor Marketing. Advanced discussion and analysis of labor marketing concepts, structures, and processes. Examination of sources of information and different approaches to study, analysis, and resolution of problems in the labor market. (3 cr; prereq 52 or 152) Gregory, Mahoney, Seltzer, Simler, Smythe, Zaidi

182B. Intermediate Manpower Management. Manpower management policy development, application, and evaluation within union and company managements; manpower research and auditing. (3 cr; prereq 72 or 172) Heneman, Mahoney, England, Smythe

182C. Intermediate Labor Marketing and Manpower Management. An advanced course for line managers who are concerned with their personnel and labor relations functions. Policy, administration, and control of major manpower functions such as recruitment and staffing, training and development, motivation and compensation, labor relations, employee benefits and services, manpower research and auditing; labor marketing and labor legislation. This is a course for the nonspecialist. (3 cr, §182A or §182B or equiv; prereq grad, 152 or 172 or equiv) Heneman, Mahoney, Seltzer, Smythe, Zaidi

192. Industrial Relations Practices and Techniques. Role of quantitative measurement and analysis in formulation, administration, and evaluation of industrial relations practices and programs. (3 cr; prereq 72 or 172, 3 cr statistics) England, Mahoney, Dawis

202. Organization and Staffing. Translation of organization goals and objectives to specific manpower goals and objectives, and staffing to meet an organization's manpower needs. Techniques for recruitment, selection, and assignment of manpower resources for optimal utilization. (3 cr; prereq 72 or 172) Dawis, Dunnette, England, Lofquist, Weitzel

210. Organization Theory. Survey of theories of organization. Theories and research concerning work organizations, theories of structuring personal and functional relationships, informal and social organizations within work groups, and impact of alternative approaches to organization upon individual behavior and performance. (3 cr; prereq 72 or 172) Dunnette, Heneman, Mahoney, Weitzel

212A. Labor Education. For professional worker in labor education and industrial relations practitioner. Objectives, principles, content, and methods of university and union labor education programs and relationship of such programs to industrial relations. Program development and evaluation. (3 cr; prereq 52 or 152) Berman, Flagler

212B. Employee Development and Training. Determination of goals, implementation and evaluation of programs for improved development and training from the standpoint of professional manpower management. (3 cr; prereq 72 or 172) Dawis, Dunnette, England, Lofquist, Mahoney, Weitzel

222. Compensation and Reward Theory. Analysis of theories of reward and compensation as they influence labor force and employment behavior—labor demand, labor force participation, occupational choice, labor mobility, and productivity of labor. Draws upon relevant theories from economics, psychology, and sociology. (3 cr; prereq 152 or 172) Dunnette, Mahoney, Seltzer, Simler, Zaidi

232. Collective Bargaining: The Process. Examines the collective bargaining process in terms of its functions, variants, determinants, practices, and impacts. (3 cr; prereq 152) Berman, Seltzer, Smythe, Turnbull

242. Management Development. Examination of today's management development movement including management development programs within industry and in universities. Basic policy, current problems, and research findings concerning selection of management trainees, management appraisal and inventory, management motivation and compensation, and methods and techniques of development. (3 cr; prereq 72 or 172) Dawis, Mahoney

252. International Manpower Development and Utilization. Focuses on the processes of: (1) labor force participation, commitment, skill acquisition, evolution of occupational structures; (2) distribution among alternative employment; and (3) utilization in settings external to the United States of America. Examines relationships of human resources, education, and socio-economic development. (3 cr; prereq 152 or ‡) Berman, Gregory, Seltzer, Zaidi

262. Compensation and Reward Administration. Analysis of concepts and procedures for administration of compensation and rewards within an organization. Examination of approaches to determination of compensation levels, forms of compensation and rewards, compensation structures and differentials, and determination of individual compensation. (3 cr; prereq 152 and 172) Heneman, Mahoney, Seltzer, Smythe, Turnbull

272. Graduate Topics. Selected topics in industrial relations. (3 cr; prereq 152 or 172) Staff

282. Collective Bargaining: Legal Framework and Public Policy Issues. Examines legal requirements and constraints upon the collective bargaining process. Considers present public policy and its evolution and developing issues. (3 cr; prereq 152) Smythe, Seltzer, Turnbull, Heneman

292A. Readings in Manpower Economics and Industrial Relations. Readings useful to student's individual program and objectives, but not available in regular course offerings. (Cr ar; prereq consent of adviser and instructor in field covered)

292B. Graduate Research in Manpower Economics and Industrial Relations. Individual research projects especially useful to student's objectives and program. (Cr ar; prereq consent of adviser and instructor)

322. *Seminar in* Staffing, Training, and Development. Advanced analysis and study of staffing and training functions in light of human behavior theory research. (3 cr; prereq 202 and 212B) Dawis, England, Lofquist

332. Seminar in Compensation. Advanced study and research into problems of employee compensation and rewards. Students plan and carry out original research into selected problems concerning compensation and rewards. (3 cr; prereq 222 or 262) Mahoney

352. Seminar: Labor Marketing. Advanced analysis and study of functions and operations of labor markets, labor market theory and research. (3 cr; prereq 182A) Heneman, Mahoney, Seltzer, Turnbull

362. Seminar: Organization Theory. Advanced analysis and study of organization theories and their application in industrial relations research and practice. (3 cr; prereq 210) Mahoney, Dunnette

372. Seminar: Industrial Relations Research Methodology. Advanced analysis of research methodology appropriate to study of industrial relations; application of methodology in research projects. (3 cr; prereq 192) Dawis, England, Mahoney

382. Seminar: Systems of Industrial Relations. Advanced analysis and study of industrial relations systems in labor marketing and manpower management—historical development, cultural differences, and relative effectiveness. (3 cr; prereq 152 and 172) England, Gross, Heneman, Mahoney, Seltzer

392. Seminar: Collective Bargaining. Advanced analysis of collective bargaining process, its substance, procedures, determinants, and socio/political/economic incidences. (3 cr; prereq 232 or 282) Seltzer, Simler, Smythe, Turnbull

Plan B papers may be written in all courses.

INFORMATION AND AGRICULTURAL JOURNALISM

Course Carrying Graduate Credit When Program Related

134. Rural Communication Media and Media Behavior. Mass media behavior in rural communities, theoretical approaches relevant to problems of rural mass media behavior; analysis of research aimed at adult education efforts through mass media. (3 cr; prereq 53, Psy 2, Soc 14, or ‡) Swanson

INTERNATIONAL RELATIONS AND AREA STUDIES

Candidates for graduate degrees may, in consultation with advisers, plan interdepartmental programs in international relations or in area studies. General regulations of the Graduate School for admission and graduation apply, except that an equivalent program will replace the normal major and minor requirement. The following programs are offered.

Note—For a more complete statement concerning requirements, recommended courses, and vocational suggestions, see the special bulletin, *Programs in International Relations and Area Studies.*

General International Relations

Advisers:

Professor

Jan O. M. Broek (Geography)
Roy E. Carter, Jr. (Journalism)
John S. Chipman (Economics)
Harold C. Deutsch (History)
Rodolfo O. Floripe (Romance Languages)
Robert T. Holt (Political Science)
Charles H. McLaughlin (Political Science), *director of graduate studies*
Raymond B. Nixon (Journalism)
John E. Turner (Political Science)

Associate Professor

Edward Coen (Economics)
Robert E. Riggs (Political Science)
Burton M. Sapin (Political Science)
Harlan M. Smith (Economics)

Assistant Professor

John K. Munholland (History)

Prerequisites—Ordinarily an undergraduate major in international relations, an area study, or one of the social sciences is required. Students without such background may be permitted to enter if they have completed courses prerequisite to those in the fields of graduate study proposed and are prepared to undertake any additional study needed to correct deficiencies in their preparation. Preparation in an appropriate language at least through the first Upper Division sequence is also expected.

Language Requirement—For the M.A. degree prerequisite course work plus a test of reading knowledge in either French or German. For the Ph.D. degree a reading knowledge of an additional language, normally French or German. Alternative foreign languages may be authorized upon recommendation of the graduate adviser if appropriate to the candidate's program of study or research.

It is not recommended that candidates for the M.A. or Ph.D. degrees with a major in other subjects attempt to present a minor in international relations unless their previous preparation in this field is such that an intensive

and well-integrated program in several departments can be completed within the limited time available for the minor. Consult graduate advisers.

Programs for the M.A. Degree—PLAN A. Students will present a minimum of 27 credits of graduate course work, ordinarily including a subfield of concentration of from 12 to 15 credits in one of the social sciences, the remaining credits to be distributed among related courses in other social sciences or in journalism, art, languages and literature, humanities, and philosophy. At least 6 credits should be in seminars, proseminars, or readings courses. Candidates must receive a grade of B or better in at least two-thirds of their course work and a grade of not lower than C in all other courses offered for the degree.

PLAN B. Students will present a minimum of 45 credits of graduate course work, including a subfield of concentration of from 15 to 18 credits in one of the social sciences, the remaining credits to be distributed among related courses in at least two other social science departments, and in journalism, art, languages and literature, humanities, and philosophy. At least 9 credits should be in seminars, proseminars, or readings courses.

Programs for the Ph.D. Degree—The work leading to the Ph.D. degree in international relations comprises at least 3 full years of graduate study and will vary in amount according to the candidate's individual needs and the extent of his undergraduate preparation. Requirements may be decreased for those who enter with advanced standing. Candidates will prepare for the written and oral examinations prescribed by the Graduate School in six subfields of study, ordinarily completing a minimum of 12 credits in graduate courses or seminars in each subfield, including in each case at least 3 credits in a seminar or course based upon individually assigned reading or research. The six subfields should be distributed among not less than three social science departments and may include one or two subfields in journalism, art, language and literature, philosophy, or humanities. An area of concentration consisting of two subfields within a single social science department shall be included. Definition of subfields must be made in consultation with a graduate adviser, and the entire program should form a consistent, integrated plan of study. General requirements of the Graduate School must be satisfied, including a substantial dissertation in the area of concentration.

Area Studies

Advisers:

West Europe

Prof. John R. Borchert (Geography)
Prof. Jan O. M. Broek (Geography)
Prof. Harold C. Deutsch (History)
Prof. Alrik Gustafson (Scandinavian)
Prof. Don A. Martindale (Sociology)
Prof. Edwin F. Menze (German)
Prof. Samuel H. Monk (English)
Assoc. Prof. Marion Nelson (Scandinavian)
Prof. Herman Ramras (German)
Prof. Armand Renaud (Romance Languages)
Prof. Arnold M. Rose (Sociology)
Prof. Mulford Q. Sibley (Political Science)
Assoc. Prof. John W. Webb (Geography)
Prof. David H. Willson (History)
Prof. Cecil Wood (German)
Assoc. Prof. William E. Wright (History)

Russia

Assoc. Prof. Theofanis G. Stavrou (History)
Prof. Francis M. Boddy (Economics)
Prof. John R. Borchert (Geography)

Prof. Robert J. Holloway (Business Administration)
Prof. John E. Turner (Political Science)

East and South Asia

Prof. Jan O. M. Broek (Geography)
Assoc. Prof. Edward M. Copeland (East and South Asian Languages)
Assoc. Prof. O. Eldon Johnson (Anthropology)
Prof. Anne O. Krueger (Economics)
Prof. Richard B. Mather (East and South Asian Languages)
Assoc. Prof. Karl F. Potter (Philosophy)
Prof. Robert F. Spencer (Anthropology)
Assoc. Prof. Donald C. Swanson (Classics)
Assoc. Prof. Romeyn Taylor (History)
Prof. John E. Turner (Political Science)

Latin America

Assoc. Prof. Ward J. Barrett (Geography)
Prof. Oswald H. Brownlee (Economics)
Prof. John S. Chipman (Economics)
Prof. Rodolfo O. Floripe (Romance Languages)
Assoc. Prof. O. Eldon Johnson (Anthropology)
Prof. Eugene C. Mather (Geography)

In addition to these advisers students may consult any other member of a committee whose specialization corresponds with the student's subfield of concentration. For committee lists see the special bulletin, *Programs in International Relations and Area Studies.*

Able students who have adequate preparation will be permitted to plan graduate programs in area studies. Programs leading to the M.A. degree may be arranged in any of the following areas: West Europe, Russia, East and South Asia, Latin America. In the West Europe area program the student is expected, after completion of basic work upon the area as a whole, to specialize in one of several subareas, either the Scandinavian Countries, Great Britain, France, or Germany. In the East and South Asia program, specialization is permitted in either East Asia, South Asia, or Southeast Asia.

Prerequisites—At least 18 credits in courses regarded by area study advisers as suitable undergraduate preparation for such work and prerequisites for the individual courses in the graduate program. Consideration will be given to study or other relevant experience abroad. Since graduate work in the West Europe program is expected to emphasize a particular subarea, candidates should have completed basic courses on Europe as a whole at the undergraduate level. In some cases they may be permitted to remove deficiencies in this respect while pursuing work in the graduate major. No specific prerequisite in foreign languages is stated because of disparity in the offerings available in different languages, but a working knowledge of one or more languages appropriate to the area chosen is considered especially important. Where course offerings permit, language preparation should equal that required for the general international relations major.

Program for the M.A. Degree—General regulations for admission and graduation apply, except that an equivalent program will replace the normal major and minor requirement. An approved language appropriate to the area or to research concerning the area may be presented in satisfaction of the foreign language requirement. All programs must be planned in consultation with an area adviser.

PLAN A. Students will obtain a minimum of 27 graduate credits, including at least 9 in the social sciences. The remainder may be distributed among two or three subfields, including the social sciences, literature, art, humanities, and philosophy. The whole should constitute a coherent, well-balanced program.

PLAN B. Students will obtain a minimum of 45 graduate credits, including at least 9 in the social sciences. The remainder will be distributed among the social sciences, literature, art, humanities, and philosophy.

A minor program under Plan A, or "related courses" under Plan B, may also be elected in an area study intended to support a departmental major. However, this is feasible only when the student has some previous area training.

Programs for the Ph.D. Degree—A Ph.D. degree is not presently offered with a major in area studies, since teaching materials are inadequate for intensive area study at this level in several of the contributing disciplines. Where relevant, area study may be included as part of a major program for the Ph.D. degree in a related graduate major or in international relations. It may also be presented as a minor program, in which case it is recommended that it comprise such aspects of study in the chosen area as are especially relevant to the major field. Major and area advisers should be consulted.

Preparation for the Foreign Service

Advisers:

Professor

Charles H. McLaughlin (Political Science)
Burton M. Sapin (Political Science)
George A. Warp (Public Administration)

A specific graduate major in preparation for the Foreign Service is not offered, but candidates for a graduate degree may obtain the instruction recommended for this purpose as a part of an international relations or an area major, or may take some relevant work in conjunction with a departmental major. They may also undertake training for the Foreign Service without candidacy for a graduate degree.

Intelligence Research Training Program

Adviser:

Professor

Tom B. Jones (History)

This is a program designed to provide basic training in intelligence research at the graduate level. Candidates for the M.A. or Ph.D. degrees may combine this training with a graduate major in area studies or international relations, or one of the social science majors. Certificates of proficiency in intelligence research will be awarded to students who successfully complete the prescribed work. Two years of graduate study are usually required to complete the program in conjunction with an M.A. degree. Foreign language competency, research skill and command of methods, and area specialization are stressed.

Those admitted to the program must be able graduate students with a genuine motivation toward careers in intelligence research or related work. They will be expected to have satisfactory reading knowledge of at least one foreign language and a reasonable familiarity with the cultural area chosen for specialization. They should also have completed undergraduate courses in sta-

tistics and cartography, but in appropriate cases deficiencies in these skills may be removed during the first year of training.

Programs must be planned in consultation with the adviser. They will consist in general of a foreign area study, or a combination of area training with a major in a social science discipline. In addition the program will include the following required courses:

1. Lib 62, 160, 166, Reference (9 cr)
2. 9 credits of seminar work in the major field
3. IRT 200-201-202, Intelligence Research Training Seminar. (9 cr; prereq registration in the intelligence research training program and permission) Jones
4. Additional foreign language training, as needed, to assure a reading knowledge of a second foreign language by the end of the training period.

Undergraduates who plan to enter the program after graduation should consult the adviser at an early date. For further details consult the special bulletin, *Programs in International Relations and Area Studies.*

JOURNALISM AND MASS COMMUNICATION

Professor

Robert L. Jones, *head*
Roy E. Carter
Mitchell V. Charnley
Edwin Emery
J. Edward Gerald
George S. Hage
Raymond B. Nixon
Jack N. Peterman
Willard L. Thompson
Harold W. Wilson

Associate Professor

Donald M. Gillmor, *director of graduate study*
Robert G. Lindsay
John C. Sim
Phillip J. Tichenor

Prerequisites—Courses in journalism are open to regularly enrolled graduate students who meet prerequisites stated in course descriptions. Students seeking the M.A. degree must have a minimum of 15 credits in basic journalism. Prerequisites may be taken while the student is enrolled in the Graduate School.

Degree of Master of Arts

The Master's degree is offered under Plan A and Plan B. Minnesota undergraduate journalism majors who contemplate graduate work in journalism should consult a graduate adviser at the end of the junior year.

For Plan A, course 200 and 18 additional credits in journalism are required, including two seminars numbered above 200. For Plan B, course 200 and at least two seminars numbered above 200 are required.

Minor—Majors in other fields who desire a journalism minor dealing with social and cultural aspects of the mass media of communication, or with specialized communications research techniques, may select courses with the consent of a graduate journalism adviser from among the following: 103, 106, 109, 110, 111, 112, 114, 115, 121, 124, 125, 126, 131, 164, 177, 190, and any course numbered 200 or above for which the student is eligible. Minors whose purpose is preparation for employment in communications must present as prerequisites a minimum of 15 credits either in reporting and editing or in basic advertising courses. Teachers of journalism in secondary schools should select

prerequisites and courses in consultation with a journalism adviser. A program especially suited to their needs is available.

Language Requirement—For Plan A, reading knowledge of a foreign language is required of all candidates, except those who present additional work in statistics to support a concentration in research methodology. For Plan B, a foreign language is not required but is recommended for students in international communications.

Degree of Doctor of Philosophy

The program in the School of Journalism and Mass Communication leading to the Ph.D. in journalism is intended for students who plan careers in research, teaching, or specialized journalism areas. The candidate, with the approval of his adviser, shall elect three subfields appropriate to his individual needs and goals. One subfield shall be designated the thesis subfield. The subfields are (a) theory of communication and public opinion, (b) history of communications, (c) communication agencies as social institutions, (d) international communications and comparative foreign journalism, and (e) specialized research methodology. To a varying degree, the subfields include supporting courses in other disciplines. Prospective students should write the director of the School of Journalism and Mass Communication for detailed subfield descriptions. At the time of the preliminary examination the candidate will be held responsible for the subject matter in Jour 200-201 and in one core course in each of the subfields not offered.

Minor—A candidate for the Ph.D. in other fields may elect a minor in journalism by obtaining the approval of his adviser and the director of graduate study of the School of Journalism and Mass Communication. Specialists in one of the natural or social sciences can establish minors leading to the practice of journalism. Written preliminary examinations are required of all minors.

Language Requirement—Either (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge. Acceptable languages are Arabic, Chinese, French, German, Italian, Japanese, Russian, Spanish or Portuguese.

101w,s. Reporting of Public Affairs. Reporting court trials, city, county, state, federal, administrative, and legislative agencies; political, business, and labor news. Students attend and report trials, hearings, legislative sessions, and press conferences. (3 cr; prereq 51) Hage

102f,w. Science Communication. Role of journalistic communication in science; scientist-journalist relationships; communicating results of scientific investigations to public and specialized audiences; form of secondary communication of science and technology in industry. (4 cr; prereq 50 or 71 or ‡) Tichenor

103s.° Literary Aspects of Journalism. Literary aspects of journalism exemplified in works of English and American fiction writers, past and present. (3 cr; prereq ‡) Hage

106f.° Critical Writing. Book, theater, and motion picture reviews. Analysis of leading critics and critical periodicals. Weekly writing assignments. (3 cr; prereq a jr or sr writing course, ‡) Hage

107f, 108f. Advanced Projects in Photojournalism. Intensive work in two specialized areas —the documentary picture story (107) and color photography (108). Documentary picture story: definition, scope, research, and approaches for magazines and picture

books. Color: analysis of contemporary use of color in photography for the print media; materials and processes. (3 cr per qtr; prereq 65 and ‡; 107 offered alt yrs with 108) Schuneman

109f.° History of Journalism. Development of American newspapers and periodicals, from early beginnings in Europe to the present day; rise of radio and television; relation of communications developments to political, economic, and social trends in America. (3 cr) Emery

110w.° Topics in the History of Journalism. Intensive study of significant individuals, newspapers, and periodicals in the history of American journalism; examination of major periods of change and of developing trends. Individual projects and readings. (3 cr; prereq 109) Emery

111f.° Development of American Broadcasting. Historical and economic development of radio and television in the United States; government regulation; self-regulation and social controls. The broadcaster as journalist. Contemporary issues. (3 cr) Charnley, Lindsay, Paulu

112f,s. Communication and Public Opinion. Theories of communication process and of persuasion and attitude change. Functions of interpersonal and mediated communication in diffusion of information and in opinion formation. (3 cr; prereq 15 cr in social sciences) Carter, Nixon

114s. Mass Communication Theory. Research concepts and findings that seem to offer the most promise for development of a general theory of mass communication. Analysis of research findings in communication of ideas and information through mass media. (3 cr; prereq 112) Nixon

115w,s.° Communications Analysis: Content, Audiences, Effects. Analysis of content and audiences of newspapers, magazines, radio, television, and motion pictures. Procedures for study of mass media effects. (3 cr; prereq introductory course in statistics and ‡) Jones, Carter, Tichenor

121w.° Mass Media in a Dynamic Society. Economic, political, and social determinants of the character and content of mass communications. Patterns of operations, their effect on content, and their relative social utility. Government and mass communications. (3 cr; prereq 18 or 50 for journalism majors, ‡ for others) Gerald, Gillmor

122s.° Current Communications Problems. Individual project method is used for analyses of communications problems of current importance in the light of their social, economic, and technological environment. Conducted in small seminar like groups. (3 cr; prereq 51) Gerald, Gillmor

124f.° International Communications and Foreign Affairs. Channels of international communication and news gathering agencies. Factors affecting flow of news throughout the world. Role of foreign correspondent. Relation of communications to foreign affairs and international understanding. (3 cr, §old 111; prereq 15 cr in social sciences, with inclusion of an upper division course in history or political science...course in international relations recommended) Nixon

125w.° Communication Systems of the Western World. Communications in other democracies as compared with the United States and with totalitarian systems. Great Britain, the Netherlands, the Scandinavian countries, France, and Latin America emphasized; problems of constructing a free press in Germany, Italy, Japan, and newly developing areas. (3 cr; prereq 15 cr in social sciences with an upper division course in international relations or comparative government recommended) Nixon

126s.° Communications in Authoritarian Society. Operational relationships between government and communication media in authoritarian nations. Rise of totalitarian regimes; their impact upon structure and operations of mass communication media. Case studies of communications in selected authoritarian states, including the U.S.S.R. (3 cr; prereq 15 cr in social sciences with an upper division course in international relations or comparative government recommended) Nixon

131w. Public Opinion and Persuasion. Advanced study of theories of opinion formation, persuasion, and attitude change. The communication process in relation to interpersonal influence and to community power structure. Polls, politics, and pressure groups. (3 cr; prereq 112) Carter

AgJo 134. Rural Communication Media and Media Behavior. Theoretical approaches relevant to problems of rural mass media behavior and analyses of research aimed at adult education efforts through mass media. (3 cr; prereq AgJo 53, Psy 1-2, Soc 14, or ‡) Swanson, Tichenor

140f-141w. Interpretation of Contemporary Affairs. Analysis of major political, economic, and social developments and their interpretation in the editorial, interpretative article, and commentary. (3 cr per qtr; prereq 51 and 15 cr in social sciences) Gerald, Emery, Nixon, Gillmor

142s. News Interpretation for Radio and Television. Preparation, writing, scripting of news analyses, commentaries, editorials, documentaries, interpretative material for electronic media. Emphasis on editorial investigation and content, style and techniques, audience and effects, in the presentation of such programs. (3 cr; prereq 85) Lindsay

143s. Interpretation of Science and Technology. Analysis of scientific research and technological development for mass and specialized media; critical study of science content in media; audience impact of science content in various media. (3 cr; prereq 102, 112, Phil 160) Tichenor

149w. Public Relations Principles. Theories and principles of the public relations function; their application in industry, government, education, social agencies and other institutions; pertinence of social science research and journalistic implications in the public relations process. Case studies and analyses. (3 cr; prereq 78, 112 or 15 cr in social sciences and ‡) Lindsay

150s. Institutional Public Relations. Principles and practices of public relations in public health, social work, education, and other community institutional service fields. Use of the mass media and journalistic implications of the public relations process. (2 or 3 cr; not open to journalism majors; prereq ‡) Lindsay

161f,w. Advertising: Print Media. Characteristics of newspapers, magazines, direct mail, outdoor, specialty media, their role in advertising; relations with retail advertisers, national representatives, agencies, organizations. Rate structures, rate economics. (3 cr; prereq 18, 57 and 79) Barden, Thompson

162f,w. Advertising: Radio and Television Media. Contrasts and similarities of radio and television characteristics; interaction of sponsor, agency, station network, and station representative; program and market selection; rate structure, audience analysis; creating and measuring impact of commercials. (3 cr; prereq 18, 79) Barden, Peterman

163f,s. Advertising: Media Strategy and Analysis. Relation of advertising media to creative strategy; media "mix"; evaluation and use of media and market measurements and data; comparison of rates and relative economy of media; media purchasing, scheduling, and appropriations; cases and campaigns. (3 cr; prereq 18, 161, 162 and ‡)

164w,s. Current Advertising Developments and Problems. Creative, management, research, media, and technical developments in advertising. Discussion and analysis of specific problems and case studies in the advertising-marketing process. Contributions of related fields of behavioral sciences and communications. (3 cr; prereq 163 or ‡) Peterman

177f,s. Contemporary Problems in Freedom of Speech and Press. Anglo-American concept of freedom and responsibility, constitutional development in the United States, areas of present tension. The Bill of Rights and journalism today. (3 cr; prereq 15 cr in social sciences) Gerald, Gillmor

190s. Advanced Problems in Journalistic Writing. Investigation and analysis of problems of superior professional accomplishment in the fields of journalistic writing. Uses of literary and journalistic forms. Experiments in individual effectiveness in journalistic presentation. (3 cr; prereq demonstration of acceptable writing achievement and ‡) Charnley

200f, 201s. Scope and Methods of Communications Research. 200: Areas of study in mass communications. Introduction to research methods and major sources of data. 201: Field survey, content analysis, and the controlled experiment as applied to mass communications problems. (3 cr per qtr; prereq consent of adviser) Jones and others

209w-210s.° Seminar: History of Communications. Research in history and development of mass media. Historical bibliography and criticism in the field of journalism. (3 cr; prereq 110 or ‡) Emery

213w.° Seminar: Mass Communication Theory. Intensive examination of research concepts and findings which offer the most promise for development of a general theory of mass communication. Emphasis on empirical studies that throw light on problems of professional journalists in trying to communicate more effectively through mass media. (3 cr; prereq 113 and ‡) Nixon

215w-216s.° Seminar: Communications Analysis. Research designs; procedures for quantitative studies of media control, content, audiences, and effects; relationships between research and decision making. (3 cr per qtr; prereq 200, 201 or 115, and a course in statistics, or ‡) Jones, Carter, Tichenor

221w-222s.° Communication Agencies as Social Institutions. Influence of political, social, and economic forces upon national character and performance of mass media. (3 cr per qtr; prereq ‡) Gerald, Gillmor

224f-225s.° Seminar: International News Communication and Comparative Journalism. Problems in communication of news and opinion between nations and under varying types of political and economic systems. (3 cr per qtr; prereq 124, 125 or 126, and reading knowledge of a foreign language) Nixon

230s.° Seminar: Public Opinion and Propaganda. Theoretical bases of public opinion and propaganda. Developing literature in this field of specialization. (3 cr; prereq 130 and consent of adviser) Carter

264s.° Seminar: Advertising Research. Advertising as persuasive communication. Application of research findings and techniques of related social sciences to the advertising decision-making process. Comparison of "quantitative" and "qualitative" techniques. Survey of new developments in creative, media, and market research. (3 cr; prereq 115 or 215 or ‡) Peterman

277f. Freedom of Press and Communications Law. Agencies of mass communication under the United States Constitution today. (3 cr; prereq 177 or ‡) Gerald, Gillmor

278w-279s.° Government and Mass Communications. Reconciliation of social and individual interest through government actions affecting mass media. (3 cr per qtr; prereq 177, 277 or ‡) Gerald

290f-291w-292s.° Special Problems in Mass Communications. Individual research; for graduate students with major or minor programs in journalism. (3 cr per qtr; prereq ‡) Graduate staff

LAW

Professor

Carl A. Auerbach, *director of graduate study for the major*
George C. Christie
John J. Cound
David L. Graven
Bruno H. Greene
James L. Hetland
James F. Hogg
Stanley V. Kinyon
Robert J. Levy
William B. Lockhart, *director of graduate study for the minor*
Robert C. McClure
Allan H. McCoid
C. Robert Morris
Maynard E. Pirsig
Stephen B. Scallen
Thomas L. Waterbury

Associate Professor

Arnold N. Enker

Master of Arts Degree in American Legal Institutions—This degree is available for foreign-trained lawyers. It is designed to give lawyers trained under other legal systems some understanding of the American legal system and its institutions. It requires not less than a full year in residence during which the candidate takes law courses selected to meet his special needs and interests, together with advanced work in other departments of the University, selected to put his studies in the Law School in their proper social, economic, political, and cultural framework. The degree is subject to the regular Plan B credit requirements.

Minor—A minor for either the Master's degree or the Ph.D. degree may be earned in law when this field logically relates to the field in which major work is being pursued. Effort will be made to suit the minor program to the particular needs and interests of the student.

Courses will be individually arranged both for the Master of Arts Degree and for the minor in law. For typical course offerings see the *Law School Bulletin.*

LIBRARY SCIENCE

Professor
David K. Berninghausen, *director, director of graduate study*
Ralph H. Hopp
Errett W. McDiarmid
John Parker
Wesley C. Simonton
Edward B. Stanford

Associate Professor
Raymond H. Shove

Assistant Professor
James Kingsley, Jr.
Lowell E. Olson

Instructor
Nancy J. Freeman
Edith Kromer

Lecturer
Marie Samanisky
Yvonne Van der Boom

Students may plan their study programs for work in college, university, public, special, children's, or school libraries.

Prerequisites—Admission to the Graduate School for major work in library science requires a Bachelor's degree from an approved college or university.

Language Requirement—Reading knowledge of one foreign language.

Master's Degree—Offered under both Plan A and Plan B. Each candidate for the M.A. degree is required to take one of the following courses: 254, 255, 256, or 257.

Doctor's Degree—A minor in library science may be presented for the Ph.D. with an appropriate major field.

101. Library Administration. Principles of library administration, organization, and management. General course for all librarians. (3 cr) Berninghausen

102. Reference I. Intensive study of some 150 outstanding and useful reference books and tools most frequently used by students and librarians, landmark reference books, indexes, and periodical guides. Theory and practice of reference work. (3 cr) Van der Boom

103. Cataloguing and Classification. Basic principles of descriptive cataloguing, rules of entry, subject headings, and classification in libraries, for all types of libraries. (3 cr) Samanisky

104. Selection of Library Materials. Theory, principles, and techniques of selection; basic tools for selection of books, magazines, pamphlets, phonograph records, films, etc., for all types of libraries. (3 cr) Freeman

105. History of Libraries and Librarianship. Library development from ancient times to present; library service in the United States in the 19th and 20th centuries. Libraries as social agencies. (3 cr) Shove

171. Reading Guidance for Children. (3 cr; prereq 104) Olson

172. Reading Guidance for Adolescents. (3 cr; prereq 104) Olson, Kromer

173. Reading Guidance for Adults. (3 cr; prereq 104) Kromer

206. Legal Literature and Research. Minimum instruction in legal research methods and materials for law libraries. (3 cr, §Law 106; prereq 102, ‡) Greene

231.* **Public Library Extension and Development.** Larger units of service based upon county and multi-county patterns. Operation of federal and state aid programs. Legal basis for the larger unit of service. Consideration of financial, administrative, materials selection, personnel problems involved. (3 cr; prereq 101)

241. Library Mechanization and Systems Analysis. Application of systems analysis to library operations; principles, problems, and examples of library mechanization. (3 cr; prereq 101 and 103 or ‡) Simonton

242. Introduction to Information Retrieval. Theory of various methods of subject analysis; methods of data representation, including coding; search strategies. (3 cr; prereq 103 or ‡) Simonton

243. Advanced Information Retrieval. Advanced topics in library mechanization and information retrieval. (3 cr; prereq 241, 242) Simonton

253. The History of Books and Printing. Bookmaking in its various forms from earliest times to present. Evolution of the alphabet; the manuscript book; invention and spread of printing; design of the modern book. Emphasizes aesthetic and technical aspects. (3 cr; prereq ‡) Shove

254. The Public Library. History and development. Service standards. Modern trends and problems. Overview of the literature of the field. Development of the materials collection. (3 cr; prereq 101) Smith

255. The College and University Library. The place of the library in the college and university organization. Influence on the library of developments and trends in higher education. (3 cr; prereq 101) McDiarmid

256. Special Libraries. Procedures, practices, and problems of newspaper, music, insurance, medical, technical, and other special libraries. (3 cr; prereq 101) Aspnes

257. School Library Problems. Library objectives in relation to educational objectives, larger units of school service, value and effect of standards. (3 cr; prereq 101) Olson

258. Problems in College and University Librarianship. (3 cr; prereq 101 and 255) Berninghausen, McDiarmid

259. Problems in Public Librarianship. (3 cr; prereq 101 and 254)

260. Literature of the Social Sciences. Bibliographical and other reference sources. Development of knowledge, landmark books, and current trends in the subjects covered. (3 cr; prereq 102) Shove, Kromer

261. Literature of the Humanities. Bibliographical and other reference sources including reviewing mediums. Developments and trends in the subjects covered. (3 cr; prereq 102) Van der Boom

262. Literature of the Natural Sciences. Bibliographical and other reference sources, with emphasis on indexing, abstracting, and reviewing mediums. Growth and development of scientific literature and its control and dissemination. Science background is not required for this course. (3 cr; prereq 102) Shove

265. Advanced Bibliography. National and trade bibliographies of the world, with emphasis on those of the United States, Great Britain, France, Germany, and Russia. Their use in selection and acquisition of books and in preparation of subject bibliographies. (3 cr; prereq 102) Shove

266. Advanced Reference. A subject approach to major reference sources, especially in law, medicine, business, genealogy, local history, history, literature, education, agriculture, pure and applied science. City, state, and national government documents and UNESCO publications. Research information resources for urban area. (3 cr; prereq 102)

267. Descriptive Bibliography. Problems in bibliographical research, especially bibliographical problems encountered in acquisition, cataloguing, and description of antiquarian books. (3 cr; prereq 103, 265, or ‡) Parker

268. Research Methods in Librarianship. Evaluation of research reported in library literature. (3 cr; prereq ‡) McDiarmid, Olson

272. Children's and Young People's Work. (3 cr; prereq 254 or 257) Olson

275. Publishers and Publishing. Publishing in the United States in the 19th and 20th centuries. Economics and organization, copyright, influence of machines, important publishers and booksellers, special publishing, censorship, etc. Book production and book distribution. (3 cr) Shove

276. Communication Media and the Library. Process of communication, books, magazines, newspapers, television, radio, and the film in relation to libraries in society. (3 cr; prereq ‡) Berninghausen

277. History of Children's Literature. Traced to gain a general appreciation, to discover characteristics of books chosen by children, and to help develop standards for selection of children's books. (3 cr; prereq ‡) Kromer

283. Advanced Cataloguing and Classification. Rules of entry, descriptive cataloguing and subject analysis of library materials; administrative problems in cataloguing. (3 cr; prereq 103) Simonton, Samanisky

295,* 296,* 297.* Library Research. Graduate students may register for one or more of these courses, with the approval of the professor who will guide the research paper. (3 cr; prereq 101, 102, 103, 104, 105 and admission to the Graduate Library Program) Staff

298. Independent Study in Library Science. (3 cr; prereq ‡) Staff

LINGUISTICS

Professor

Harold B. Allen
John W. Clark
Walter Lehn, *chairman, director of graduate study*
Walter T. Pattison
Robert F. Spencer
Donald C. Swanson
Cecil Wood

Associate Professor

Evelyn S. Coleman
Nils Hasselmo
Richard B. Mather
Richard A. Narvaez

Assistant Professor

Owen R. Loveless
Harvey B. Sarles

Students interested in languages and linguistics and who would like to prepare themselves professionally for a career in language teaching, linguistic research, lexicography, dialectology (and other field work), or in historical and cultural studies based on linguistics and philology, are encouraged to consult the chairman. Tentative programs can be worked out to suit backgrounds and needs of qualified students.

The aim of the program is to train competent students in the whole spectrum of modern linguistics, students who are at home in both descriptive-structural and historical-comparative fields as well as in use of teaching methods and recording devices and research tools such as simple statistics and the digital computer.

Certain courses in peripheral departments are recommended to the attention of students as possible ingredients in a minor sequence or as a supporting program of study. These are Spch 109 and 275, Phil 154 and 162, Psy 118.

Prerequisites—For major work, not less than 6 quarter credits above 50 in each of two foreign languages, one of which must be German or Latin. For minor work, not less than 6 quarter credits above 50 in a foreign language. See also requirements for the B.A. degree in this program.

Master's Degree—Offered under Plan B; Plan A may be followed by petition. Reading knowledge of Latin and German and an elementary knowledge of a third foreign language are generally required of all candidates.

Doctor's Degree—The M.A. degree (or an equivalent in course work) is a prerequisite to registration for the Ph.D.

Program—Students will work toward competence in several of the following subfields (two for the M.A., four for the Ph.D.):

1. General linguistics
2. Fluency in a modern language and knowledge of its structure and history
3. Linguistic and philological competence in an ancient language (e.g., Old Norse, Greek, Old French, Classical Arabic)
4. A non-Indo-European language, such as Arabic, Chinese, Hebrew, or Japanese; 1 year minimum of serious study
5. English linguistics—history and structure

Note—For details in courses listed below, see listing under the department involved.

General Courses

Ling 101-102-103.† Linguistic Structures. (3 cr per qtr; prereq ‡) Lehn

Clas 106w-107s. Introduction to the Study of Language. (3 cr per qtr; prereq 56 or ‡)

Spch 140f. Introduction to Voice Science. (3 cr; prereq 5, Psy 2) Wendahl

Spch 141w. Anatomy and Physiology of Voice Mechanism. (3 cr; prereq Spch 5, 67, or ‡, Psy 5) Wendahl

Spch 142s. Physical Bases and Instrumentation of Speech. (3 cr; prereq Spch 5, 67, 140, or ‡, Psy 5) Wendahl

Ling 151f, 152w, 153s. Readings Course. (1-3 cr per qtr; for majors only)

Phil 162. Philosophy of Language. (3 cr; prereq Phil 2, 6 upper division credits in philosophy or ‡; offered when feasible) Mason

Anth 180-181.† Descriptive Linguistics. (3 cr; prereq ‡) Spencer

Anth 185. Language and Culture. (3 cr; prereq 2A or 100 or △) Spencer

Ling 204-205-206.† Seminar: Methods of Analysis and Theories of Grammar. (3 cr per qtr; prereq Clas 107 or ‡) Lehn

Classics

Grk 101. Structure of Greek. (3 cr; prereq 2 yrs Greek and Clas 56; offered 1966-67) D Swanson

Skt 128-129-130. Readings in Sanskrit. (3 cr per qtr; offered 1966-67) D Swanson

Lat 133. Vulgar Latin. (3 cr; open to advanced students of Latin or a Romance language with ‡; offered 1966-67) D Swanson

East and South Asian Languages

Chin 105-106-107. Introduction to Chinese Linguistics. (3 cr per qtr; prereq Chin 103 or Clas 56 or ‡) S Wang

Indn 105. Structure of Hindi. (3 cr) Staneslow

Indn 106-107. Hindi Linguistics. (3 cr per qtr; prereq ‡, some background in linguistics) Staneslow

Jpn 105-106-107. Introduction to Japanese Linguistics. (3 cr per qtr; prereq Jpn 103 or Clas 56 or ‡)

English

100f. Old English. (4 cr; prereq 5 cr in literature in English Dept, exclusive of classics and A-B-C)

102w. Readings in Old English Prose and Verse. (3 cr; prereq 100)

103s. Beowulf. (3 cr; prereq 100)

165f,w. Introduction to Modern English. (3 cr; prereq 5 cr in literature exclusive of classics and A-B-C) Allen

166. Historical Backgrounds of Modern English. (3 cr; prereq 5 cr in literature in English Dept, exclusive of classics and A-B-C; offered when feasible) Allen

174s. American English. (3 cr; prereq 6 cr in English literature, including language above A-B-C, or ‡) Allen

204, 205, 206. Studies in English Language. (3 cr per qtr; prereq 100) Allen

German

107-108-109.† Structure of Modern German. The linguistic approach to study of the structure of present-day German. (3 cr per qtr; offered 1966-67) C Wood

110-111-112. Middle High German. (3 cr per qtr)

113f. Gothic. (3 cr) C Wood

114-115. Methods of Comparative Germanic Linguistics. (3 cr per qtr) C Wood

119-120-121. Old High German. (3 cr per qtr) Coleman

122, 123. History of the German Language. (3 cr per qtr)

125. Runic Inscriptions. (3 cr; prereq ‡) C Wood

126. Old Saxon. (3 cr; prereq 121) C Wood

Middle Eastern Languages

Arab 105w. Structure of Arabic. (3 cr; prereq 2 yrs of Arabic or ‡) Staff

Arab 154f-155w-156s. Seminar: Development of Arabic Language and Literature. (3 cr per qtr; prereq ‡) Staff

Heb 151f-152w-153s. Northwest Semitic Inscriptions. (3 cr per qtr; prereq Heb 53 or ‡) Staff

Psychology

117. Analysis of Behavior. (3 cr; prereq Psy 2, one course numbered 50 or above) MacCorquodale

118. Verbal Behavior. (3 cr; prereq Psy 2 and one course numbered 50 or above) MacCorquodale

Romance Languages

Fren 107-108-109. Structure of Modern French

Fren 207-208-209. Old Provençal

Fren 241-242-243. Old French Philology

Fren 244-245-246. Readings in Old French Literature

Rom 114s. Introduction to Romance Philology. (3 cr)

Span 107-108-109. Structure of Modern Spanish

Span 241-242-243. Old Spanish Philology

Span 244-245-246. Readings in Old Spanish Literature

Scandinavian

121-122-123. Old Norse: Language and Literature. (3 cr per qtr) Hasselmo

124. The Structure of the Scandinavian Language. (3 cr) Hasselmo

125. History of the Scandinavian Languages. (3 cr) Hasselmo

126. Seminar: Scandinavian Linguistics. (3 cr) Hasselmo

Slavic and East European Languages

Russ 107-108-109. Structure of Modern Russian. (3 cr per qtr) Donchenko

Russ 125-126-127. History of the Russian Language. (3 cr per qtr)

Slav 113-114-115. Old Church Slavic (Old Bulgarian). (3 cr per qtr)

MARRIAGE AND FAMILY STUDY

Several departments of the Graduate School converge to offer training relevant for marriage and family educators, counselors, and researchers. Five graduate major areas permit marriage- and family-oriented graduate students to concentrate in this area for the Master's degree or the Ph.D. so long as they fulfill all other requirements for the basic major: child psychology, educational psychology, home economics, psychology, or sociology. The staff and advisory committee of the Family Study Center exercise an over-all interest and supervision of this graduate program, providing consultation to advisers in the major and aid to graduate students in designing individualized programs of study. All candidates, regardless of major, are expected to receive instruction in four functional categories of training: (a) theory and content, (b) research methods relevant for family study, (c) counseling theory and methods, and (d) teaching methods relevant for functional marriage education.

The designing of the individual student's program takes into account the assets and deficiencies peculiar to the discipline in which he is majoring, broadening his program by supplementation in the minor and collateral fields or in the supporting program of study. This enables the student to complete his graduate study adequately equipped to serve as an educator or researcher in the field of the family.

Special services within this program of training include an apprenticeship in college teaching in the undergraduate marriage preparation classes operated by the Family Study Center and a marriage counseling practicum offered through the facilities of the Student Counseling Bureau.

MATHEMATICS

Professor
Alfred Aeppli
Donald G. Aronson
Robert H. Cameron, *director of graduate study*
Rafael V. S. Chacon
Harry Furstenberg
Steven A. Gaal
Leon W. Green
Heinrich Guggenheimer
Edward L. Hill
Gerhard Kalisch
Gopinath Kallianpur
Fulton Koehler
Walter Littman, *associate chairman*
Warren S. Loud
Lawrence Markus
William D. Munro
Johannes C. Nitsche
Steven Orey, *head*
Daniel Pedoe
Edgar Reich
James B. Serrin
Yatsutaka Sibuya
Marvin L. Stein
David A. Storvick
Hugh L. Turrittin
Hans F. Weinberger

Associate Professor

George U. Brauer
John R. Cannon
Erwin Engeler
Paul C. Fife
Jesus Gil de Lamadrid
William A. Harris, Jr.
Jack Indritz
Benton N. Jamison
Howard B. Jenkins
Bernard W. Lindgren
Albert Marden
Charles A. McCarthy
Norman G. Meyers
Chester L. Miracle
William F. Pohl
Marian B. Pour El
William E. Pruitt
Peter A. Rejto
Arthur A. Sagle
John M. Slye
Warren B. Stenberg
Charlotte E. Striebel

Assistant Professor

Loren E. Argabright
Melvyn S. Berger
Robert M. Brooks
Bert E. Fristedt
E. Gebhard Fuhrken
Karl Gustafson
Laurence R. Harper, Jr.
Naresh C. Jain
James T. Joichi
Donald W. Kahn
John A. Kelingos
Gordon Keller
George H. Knightly
Jay A. Leavitt
Ottman Loos
Willard Miller, Jr.
J. Ian Richards
Wayne W. Schmaedeke
George R. Sell
Robert C. Sine
James E. Thompson
Carroll O. Wilde

Lecturer

Ilse N. Gaal

Instructor

Lincoln E. Bragg
John S. Locker
Clifford R. Perry

Students majoring in mathematics should consult Professor Cameron, director of graduate study, School of Mathematics.

Prerequisites—For students majoring in mathematics, 15 credits in analytic geometry and calculus and 15 other credits in non–Lower Division courses. Exceptions may be made in unusual circumstances. For students minoring in mathematics, 15 credits in analytic geometry and calculus.

Language Requirement—For the Master's degree, one foreign language from the following list: German, French, Russian, Italian. For the Ph.D. degree, two foreign languages from the above list are required.

Master's Degree—Offered under both Plan A and Plan B. Both written and oral examinations required. Ordinarily the degree program should contain a three-course sequence of 200-level mathematics or its equivalent. The Plan B paper requirement may be met in connection with any course accepted for graduate credit if the instructor's approval is secured. The written Ph.D. preliminary examination may be substituted for the written Master's examination.

Doctor's Degree—A student's program of work for the Ph.D. degree must be made in consultation with an adviser. The written Ph.D. preliminary examination, taken during the first or second year of graduate work, covers basic analysis, basic algebra, and basic point-set topology, as well as the contents of one of the graduate courses 205, 221, or 222. Upon completion of course work, the student must pass an oral examination in which he will be required to demonstrate knowledge in the area of real and complex variable theory as well as in two of the following areas: (a) algebra, (b) geometry and/or topology, (c) an acceptable portion (equal to the contents of a three-quarter graduate sequence) of applied mathematics, statistics, etc. The examination will also include the minor.

Minor—Students who wish to minor in mathematics at the Ph.D. level must have completed course work in mathematics containing at least one three-course sequence at the 200 level or the equivalent.

For more detailed information about the courses offered in 1967-68, students should consult the program of the School of Mathematics as recorded in the *Bulletin of the Institute of Technology*.

Note—For information on work in statistics, see section on Statistics. Attention is called to several Ph.D. programs of an interdisciplinary nature that rely heavily on mathematics. Interested students should consult the entries in this bulletin under Control Sciences and Fluid Mechanics.

104. Variational Problems. Euler-Lagrange equations, isoperimetric problems, geodesics, Fermat's and Hamilton's principles, vibration and stresses in elastic bodies, methods of Rayleigh-Ritz, Galerkin, Kantorovich, etc., eigenvalues and eigenfunctions. (3 cr; prereq 153 or 148 or 150 or ‡)

106. Differential Equations. Problem course, methods for solving ordinary differential equations of various types with necessary theory for developing these methods. (3 cr, §32; prereq 55)

107-108.* Advanced Calculus. Introduction to analytic theory of limits and continuity, uniform convergence; partial derivatives; differentials; Taylor's theorem for several variables, relative and absolute extrema, Lagrange multipliers; transformations for 2 space and 3 space; basic theory of Riemann single and multiple integrals; line and surface integrals; introduction to vector analysis; theorems of Green and Stokes, divergence theorem, improper integrals; beta and gamma functions. (3 cr per qtr, §151, 153; prereq 32 or 55)

109. Theory of Numbers. Elementary properties of integers; prime and composite numbers; Euclid's algorithm; congruences; the theorems of Fermat and Wilson; primitive roots; indices; Diophantine equations. (3 cr; prereq 31 or 44)

110x. Tutorial Course in Advanced Mathematics. Qualified students whose needs are not met by courses offered may make special arrangements for obtaining the content of other graduate courses regularly offered by the department. (Cr ar; prereq 31 or 44)

111. Development of the Number System. Systematic construction of the real number system by extension from the natural numbers via rational numbers to irrational numbers; negative numbers; properties of the system; operation with numbers and laws governing the operations. (3 cr, §111A, B; prereq 31 or 44)

111A-B. Development of the Number System. Systematic construction of the real number system by extension from natural numbers via rational numbers to irrational numbers; negative numbers; properties of the system; operations with numbers and laws governing the operations. (3 cr per qtr; prereq 31 or 44)

112. Elementary Set Theory. Basic properties of operations on sets, cardinal numbers, simply ordered sets, well-ordered sets, ordinal numbers, axiom of choice, axiomatics. (3 cr; prereq 32 or 44)

112A-B-C. Mathematical Logic. Propositional and predicate calculi, models for systems of logic, recursive functions, decision and completeness problems. (3 cr per qtr; prereq 32 or 55 or Phil 155 or ‡)

115A-B-C. Differential Geometry. Curves in the plane and in space; Frenet formulas, foundations of calculus of variations. Theory of surfaces; fundamental forms, curves on surfaces. Surfaces of constant curvature, non-Euclidean geometry and trigonometry. Minimal surfaces. Deformations; introduction to theory of continuous transformation groups. Differential geometry of n-dimensions; parallelism, affine connection, curvature. (3 cr per qtr; prereq 32 or 55 and 131A or ¶131A)

116A-B. Modern Geometry. Geometric transformations; similarities, affinities, collineation, inversion. The notion of a transformation group. Projective geometry as a study of the invariants of the general linear group (Erlanger Program). Problems in geometry of transformation groups, mathematical analysis of the space problem. (3 cr per qtr; prereq 131A or ¶131A for 116B)

117A, B, C. Geometry. Selected chapters of geometry, such as convex bodies, projective geometry, geometry and imagination, elementary algebraic geometry, geometry of transformation groups, axiomatic geometry, geometrical constructions. (3 cr per qtr; prereq 31 or 44)

119. Topics in Finite Groups. Introduction to the theory of finite groups. Group axioms, examples of groups, subgroups and direct products, factor groups and composition series, permutation groups, prime power groups, Abelian groups. (3 cr; prereq 44 or equiv)

121-122-123. Mathematical Theory of Statistics. See Stat 131-132-133.

125A-B. Critical Reasoning in Mathematical Analysis. Notions of limit, sequence, series, function, derivatives, and integral. Gives more mature understanding of these concepts. Technique of developing accurate proofs; intuition and logic in connection with these techniques. (3 cr per qtr; prereq 32 or 44)

127-128-129. Applied Mathematics for Social and Biological Sciences. Mathematical tools and concepts other than statistics useful in behavioral sciences. Examples and problems taken from fields concerned. Topics include matrices, functions of several variables, probability, difference equations, learning models, two-person games. (3 cr per qtr, not accepted for mathematics majors [all degrees] as part of mathematics programs; prereq 32 or 55)

130A-B-C. Introduction to Analysis. Theory of real numbers; elements of point set theory; limits; continuity; infinite sequences and series; integration and differentiation; vector analysis. Principally designed for prospective graduate majors in mathematics, as preparation for graduate courses in analysis. (3 cr per qtr; prereq 32 or 55)

131A-B-C. Linear Algebra and Group Theory. Finite dimensional vector spaces; linear transformations and matrices over the real or complex fields; linear equations; determinants; characteristic values; canonical forms; bilinear and quadratic forms; applications; introduction to abstract concepts of modern algebra; more detailed study of finite groups, including Jordan-Hölder theorem and basis theorem for Abelian groups. (3 cr per qtr, §149, §142-143, §180; prereq 31 or 44)

133B-134B. Probability with Technological Applications. Spectral analysis of stationary processes, linear and nonlinear transformations, prediction and smoothing, recurrent events, random walk and diffusion, Markov chains, Poisson processes. (3 cr per qtr; prereq Stat 131 and ♯)

135. Integral Equations. Introduction to integral equations with emphasis on applications and techniques of solution including Fredholm formula, Neumann series, Laplace transforms, successive approximations, and numerical methods. Relation of integral equations to systems of linear algebraic equations and to differential equations. (3 cr; prereq 32 or 106)

136. Solid Analytic Geometry. Algebraic treatment of planes and lines; direction cosines; systems of planes. Cylinders; surfaces of revolution. Quadratic surfaces; tangent planes, ruled surfaces. Co-ordinate transformations, invariants. General equation of the second degree. (3 cr; prereq 22 or 43 or ¶22 or ¶43)

140. Projective Geometry. Geometric properties invariant under projective transformations; theorems of Desargues, Pascal, and Brianchon, and applications. Methods used in some quarters are mainly synthetic; in other quarters they are mainly analytic. (3 cr; prereq 31 or 44)

142-143. Linear Algebra. Systems of linear equations, determinants, finite dimensional vector spaces, matrices, characteristic values and their numerical estimation, reduction to canonical forms, quadratic and bilinear forms. Application to engineering problems. (3 cr per qtr, §149, §131A-B-C; prereq 31 or 44)

144-145-146. Fourier Series and Orthogonal Functions. General theory of orthonormal functions developed and applied to Fourier, Legendre, Bessel, Hermite, and other series. Convergence and summability theorems are proved, and Fourier integral is considered. (3 cr per qtr; prereq 108 or 153 or ♯)

147. Vector Analysis. Scalar and vector products, derivatives, geometry of space curves, del operator, line and surface integrals, divergence and Stokes's theorem, transformation of co-ordinates, dyadics, applications. (3 cr; prereq 32 or 55)

148. Differential Equations. Linear differential and difference equations with constant coefficients, isoclines, phase plane, reduction in order, Picard's method, uniform convergence, series solutions, Bessel functions, Legendre polynomials, introduction to boundary value problems. (3 cr, §150; prereq 32 or 106)

149. Determinants and Matrices. Determinants, matrices, linear equations, vector spaces, quadratic and bilinear forms, characteristic roots, applications to systems of ordinary differential equations. (3 cr, §63, §131A; prereq 31 or 44)

150. Ordinary Differential Equations. Linear equations of second order, successive approximations. Existence theorems, systems of ordinary differential equations. Numerical integration and solution by series. (3 cr, §148; prereq 32 or 106)

151. Advanced Calculus I. Limits, properties of continuous functions of one and several variables, partial differentiation, implicit functions, maxima and minima, Taylor's theorem, transformations and mappings, integrals containing a parameter or variable limits, Stieltjes integral. (3 cr, §107; prereq 32 or 55)

153. Advanced Calculus II. Infinite series, computation with series, series with variable terms, uniform convergence, power series. Improper integrals. Fourier series and orthogonal functions. Fourier integrals. Special functions. (3 cr, §108; prereq 151)

155-156. Tensor Analysis with Applications. (3 cr per qtr; prereq 147, 149 or 131A, 147 or ‡)

157-158-159. Methods of Applied Mathematics. Integrated study of analytic tools used in applications of mathematics; emphasis on technique. Real and complex variables, matrices, ordinary and partial differential equations, calculus of variations, asymptotic expansions, etc. (3 cr per qtr; prereq 108 or 153 or ‡)

161-162-163. Analytical Dynamics. Basic laws and principles. Lagrange's equations. Motion of particles and rigid bodies; e.g., satellites and gyroscopes. Matrix methods for small oscillations. Variational methods, Hamilton's principle, extremal properties of eigenvalues. Hamilton's equations, transformation theory, separable systems. (3 cr per qtr; prereq 147, 149 or 131A, 147 or ‡)

164-165-166. Theory and Programming of Modern Digital Computers. Number systems. Analysis of arithmetic algorithms. Logical organization. Storage, control, and input-output units. Basic and advanced machine language and compiler programming. Libraries, advanced assembly techniques, interpretive systems, compilers. Application to mathematical and physical problems. Informal laboratory. (3 cr per qtr, §65; prereq 32 or 55 or ‡)

167. Fourier Series and Boundary Value Problems. Partial differential equations of theoretical physics, Fourier series, proof of convergence, orthogonal systems. Sturm-Liouville systems, solution of boundary value problems by separation of variables, applications. (3 cr, §173; prereq 32 or 106)

168A. Elementary Theory of Complex Variables. Derivative and integral of a function of a complex variable. Cauchy's integral theorem and formula, residues. Application to evaluation of integrals, conformal mapping. (3 cr, §175; prereq 151, 153 or 147, 148, 149 or 108 or ‡)

168B. Applications of Complex Variables. Conformal mapping, Schwarz-Christoffel transformations, Laplace transforms, and applications. (3 cr; prereq 168A or ‡)

169. Mathematical Theory of Fluid Flow. General equations of fluid mechanics. Concepts from thermodynamics. Classical constitutive equations. Specialization to various subfields of fluid mechanics, including hydrostatics, barotropic perfect fluids, gas dynamics, and viscous flow theory. Examples of exact solutions. (3 cr; prereq 147, 174, or 147, 168A, or ‡)

173-174-175. Elementary Partial Differential Equations. Partial differential equations of theoretical physics, one-dimensional wave equation, characteristics, classification of second order equations, heat and Laplace equations, uniqueness, maximum principle, orthogonal systems, Fourier series, separation of variables. Complex numbers, derivatives and integrals of analytic functions, elementary functions and their geometry, Cauchy's integral theorem and formula, Laurent expansions, evaluation of contour integrals by residues. Fourier and Laplace transforms and their inversion, method of residues, applications to ordinary and partial differential equations, applications to the heat, wave, and Laplace equations. (3 cr per qtr, §167, §168A; prereq 32 or 106, 55, ‡)

178. Probability. Elementary principles of probability, total and compound probability, expectation, repeated trials, and as time permits topics chosen from the following: Stirling's formula, the probability integral, geometrical probability, probability of causes, Bayes's theorem, errors of observation, principle of least squares. (3 cr; prereq 31 or 44)

178A-B-C. Introduction to Probability. Logical development and various applications of probability. Probability spaces, random variables, central limit theorem; Markov chains. (3 cr per qtr; prereq 108 or 153 or Stat 133 or ‡)

180. Group Theory. Permutation groups, groups related to geometrical configuration; invariant subgroups, the Jordan-Hölder composition theorem, Sylow groups, Abelian groups, elementary divisors, representation theory, applications. (3 cr; prereq 143 or ‡)

181-182-183. Selected Topics in the Theory of Numbers. (3 cr per qtr; prereq 108 or 153 or ‡) S Gaal

181A-B. Topology of the Cartesian Plane. Limit points, coverings, compactness, connectedness, arcs, simple closed curves, mappings, Peano continua, Jordan curve theorem. (3 cr per qtr; prereq 32 or 55) Slye

184. Elementary Numerical Analysis in Engineering. Finite differences, interpolation, summation of series, numerical integration, Euler-MacLaurin formula and asymptotic expansions. Numerical solutions of systems of algebraic and transcendental equations. Newton's and Graeffe's method. (3 cr; prereq 32 or 106)

185-186. Numerical Analysis in Engineering. Approximation of functions and least squares. Approximate solution of ordinary and partial differential equations, Moulton's, Runge's, relaxation and iteration methods. Calculation of eigenvalues of matrices and differential problems, Rayleigh-Ritz method. Integral equations. Programming of computers. (3 cr per qtr; prereq 184 or ‡)

187. Non-Euclidean Geometry. Foundations of Euclidean geometry, Euclid's fifth postulate and its implications. Hyperbolic plane geometry and trigonometry. Elliptic plane geometry and trigonometry. Consistency of non-Euclidean geometry. (3 cr; prereq 31 or 44)

188. Topics in Topology. Elementary and intuitive concepts associated with typical curves and surfaces. Construction of models. Elements of homotopy. (3 cr; prereq 31 or 44)

190A-B-C. General and Algebraic Topology. General topological and metric spaces. Function spaces. Fundamental group and covering spaces. Singular and simplicial homology theory. Betti and torsion groups. Fixed point theorems and applications to analysis. Classification of surfaces. (3 cr per qtr; prereq 131A or ¶131A)

192. Theory of Approximation in Numerical Analysis. Orthogonal functions. Chebyshev approximations, rational approximations, approximations in several variables, use of approximations in computing. (3 cr; prereq 168A, 175, 185, or ‡)

193A. Axiomatic Geometry. Axiomatic presentations of Euclidean and non-Euclidean geometries. Vector spaces and metric spaces. (3 cr; prereq 108 or 153 or ‡)

193B. Elementary Projective Geometry. Projective space as a global manifold. Homogeneous co-ordinates and classical projective spaces. Lattice description of projective space. Theorems of Desargue, Pappus, and Pascal. Quadratic surfaces. (3 cr; prereq 108 or 153 or ‡)

193C. Elementary Differential Geometry. Curves and surfaces in Euclidean 3-space. Frenet-Serret formulas for a curve. First and second fundamental forms for a surface, Gauss curvature. Meusnier, Euler, Dupin theorems. (3 cr; prereq 108 or 153 or ‡)

196-197-198. Special Functions in Mathematical Analysis. Asymptotic expansions. Gamma and Beta functions. Hypergeometric functions as solution of differential equations. Bessel functions using Sommerfeld's contour integrals. Legendre functions. (3 cr per qtr; prereq 168A or 175 or ‡)

199A,B,C. Problem Course. Develops problem-solving techniques in many areas of mathematics. Topics range from elementary to advanced levels, adapted to students of varied backgrounds. (3 cr per qtr; prereq ‡)

202A-B-C. Advanced Logic. (3 cr per qtr; prereq 112C or ‡)

203A-B-C. Topics in Logic. (3 cr per qtr; prereq 112C or ‡)

204A-B. Formal Languages and Automata. Theory of computability, finite automata theory, algorithmic languages, formal aspects of the organization of abstract and actual machines. (3 cr per qtr; prereq 112A and ¶112B and ¶112C)

205A-B-C. General Algebra. A: Sets with compositions. Groups and semigroups with operators. Homomorphism theorems. Jordan-Hölder theorem. Abelian groups. Finitely generated groups. Rings, modules, and fields. Ideals and quotients. Commutative rings, especially polynomial and power series algebras. Unique factorization. Prime fields, finite fields. Finite field extensions. B: Vector spaces and modules. Duality, space of linear maps. Multilinear algebra; tensor products; special algebras. Application to algebraic field extensions; Galois theory. Transcendental field extensions. Valuations. C: Simple and semisimple rings. Chain conditions on rings and modules. Wedderburn theorem. Representations of finite groups. (3 cr per qtr; prereq 131C or ♯)

206A-B-C-D-E. Topics in Algebra.

206A: Lattice Theory. Order relations, general lattices, modular and distributive lattices, Boolean algebras, algebraic and geometric models. (3 cr; prereq 205A or ♯)

206B: Group Theory. Finite groups, Sylow theory, simple groups, finitely generated groups, word problem, solvable groups, nilpotent groups. (3 cr; prereq 205A or ♯)

206C: Homological Algebra. Complexes, resolutions, homology and homotopy. Derived functors and their relation to homology. Finite groups. (3 cr; prereq 205B or ♯)

206D: Noetherian Modules. Hilbert's basis theorem, primary decomposition and uniqueness theorems, extension and contractions, local rings, regular local rings, structure of complete rings. (3 cr; prereq 205C or ♯)

206E: Algebraic Number Theory. Integrally dependent rings, integrally closed rings, Dedekind domains, extension of Dedekind domains and decompositions of prime ideals, ramification theory, different and discriminant, class group and class number. (3 cr; prereq 205C or ♯)

207A-B-C. Foundations of Algebra. Lattices and structure of algebraic systems, universal algebra, and interconnections between logic and algebra. (3 cr per qtr; prereq ♯) Jonsson

208A-B-C. Structure of Rings and Algebras. Rings with minimum condition, semi-simple rings, Wedderburn theorems; matrix representations; crossed products; cyclic algebras; rational division algebras; primitive rings; rings with a radical; nonassociative rings and algebras. (3 cr per qtr; 205C)

209A-B-C. Group Theory. Topics include the Sylow theorems, P-groups, nilpotent groups, solvable groups, the Jordan-Hölder theorem for groups with operators, automorphism groups, permutation groups, representation theory for finite groups, finite simple groups, free groups and free products. (3 cr per qtr; prereq 205C or ♯)

210A-B-C. Theory of Local Rings. Rings, ideals, primary decomposition, rings of quotients, rank and dimension, integral elements, affine rings, local rings, semilocal rings, ring extension, regular local rings, structure theorem, Hilbert function, systems of parameters, multiplicity, unmixedness theorem. (3 cr per qtr; prereq 131C and ♯)

211A-B-C. Homological Algebra. Elementary theory of categories and their lattice structure, Abelian categories, functors and satellites, spectral sequences, universal mappings, semisimplicial complexes, local categories, applications. (3 cr per qtr; prereq 131C and ♯)

212A-B. Topics in Number Theory and Algebraic Geometry. Topics will include Riemann Zeta function, its functional equation and distribution of its zeros. Explicit formulas will be developed following A. Weil in terms of generalized functions. Theory of Zeta functions of algebraic number fields, function fields and of algebraic varieties, elliptic modular functions. Riemann-Roch theorems and complex multiplication. (3 cr per qtr; prereq 174, 205B or ♯)

212C. Topics in Number Theory and Algebraic Geometry. Riemann Zeta function, its functional equation and distribution of its zeros. Explicit formulas developed following A. Weil in terms of generalized functions. Theory of Zeta functions of algebraic number fields, function fields and of algebraic varieties, elliptic modular functions. Riemann-Roch theorems and complex multiplication. (3 cr; prereq 174, 205B or ♯)

221A-B-C. Complex Analysis. Review of fundamental concepts of analysis, real and complex numbers, analytic functions and conformal mapping. Cauchy's theorem and related concepts, sequences of analytic functions, Taylor and Laurent series; infinite products; residue calculus, the argument principle. Analytic continuation, algebraic functions. (3 cr per qtr; prereq 130C or equiv or 173-174-175 or ♯)

222A-B-C. Real Analysis. Review of fundamental concepts of analysis, elementary set theory. Measures and measure space, measurable functions, Borel and Lebesgue measure. Integration, fundamental convergence theorems, Radon-Nikodym theorem; Fubini's theorem. Differentiation of functions of a single variable; arc length. Metric, linear, and Banach spaces; L_p spaces, representation of linear functionals; C(X) spaces, Riesz representation theorem, Stone-Weierstrass theorem, Hilbert space, compact operators. (3 cr per qtr; prereq 130C or equiv or 221C or ♯)

223. Theory of Differentiation. Vitali's covering theorem; differentiation of set functions, Radon-Nikodym derivative, Lebesgue set, integral averaging. Calculus of generalized derivatives. Relation to classical differentiation process. Sobolev-Morrey inequalities; theory of trace. (3 cr; prereq 222C) Serrin

225A-B-C. Asymptotic Methods in Linear Analysis. Techniques for studying asymptotic behavior of solutions of linear differential, difference-differential, and integral equations by Laplace transforms. Laplace transform in the complex plane. Behavior at infinity. Abelian and Tauberian theorems. Routh-Hurwitz and Pontryagin stability criteria. (3 cr per qtr; prereq 211C or ♯)

226A-B-C. Conformal Mapping. Mapping of simply connected regions, Riemann's mapping theorem, boundary behavior of mapping function and its derivatives; Schwarz-Christoffel formula, elliptic modular function. Mapping of multiply connected regions onto canonical regions. Some variational problems in the complex domain, kernel functions. Applications to potential theory and aerodynamics. Numerical methods. (3 cr per qtr; prereq 221C or ♯)

227A-B-C. Riemann Surfaces. Heuristic introduction. Abstract definition of Riemann surface. Examples. Topology of two-dimensional manifolds. Existence and properties of harmonic functions. Generalized Riemann mapping theorems and the fundamental polygon. Introduction to classification theory. Method of extremal length. Theory of differentials. Existence of meromorphic functions. The special case of closed surfaces. (3 cr per qtr; prereq 221C or ♯)

228A-B-C. Topics in the Theory of Analytic Functions. (3 cr per qtr; prereq 221C or ♯)

229. Quasiconformal Functions. Geometric definition of quasiconformal mappings. Functions with generalized L_p-derivatives. Generalized solutions of Beltrami differential equations. Various characterizations of quasiconformal functions. Stoilow's theorem on interior mappings. (3 cr; prereq 221C or ♯)

229A-B. Theory of Quasiconformal Mapping. Extremal length. Conformal moduli. Standard extremal domains. Distortion theorems. Convergence theorems. Extensions of mappings. Analytic definition. Hilbert transform. Beltrami equation. (3 cr per qtr; prereq 221C)

230A-B-C. Topics in Several Complex Variables. (3 cr per qtr; prereq ♯)

231A-B-C. Dirichlet Series. Almost periodic functions, representation by Dirichlet series, convergence, absolute convergence and uniform convergence of Dirichlet series. Analytic functions represented by Dirichlet series, growth properties, Tauberian theorems. (3 cr per qtr; prereq 175 or ♯)

234A-B-C. Ergodic Theory. Concepts of ergodic theory; mixing conditions; norm and almost everywhere ergodic theorems; entropy; recent developments. (3 cr; prereq 222A-B-C)

235A-B-C. Functional Analysis. Basic properties of topological, locally convex and Banach spaces: theorems of Hahn-Banach, Krein-Milman, Mazur, Banach-Steinhaus, Eberlein; also open mapping, closed graph, uniform boundedness, Riesz convexity theorems; resolvents, spectra, spectral theorem in Hilbert space, integration of vector-valued functions. (3 cr per qtr; prereq 222C or ♯)

236A-B-C. Linear Spaces and Operator Theory. Basic properties of topological linear spaces. Hilbert spaces. Spectral theorem and spectral multiplicity theory. Rings of operators. Dimension theory. (3 cr per qtr; prereq 205C and 222C or ♯)

237A-B-C. Topics in Operator Theory. Linear ordinary differential equations, initial and boundary value problems; linear integral equations, semigroup theory, dynamical systems. Functional analytic methods and necessary Banach space and measure theory material. (3 cr per qtr; prereq 221C and 222C or ♯)

238A-B-C. Banach Algebras and Harmonic Analysis. Material from the books of Loomis, Naimark, Rudin, Hewitt. (3 cr per qtr; prereq 205C and 222C or ♯)

239A-B-C. Generalized Functions, Distributions, and Applications. Material from the books of A. Friedman, Gelfand-Šilov, Hörmander. (3 cr per qtr; prereq 221C, 222C or ‡)

240A-B-C. The Wiener and Feynman Integrals. First quarter: heuristic survey of the field. Second quarter: rigorous proof of countable additivity of Wiener measure, the translation theorem, and other topics. Third quarter; analytic and sequential Wiener and Feynman integrals; ILSTOW and related Feynman and limiting Feynman integrals. (3 cr per qtr; prereq 222C or ‡)

241A-B-C. Topological Groups. Work as found in the books of Pontryagin, Weil, Montgomery-Zippin, Rudin, Hewitt. (3 cr per qtr; prereq 205C, 251C or ‡)

242A-B-C. Group Representations. Basic properties through the work of Gelfand, Mackey, etc. (3 cr per qtr; prereq 205C, 238C or ‡)

243A-B-C. Abstract Operator Theory. Analysis of linear operators on linear topological spaces; spectral theory; semigroup theory; perturbation theory; applications to differential equations and probability. Extensions to topics in nonlinear analysis as time permits. (3 cr per qtr; prereq 222C or ‡)

246A-B-C. Topics in Point Set Topology. Dimension theory, upper semicontinuous collections, partitions, homotopy theory. (3 cr per qtr; prereq 190C or ‡)

247A-B-C. Algebraic Topology. Axiomatic homology theory; various homology and cohomology theories; introduction to homotopy theory. (3 cr per qtr; prereq 190C or ‡)

248A-B-C. Homotopy Theory. Review of singular homology and cohomology, homotopy of mappings extension and retraction, classification of maps of the circle into the circle, fundamental groups, Hurewicz's theorem, fiber spaces, cross sections, homotopy groups, homotopy groups of special spaces, obstruction theory, homotopy groups of spheres, fundamental theorems of Morse theory. (3 cr per qtr; prereq 190C or ‡)

249A-B-C. Convex Sets. Basic properties of convex sets. Hahn-Banach theorem. Support functional. Dual cone. Helly type theorems. Minkowski geometry. Isoperimetric inequalities. Special problems in low dimensions. (3 cr per qtr; prereq 130A or equiv or ‡)

250A-B-C. Riemannian Geometry. Tensor algebra. Differential manifolds. Riemannian metric. Exterior differential calculus. Methods of global differential geometry. Differential equations of mathematical physics. (3 cr per qtr; prereq 115C or ‡)

251A-B-C. Differential Topology. A general introduction to algebraic topology, as far as is needed for development of special tools of differential topology. Theory and applications of differentiable sheaves. (3 cr per qtr; prereq 190C or ‡)

252A-B-C. Lie Groups and Lie Algebras. Groups of matrices, topological groups, local groups. Lie algebras and Lie groups. Structure theorems, classification of semisimple Lie algebras. Topics in homogeneous spaces and representations. (3 cr per qtr; prereq 205C or ‡)

253A-B-C. Topics in Advanced Differential Geometry. (3 cr per qtr; prereq ‡)

254A-B-C. Algebraic Geometry. (3 cr per qtr; prereq ‡)

260A-B-C. Theory of Probability. Topics in modern probability theory, including recent advances in limit theorems and introduction to stochastic processes. (3 cr per qtr; prereq 222C or ‡)

261A-B-C. Stochastic Processes. General theory of continuous parameter stochastic processes. Gaussian processes, processes with independent increments, Markov processes and their connections with functional equations. (3 cr per qtr; prereq 260C or ‡)

262A-B-C. Topics in the Theory of Probability. (3 cr per qtr; prereq 260C or ‡)

266A-B-C. Theory of Ordinary Differential Equations. Existence and uniqueness theorems, linear and nonlinear differential equations, singular points and series solutions, eigenvalue problems, oscillation and comparison theorems, stability of solutions, periodic solutions, Poincaré-Bendixson theory, equations of Duffing and van der Pol. (3 cr per qtr; prereq 130C or equiv, 150, or ‡)

267A-B-C. Theory of Nonlinear Oscillations. Background from theory of ordinary differential equations. Existence and stability of oscillations in nearly linear systems, periodic and almost periodic solutions, parametric resonance, invariant manifolds. (3 cr per qtr; prereq 266 or ‡)

268A-B-C. Topics in Differential and Difference Equations. (3 cr per qtr; prereq ‡)

271A-B-C. Partial Differential and Integral Equations of Applied Mathematics. Linear integral equations; Fredholm's theorem, symmetric kernels, the expansion theorem, Volterra equations, topics in calculus of variations; Sturm-Liouville problems. Rayleigh-Ritz method, partial differential equations, introduction and classification. Heat equation and wave equation; energy method. Boundary value problems for Laplace and Poisson equations. Nonlinear hyperbolic problems. (3 cr per qtr; prereq 153 or 175 or ‡)

272A-B-C. Theory of Partial Differential Equations. Derivation of special equations. First order equations. Classification. Cauchy-Kowalewski theorem. Hyperbolic equations; general theory of characteristics, first order systems, energy method, special topics. Elliptic equations; maximum principle and applications, general theory of the Laplace equation, potential theory, boundary value problems. Higher order parabolic equations. (3 cr per qtr; prereq 130C or equiv, 150 or ‡)

273A-B-C. Topics in Partial Differential Equations. (3 cr per qtr; prereq 223, 272C or ‡)

275A-B-C. Calculus of Variations in the Large. Classical variational theories on differentiable manifolds. Morse theory on finite and infinite dimensional manifolds with applications to the theory of geodesics, minimal surfaces, and other variational problems. (3 cr per qtr; prereq 190A-B-C or ‡)

276A-B-C. Calculus of Variations and Minimal Surfaces. Euler's equation, differentiability theorems, necessary conditions of Legendre and Weierstrass, isoperimetric problems. Theory of fields, Hamilton-Jacobi theory. Sufficiency theorems, direct methods, local behavior of extremals. Local and global properties of minimal surfaces, Plateau's problem. (3 cr per qtr; prereq 130C or equiv, 150 or ‡)

277A-B-C. Potential Theory. Concept of potential. Laplace and Poisson equations. Divergence theorem and Stokes's theorem. Spherical harmonics. Surface distributions. Boundary value problems, Poisson integral, Harnack's theorems. Fundamental existence theorems; alternating method, integral equations, direct methods in calculus of variations. Second order elliptic equations. Maximum principles, subharmonic functions, behavior of solution at a boundary point. (3 cr per qtr; prereq 153 or ‡)

280A-B-C. Mathematics of Computers and Control Devices. Theory of elementary control and computing devices, open and closed systems, dynamic and transient responses. Synthesis and analysis of systems. Analog and digital computers. (3 cr per qtr; prereq 186 or ‡)

282. Advanced Numerical Analysis of Linear Systems. Solution of linear equations, gradient method, projection method, matrix inversion and decomposition, matrix diagonalization, linear programming, extensions to Hilbert space. (3 cr per qtr; prereq 131B, 186, or ‡)

283. Advanced Numerical Analysis of Partial Differential Equations. Linear equations of first order, hyperbolic, elliptic, and parabolic equations, choice of grid, boundary value problems, eigenvalue problems. (3 cr per qtr; prereq 175, 186 or ‡)

284A-B-C. System Programming. Description of computer systems: assembly, compiler, interpretive, input-output, monitor. Construction of assembly. Macro implementation. Assembly to assembly translation. Simulation. Compiler implementation, early techniques. Analysis of arithmetical expressions: iterative techniques, three-address normal form, Polish and reverse Polish, implementation of logical operators. Optimization techniques. System implementation: input-output tables, job sequences, basic library. Language and computer evolution according to the needs of users. (3 cr per qtr; prereq 166 or ‡)

286A-B-C. Advanced Methods of Applied Mathematics. Fundamental linear problems; linear transformations and quadratic forms, orthogonal series, linear integral equations, calculus of variations, eigenvalue problems and expansions, singular eigenvalue problems and expansions. (3 cr per qtr; prereq 159 or equiv or ‡)

287. Variational Methods in Boundary Value Problems. Variational characterization of the solution of a boundary value problem in elliptic differential equations. Construction of arbitrarily close upper and lower bounds for physical quantities such as strain energy, electrostatic capacity, and virtual mass as well as for solutions of steady state problems in elasticity, potential theory, and hydrodynamics. (3 cr per qtr; prereq 153 or 175 or ‡)

288. Variational Methods in Eigenvalue Problems. Minimum, maximum-minimum, and minimum-maximum characterizations of eigenvalues and eigenvectors ("natural frequencies" and "normal modes") of various differential operators occurring in mathematical physics. Methods yielding upper and lower bounds for eigenvalues. Approximation of eigenvectors. (3 cr per qtr; prereq 153 or 175 or ‡)

289A-B-C. Mathematical Theory of Elasticity. World structure and motion. Deformation gradient, rotation, stretch, reference configurations. Line, surface, and volume integrals deforming with a motion. Invariance principles, work, dynamical laws, thermodynamics. Elasticity, small deformations, linear elasticity, problem solution. Waves. (3 cr per qtr; prereq tensor analysis and mathematical maturity or ‡)

290A-B-C. Mathematical Theory of Fluid Dynamics. Equations of continuity and motion. Kinematics, Bernoulli's theorem, stream function and velocity potential. Applications of conformal mapping. Foundations of thermodynamics. One-dimensional flow. Plane flow of gas, characteristic method, hodograph method. Singular surfaces, shock waves and shock layers. Viscous flow, Navier-Stokes's equations, exact solutions; uniqueness, stability, and existence theorems. (3 cr per qtr; prereq 108, 153 or 175 or ‡)

291. Mathematical Aspects of Boundary Layer Theory. Navier-Stokes's equations, exact solutions illustrating boundary layer concept. Boundary layer equations. General properties and critique. Theory of similar solutions, Goldstein's theorem, Blasius solutions, existence theorems. Von Mises transformation. Qualitative theory, asymptotic behavior, and uniqueness. Remarks on compressible boundary layers, Stewartson-Illingworth theorem. (3 cr per qtr; prereq 108, 150, 153 or 175, or ‡)

292A-B-C. Joint Seminar with Aeronautical Engineering. Topics covered vary from year to year. (3 cr; prereq ‡)

293. Information Theory. Mathematical theory of transmission of information in the presence of noise; heuristic background of the problem; review of some topics from probability theory; the entropy function; discrete memoryless channels; finite memory channels; continuous channels with additive noise. Axiomatic approach—emphasis on mathematical rather than engineering aspects. (3 cr per qtr; prereq 108, Stat 131, 153 or 175, 178A or ‡)

296A-B-C. Mathematical Problems in Theoretical Physics. (3 cr per qtr; prereq ‡) Hill

299A-B-C. Reading and Research.

The courses listed below are offered from time to time.

102-103. Advanced Analytic Geometry

120. Representations of Groups

126. Calculus of Finite Differences

199. Calculus of Variations

MECHANICAL ENGINEERING**

Professor

Richard C. Jordan, *head*
Perry L. Blackshear
Ernst R. G. Eckert
Edward A. Fletcher, *director of graduate study*
Richard J. Goldstein
Warren E. Ibele
Clarence E. Lund
Gayle W. McElrath
Katsuhiko Ogata
Ephraim M. Sparrow
Robert E. Summers
James L. Threlkeld
Kenneth T. Whitby

Associate Professor

John E. Anderson
Sant Ram Arora
Fulton Holtby
William A. Kleinberg
Homer T. Mantis
Thomas E. Murphy
Emil Pfender
Charles J. Scott

Assistant Professor

Darrell A. Frohrib
Adolph O. Lee
Benjamin Y. H. Liu
Ronald J. Mogavera
R. Stanford Nyquist

** Professional degrees in engineering are administered by the Institute of Technology.

Prerequisites—For major work, adequate preparation in undergraduate subjects and in the sciences fundamental to mechanical or industrial engineering in addition to the general admission requirements. For minor work, the prerequisites to the courses to be pursued and approval of the department.

Language Requirement—For the M.S. degree, none. For the Ph.D. degree, reading knowledge of two languages (French, German, and Russian are acceptable). Substitution of other languages or in special cases a research technique may be permitted.

Master's Degree—The M.S. degree is offered under both Plan A and Plan B with the major in mechanical engineering or industrial engineering. Work outside mechanical engineering is recommended for the minor under Plan A and for both the related fields under Plan B.

In addition to the completion of 45 credits of course work, the Plan B candidate will be required to submit three written reports representing the quality but not the range of the Master's thesis. These papers are to be prepared as an additional part of the work required for three advanced courses, seminars, or independent work with the joint permission of the student's adviser and the instructor of the course.

Doctor's Degree—Work leading to the Ph.D. degree is offered.

Note—To receive graduate credit in a mechanical or industrial engineering major, courses must be selected from those listed under "Advanced Courses in Mechanical (or Industrial) Engineering."

Mechanical Engineering

Graduate Credit Courses for Nonmajors

The following courses may be taken for graduate credit by students not majoring in mechanical or industrial engineering upon the approval of the student's adviser and the mechanical engineering graduate committee.

125x. Machine Design Laboratory. Use of vibration instruments, stroboscopes, sound meters and analyzers, photoelastic polariscope, electronic measuring devices and testing machines. (2 cr; prereq 24)

133x. Heat Transmission. Introduction to conduction, convection, and radiation of heat and their utilization in engineering applications. Discussions of heat exchangers. (3 cr; prereq 30A and Hydr 101 or AE 100A or ‡)

134x. Thermodynamics of Fluid Flow. Thermodynamic analysis of internal flow of viscous and compressible fluids. Applications to various flow processes and components in engineering systems. (3 cr; prereq 31A, Hydr 101 or equiv)

146Ax. An Introduction to Combustion and Propulsion. Flame propagation, quenching and ignition in a gaseous mixture; combustion of solid and liquid particles, and gaseous jets. Principles of propulsion, thrust, specific impulse and exhaust velocity. (4 cr; prereq 133 or ¶133)

159.° Power and Propulsion Laboratory. Quarterly group student projects relating to performance of power and propulsion system components. Performance of engines, turbines, and rockets. Combustion, fluid flow, and heat transfer problems in power systems. (2 cr; prereq 34, 146)

160A. Thermal Environmental Engineering. Thermodynamic properties of moist air; h-w diagram for moist air; solar radiation; steady-state and periodic heat transmission in

structures; water vapor transmission in structures; effects of thermal environment upon people, processes, and materials; thermal loads; thermal environmental control systems. (4 cr; prereq 133)

169.* Psychrometrics and Air Conditioning Laboratory. Psychrometry and humidity measurement; experimental studies on refrigeration systems and on the processing of moist air. (2 cr; prereq 34, 160A)

170. Manufacturing Processes. Analysis and description of the physical and economic principles underlying manufacturing processes. Illustration of principles as they are applied in basic manufacturing operations. (4 cr; prereq MetE 56)

191, 192, 193. Mechanical Engineering Design. Design of elements and systems. Interdivisional problems involving thermodynamics, mass and heat transfer, solid and fluid mechanics, economics and production, operations analysis, and automatic controls. (2 cr per qtr)

197x. System Analysis and Control. Basic theory of linear feedback control systems. Transfer function representation of solid body, fluid, pneumatic, and electro-mechanical components. On-off, proportional, floating, and rate response in control systems, including industrial instrumentation. (3 cr; prereq 21A)

Advanced Courses

PRODUCTION ENGINEERING

110. Control of Metal Working Processes. Inspection by X-ray, gamma-ray, magnetic particle, metallographic, and chemical methods. (3 cr; prereq 170) Holtby

111. Advanced Casting Processes. Advanced techniques and new developments in molding and casting; foundry control procedures. (3 cr; prereq 110) Holtby

112. Properties and Fabrication of Plastics. Materials, equipment, and processes for fabrication of plastics. Plastic product and mold design. (3 cr; prereq 170 or ‡) Holtby

113. Advanced Metal Cutting. Advanced machine tool operation. Selection, tooling, and set-up of machine tools for production. (3 cr; prereq 170) Holtby

114. Advanced Welding. Theory and applications of welding processes; factors affecting weldability; considerations in the design of weldments. (3 cr; prereq 170) Holtby

MACHINE ELEMENTS AND INSTRUMENTATION

123. Creative Engineering. Application of fundamentals of engineering design; creative aspects. (3 cr)

124. Experimental Stress Analysis. Experimental application and theoretical evaluation of methods of stress analysis. Strain gauges, surface coatings, photoelasticity, dynamic stress measurements, penetration methods, and fracture methods. (3 cr; prereq MM 37)

127. Friction and Lubrication. Friction mechanism and boundary lubrication. Hydrodynamic and hydrostatic lubrication theory applied to finite bearings. Introduction to gas bearings. (3 cr; prereq Hydr 101 or equiv)

128. Photoelastic Stress Analysis. Fundamentals of advanced stress analysis. Theory of photoelasticity and operation of polariscopes. Applications to solutions of special design problems. (3 cr; prereq MM 37)

129. Vibration Engineering. Advanced vibration theory with application to vibration absorption and isolation. (3 cr; prereq 22A)

198. Industrial Instrumentation and Automatic Control. Theory and operation of instruments and automatic controls. Domestic and industrial control mechanisms. On-off, proportional, floating, and rate response in control instruments. (3 cr; prereq EE 31)

199. Introduction to Feedback Control Systems. Basic theory of linear feedback control systems. Steady state analysis and transient response analysis. Design of simple feedback control systems. (3 cr; prereq EE 31 or equiv, Math 32) Ogata

224-225-226. Advanced Applied Dynamics. Application of principles of dynamics to selected mechanical engineering problems. (3 cr per qtr; prereq 129)

228. Photoelasticity. Stress analysis by photoelasticity. Stress patterns. Frozen stresses. Solution of individual problems. (3 cr; prereq 128)

229. Advanced Vibration Engineering. Advanced dynamics of vibration, vibration in mechanical, electrical, and equivalent systems. (3 cr; prereq 129)

296-297-298. Feedback Control Systems. Basic considerations of feedback control system design. Root locus method and synthesis of linear feedback control systems in S plane. Describing function analysis and phase plane analysis of nonlinear feedback control systems. Statistical design principles and optimal control systems. (3 cr per qtr; prereq 198, 199, Math 174 or ¶Math 174) Ogata

THERMODYNAMICS AND HEAT TRANSFER

136. Reactor Heat Transfer. Heat conduction with internal heat generation, thermal stresses, liquid metal heat transfer, forced convection in noncircular ducts, boiling and two-phase flow. (3 cr; prereq 133 or equiv)

137A. Thermodynamics of High Temperature Gases. Energy exchange processes in high temperature gases; determination of composition and properties of such systems. Thermal equilibrium. Quasi-neutrality. (3 cr; prereq 133)

137B. Thermodynamics of High Temperature Gases. Generation of high temperature gases. Diagnostic methods with emphasis on plasma spectroscopy. Modern plasma applications. (3 cr; prereq 137A or ‡)

230. Advanced Thermodynamics. Critical examination of thermodynamic principles, equations of state for liquids, gases, and mixtures. Interpretation of thermodynamic functions and applications to processes, reactions, and equilibrium states. (3 cr; prereq 32) Ibele

231. Statistical and Nonequilibrium Thermodynamics. Elements of statistical thermodynamics. Equilibrium considerations, equations of state, heat capacities. Transport property predictions, thermal conductivity, viscosity, diffusion. Irreversible effects, metastability, mechanism of two-phase equilibrium. Nonequilibrium effects. (3 cr; prereq 230) Ibele

232. Advanced Fluid Thermodynamics. Mechanism of thermodynamic actions in fluids. Irreversible effects related to viscosity, heat transfer, diffusion and chemical reaction. Flow of reactive gas mixtures. Reaction rates and their effects. (3 cr; prereq 134, 230 or ‡) Ibele

233. Conduction. Steady and unsteady heat conduction with and without heat sources or change of state, relaxation method, analogue, the regenerator. (3 cr; prereq 133) Eckert

234. Convection. Heat transfer in laminar and turbulent boundary layer and channel flow, dimensional analysis. Free convection. Condensation and evaporation. Convective mass transfer. (3 cr; prereq 233) Eckert

235. Radiation. Heat radiation of black bodies, or electrical conductors and nonconductors, of gases and flames. Heat exchange by radiation. Configuration and interchange factors. (3 cr; prereq 234) Eckert

236. Advanced Theory of Heat Transfer. Analytical treatment of problems of convection and radiation. Boundary layer and pipe flow solutions and associated mathematical techniques. Radiation problems, including integral equation formulation, and their solution. (3 cr; prereq 133)

270-271-272. Magnetohydrodynamics. Basic equations of magnetohydrodynamics. Fundamental properties of magnetohydrodynamic flows. Magnetohydrodynamic models and their extensions. Applications: magnetohydrodynamics power, generation, propulsion. (3 cr per qtr; prereq 134 or AE 102A, Math 147 or ‡) J Anderson

POWER AND PROPULSION

140-141. Thermodynamics of Modern Power Devices. Gas and solid state thermocouple, magnetohydrodynamic systems, fuel cells, and solar energy systems. Thermodynamic principles and transport phenomena involved in each device. (3 cr per qtr; prereq 133)

142. Vapor Cycle Power Systems. Vapor cycle analysis, regeneration, reheat, compound cycle modifications, combined gas turbine-vapor cycle systems, binary systems. Combustion problems; unusual energy sources, solar, nuclear for space power systems. (3 cr; prereq 31A)

143. Turbomachinery. Theoretical analysis of energy transfer between fluid and rotor, principles of axial, mixed, and radial flow compressors and turbines. Applications to gas turbines, fluid transmissions and power plants. (3 cr; prereq 31A)

148-149. Chemistry of Combustion. Nature of combustion problems. Ignition, propagation, quenching, and burning limits. Thermochemistry and use of partition function in calculating thermodynamic properties, free energy, and equilibrium constants. Chemical kinetics and steady state approximation applied to combustion phenomena. (3 cr; prereq 146A or ¶146A or ♯) Fletcher

150.° Internal Combustion Engines. Principles of spark ignition engine, fuel-air cycle analysis, combustion flames, knock phenomena, air flow and volumetric efficiency, mixture requirements, ignition requirements and performance. (3 cr; prereq 31A or ¶31A) Murphy

151. Advanced Internal Combustion Engines. Principles of diesel engine, combustion of stratified charge, knock, theory of spray formation and vaporization. Fuels and deposits, engine lubrication, air and liquid cooling. (3 cr; prereq 150)

152. Gas turbines and Compound Engines. Gas turbine cycles, regeneration, reheat and intercooling. Free turbine and free piston gasifier. Scavenging of two stroke engines, matching of compressor and turbine to engine. Turbo-jet engine performance. (3 cr; prereq 31A)

155. Rocket Propulsion. Mode of operation and performance limitations of: chemical rockets with liquid, solid and free radical propellants, nuclear and solar rockets with thermal and electromagnetic propellant acceleration. (3 cr; prereq 146A) Fletcher

242. Advanced Power Plants. Thermodynamic and economic evaluation, planning, and management of modern and anticipated future power plants and components. (3 cr; prereq 142 or equiv) Lee

246. Energy Transport in Chemically Reacting Gases. Thermodynamics, kinetics, and transport processes in chemically reacting gases; energy fluxes in chemically reacting systems with and without equilibrium; surface phenomena; a review of equations of motion for chemically reacting systems, and energy transport in chemically reacting flowing streams. (3 cr; prereq 146A)

247. Mass Transfer in Chemically Reacting Gases. Review of equations of change; mass transfer in binary mixtures; mass transfer in chemically reacting mixtures; the boundary conditions for vaporization and sublimation; boundary conditions for surface pyrolysis; integral solutions for mass transfer in chemically reacting boundary layers; jet mixing in inert and in chemically reacting gases. (3 cr; prereq 146A)

248. Atomization Vaporization and Mixing. Survey of current theories on instability of fluid spheres, filaments and sheets and review of current atomization techniques. These are employed with pertinent transport and vaporization relationships in computing fuel oxidant distributions in some combustor designs. (3 cr; prereq 31A) Blackshear

250. Dynamics of High Speed Engines. Inertia forces; balancing high-speed engines; engine torque analysis; torsional vibration, etc. Conferences, assigned readings, and problems. (3 cr; prereq 24, 150) Murphy

253. Advanced Gas Turbines and Jet Propulsion. Gas turbines and ramjets for aircraft; performance, control, nozzles, axial and centrifugal compressors, and turbines; cooling, lubrication, and construction. (3 cr; prereq 152) Murphy

255. Advanced Rocket Propulsion. Analysis and performance characteristics of chemical, nuclear, solar, ion, and photon rocket motors. (3 cr; prereq 155) Fletcher

AIR CONDITIONING AND REFRIGERATION

164. Refrigeration and Cryogenics. Thermoelectric cooling gaseous air cycle; steam jet refrigeration; production of dry ice; thermodynamics of binary mixtures, the h-x diagram, absorption refrigeration. Liquefaction of air, hydrogen and helium; production of oxygen and nitrogen by separation of air; other cryogenic topics. (3 cr; prereq 133)

166. Industrial Ventilation and Exhaust System. Contaminants, dispersion mechanisms, fans, injectors, natural drafts, and control velocities as applied to manufacturing and processing systems. (3 cr; prereq 160A) Lund

183-184. Principles of Particle Technology. Definition, theory, and measurement of particle properties, particle statistics, fluid dynamic, optional, electrical, thermal behavior of particles, particle transport, gas cleaning, and particle processing. (3 cr per qtr; prereq 31A or ‡) Whitby

265. Advanced Psychrometric Theory and Atmospheric Environmental Control. Relation of atmospheric environmental control to human comfort, industrial heat exposure, and product and process requirements. Wet-bulb psychrometry, psychrometric equations, charts, and calculation methods for atmospheric and compressed atmospheric air. (3 cr; prereq 160A or ‡) Threlkeld

266. Advanced Psychrometric Processing. Applied heat transfer and mass transfer studies in processing of atmospheric air. Fundamental performance, design, and application of heating, cooling, humidification, and dehumidification apparatus. Dehumidification with sorbent materials; convection drying of materials. (3 cr; prereq 265) Threlkeld

267. Advanced Air Conditioning. Steady-state and transient heating loads and cooling loads; intermittent heating of buildings; utilization and control of solar radiation; air distribution. Design and control of air conditioning systems. (3 cr; prereq 266 or ‡) Threlkeld

280. Theoretical Refrigeration. Problems in theory and design of refrigeration systems. Lectures, assigned reading, and reports. (3 cr; prereq 164) Jordan

282. Reverse Applications of Refrigeration—the Heat Pump. Industrial, commercial, and residential applications. Lectures, assigned reading, and reports. (3 cr; prereq 160A) Jordan

GENERAL

285-286-287. Biomedical-Engineering Seminar. (Same as Surg 285-286-287) Lectures, demonstrations, and individual research activities designed to introduce graduate students and faculty of mechanical engineering and surgery to techniques and goals of the two disciplines. (1-3 cr per qtr) Bernstein, Blackshear, and Institute of Technology and Medical School faculties

290-291-292. Mechanical Engineering Research. (Cr ar; prereq △)

293. Graduate Seminar. Colloquium for graduate students and staff. Reports and discussion by members on assigned research or problems. Recommended for graduate students and junior staff members. (No cr)

Industrial Engineering

Students who have received a Bachelor's degree in any engineering area may be admitted to graduate study majoring in industrial engineering provided they meet the entrance requirements of the Graduate School. Both the Ph.D. and master of science degrees are offered. Candidates will be expected to complete, either as undergraduates or as graduate students, adequate preparation in undergraduate subjects and in the sciences fundamental to industrial engineering. The M.S. degree in industrial engineering is offered under both Plan A and Plan B.

Related courses in mechanical engineering, business administration, psychology, and public health are recommended in conjunction with industrial engineering.

Students contemplating graduate study in this field should consult the chairman, industrial engineering division, regarding their individual programs and requirements.

Graduate Credit Courses for Nonmajors

The following courses may be taken for graduate credit by students not majoring in industrial engineering upon the approval of the student's adviser and the mechanical engineering graduate committee.

100.* Introduction to Industrial Engineering Analysis. Management and decision making, analytical methods in production management, design of production systems, operation and control of production systems. (3 cr; prereq ME 99 or ‡)

110. Introduction to Work Analysis. Fundamentals of methods engineering, work measurement, and plant layout. Charting techniques, process charts, predetermined time systems, work sampling, time study, master standard data, cross charting, line balancing. (4 cr; prereq 100 and ME 99)

120. Probability Models in Industrial Engineering and Operations Research. Concepts of compound statements, sets and functions, conditional probabilities and simple stochastic processes (including finite Markov Chains) and their relation to selected problems in industrial engineering and operations research. Waiting line models, renewal and replacement models, dynamic programming, Markov processes with rewards; Monte Carlo methods. (3 cr; prereq ME 99 or equiv)

130. Introduction to Operations Research. Industrial applications of operations research techniques using linear programming, decision models, game theory and general optimization techniques; industrial problems in allocation, inventory control, competitive strategies, scheduling. (4 cr; prereq ME 99 or equiv)

172. Manufacturing Cost Analysis. Financial accounting concepts, standard cost systems, manufacturing cost accounting, cost information for management decision making. (3 cr; prereq 100)

Advanced Courses in Industrial Engineering

133A-134A. Mathematical Methods in Operations Analysis. Linear programming, simplex technique, network flows, finite games, birth-death processes; applications to allocation, scheduling, transportation, waiting lines, inventory, reliability. (3 cr per qtr; prereq ME 99 or Stat 90 or Stat 131 or ‡)

140. Analysis of Production Processes. A case course of problems in production engineering and production management. Analysis of production problems from selected industries. Development of student's ability to recognize and diagnose industrial problems. (3 cr; prereq 172)

141. Industrial Metrology. Fundamental concepts of the science of industrial measurements. Variability of manufacturing process, process capability, errors of measurement. (3 cr; prereq ME 99 and ME 170)

145. Manufacturing Process Planning. Concepts and techniques of planning optimum manufacturing processes. Principles of product design that result in economical production. Analysis of part drawings to determine nature and sequence of production processes. (3 cr; prereq ME 170)

154. Advanced Methods Engineering and Work Measurement. Multiple operation analysis, advanced work measurement techniques, incentives. (3 cr; prereq 110)

155. Industrial Wage Administration. Job evaluation, wage surveys, wage policies, establishment and administration of incentive wage plans. (3 cr; prereq 110)

165. Industrial Plants. Analysis of materials flow; layout or production and service departments; plant buildings, service facilities, and handling equipment. (3 cr; prereq 110)

167. Materials Handling. Development of materials handling systems and selection of equipment; industrial packaging techniques. (3 cr; prereq 110)

170. Production Planning and Control. Planning of production requirements; routing, scheduling, and co-ordination of production; inventory policies and control. (3 cr; prereq 100)

171. Quality Control. Quality standards, application of statistical methods and sampling theory; interpretation of results and corrective action. (3 cr; prereq Stat 90 or ME 99 or ‡)

173. Engineering Economic Analysis. Analysis of capital expenditures and annual operating costs as the basis for management policies and decisions. (3 cr; prereq 100)

175. Elements of Reliability. Principles of experimentation, systems design, measurement, simulation, and field data utilization necessary for a total approach to producing a reliable product. (3 cr; prereq Stat 90 or ME 99)

177. Industrial Sampling Techniques. Selection and operation of attributes sampling plans; operating characteristic curves; sampling techniques for continuous production; variables sampling plans; administrative and economic comparisons. (3 cr; prereq 171)

180. Management for Engineers. Management functions and relations with employees, other supervisors, and staff departments. (3 cr; prereq 100)

182. Industrial Safety. Safety requirements for production processes, equipment, and plants; organization and administration of safety programs. (3 cr; prereq 100)

193. Introduction to Optimal Control and Dynamic Programming. Concepts of optimization, linear and nonlinear optimal systems, adaptive systems, stochastic optimization problems and introduction to dynamic programming. (3 cr; prereq ME 199)

194. Topics in Management Science. Analytical tools for decision making and management of the production function. Emphasis upon topics appearing in current literature; mathematical models, assumptions, limitations, and new developments. (3 cr; prereq 15 cr in industrial engineering)

195-196. Applied Industrial Engineering. Industrial engineering surveys and programs; case problems; studies in local plants. (3 cr; prereq 15 cr in industrial engineering)

198. Design and Analysis of Experiments I. One-factor experiments, design constructed to reduce experimental error, general linear regression model, analysis of variance, estimation and comparison of effect, orthogonal contrasts, components of variance, fixed random, and mixed models, incomplete block designs, introduction to general factorial experiments. (3 cr; prereq ME 99 or equiv or ‡)

199. Design and Analysis of Experiments II. Two or more factor experiments, designs involving crossed, nested, and mixed classifications; qualitative and quantitative factors; experiments, block confounding, fractional factorial experiments, introduction to response surface analysis. (3 cr; prereq 198 or ‡)

251, 252, 253. Advanced Industrial Engineering. Manufacturing policy, production engineering, plant operation, engineering economy, and industrial development. (3 cr per qtr; prereq ‡) McElrath

261, 262, 263. Production Engineering Problems. Application of industrial engineering principles to solution of manufacturing problems in local plants. (3-5 cr per qtr; prereq ‡) McElrath

271, 272, 273. Industrial Engineering Research. Research studies in selected areas of industrial engineering, production, and management; work of thesis quality but lesser scope. (3-5 cr per qtr; prereq ‡) McElrath

Engineering Graphics

101. Illustration for Design. (3 cr; prereq 27 or ‡)

118. Graphic Analysis of Experimental Data. Derivation of empirical equations correlating graphic and algebraic methods. (3 cr; prereq 26, Math 23 or ‡)

120. Advanced Descriptive Geometry. Graphic solutions involving one view drawings; intersection, tangency, and clearance determinations of curves and warped surfaces. (3 cr; prereq 27, Math 22 or ‡)

130. Nomography. Application of geometry to development of alignment charts. Parallel and nonparallel straight line scale and curved scale nomograms; transverse, concurrent, proportionality, and combined charts. (3 cr; prereq 26, Math 22 or ‡)

131. Graphical Mathematics. Graphical approach to problems involving algebra, differential and integral calculus; use of straight and curved line networks and combinations of networks. Correlation of algebraic and descriptive geometry solutions particularly relating to numerical control of automatic machines. (3 cr; prereq 26, Math 23 or ‡)

194. Graphics in Engineering Problems. A synthesis and extension of procedures of graphical mathematics, nomography, and descriptive geometry in solutions of complex problems within the individual student's area of interest. (2-4 cr; prereq 130 or 131 or ‡)

MECHANICS AND MATERIALS

Professor
Lawrence E. Goodman
William C. Meecham
Robert Plunkett
Patarasp R. Sethna, *chairman*

Associate Professor
Allan A. Blatherwick
Chih-Chun Hsiao
William H. Warner

Students who wish to major in mechanics and materials should consult the chairman of the departmental graduate committee, 107 Aeronautical Engineering Building.

Prerequisites—For major work, adequate preparation in fundamental engineering sciences (mathematics, physics, mechanics, and chemistry) and the general admission requirements. For minor work, course prerequisites govern.

Language Requirement—For Master's degree, none. For the Ph.D. degree, two foreign languages chosen from French, German, Italian, and Russian.

Master's Degree—Offered under both Plan A and Plan B. The Plan B paper requirements may be met in connection with any course accepted for graduate credit, seminar, or independent work under faculty supervision, subject to the prior approval of the student's adviser and of the faculty member supervising the preparation of the paper.

Doctor's Degree—Program to be developed in consultation with adviser.

126. Introduction to the Theory of Elastic Stability. Rational prediction of buckling loads and modes of failure in a variety of structural elements; interpretation of experiments; theoretical basis of design methods. (3 cr; prereq 37)

138. Intermediate Dynamics. Dynamics of rigid-body motions. Extension of the principles of impulse-momentum and work-energy; Euler's equations of motion; the gyroscope; virtual work; stability. (3 cr; prereq 36)

142. Experimental Mechanics I. Strain gauges. Photoelasticity. Experimental stress analysis. Deformation of beams and columns. Torsion, tension, and shear tests. (2 cr; prereq 37)

150. Rheology and Strength of Solids. Structure of solids, mechanical models, equation of state. Stress-strain-time and fracture properties under static and dynamic loading. Design significance of creep, relaxation, fatigue, impact, and damping properties. Multi-axial stress and theories of failure. Metallic and nonmetallic structural materials. (3 cr; prereq 37)

151. Fatigue of Materials and Structures. Submicro- and micro-mechanisms of fatigue. Crack initiation and propagation. Statistical aspects. Random loading. Fatigue environment of aerospace structures, its analysis and simulation. Elevated temperature problems. Thermal fatigue. Resonance and acoustic fatigue. (3 cr; prereq 150)

164, 165, 166. Problems in Mechanics and Materials. Short duration research problems, literature studies, and reports. (0-3 cr per qtr; prereq ‡, faculty sponsor required before registration) Graduate staff

176. Introduction to Random Vibration Theory. Statistical descriptions of response of single-degree-of-freedom damped vibrators to nondeterministic forces. Effects of damping and frequency spectra. Measurable quantities. Response of two-degree-of-freedom systems. Impedance methods. Response of linear continuous systems. Comparison higher approximations, descriptions of damping, modal coupling and spectrum shaping. Acoustic excitation. Fatigue failure criteria. (3 cr; prereq 193)

180. Applied Elasticity I. Kinematics of deformation; strain; invariants; compatibility. Stress; equations of equilibrium; invariants. Stress-strain relations; isotropy; strain energy. Plane strain, generalized plane stress; Airy's stress function; cylinder under pressure. Stress concentration. Thermoelastic equations; sphere; plane problems. (3 cr; prereq 37 or equiv)

181. Applied Elasticity II. Torsion of beams. Warping and stress functions. Multiply-connected cross sections. Membrane analogy; thin-walled sections. Bending of bars, beams, and rings. Shear center. Beams on elastic foundations. Axial forces. Curved bars, rings. Energy methods for slender bars. Introduction to inelastic behavior, residual stresses, limit analysis. (3 cr; prereq 180 or equiv)

182. Applied Elasticity III. Energy principles of elasticity; potential and complementary energy, reciprocal theorem, variational methods. Approximation techniques: Rayleigh-Ritz, Galerkin, Error methods. Applications to torsion and bending. Bending and buckling of thin plates. Lagrange equation. Energy methods for plates. (3 cr; prereq 180 or equiv)

187. Theory of Linear Viscoelasticity. Linear viscoelastic behavior; linear viscoelastic constitutive laws; method of viscoelastic analysis; and applications to simple quasi-static and dynamic viscoelastic problems. (3 cr; prereq 37; offered 1966-67)

189. Applied Thermoelasticity. Analysis of thermal stresses in various types of structures such as aerospace components, pressure vessels, and nuclear reactors. Inelastic thermal stresses. (3 cr; prereq 180 and ME 133)

193. Introduction to the Theory of Mechanical Vibrations. Vibrations of linear lumped-parameter systems. Transient and steady-state behavior of linear systems having a single degree of freedom. Influence of damping. Vibration isolation. Introduction to vibrations of multiple degree of freedom linear discrete systems. (3 cr; prereq 36)

201. Advanced Dynamics. Fundamental theory; three-dimensional kinematics, Euler's angles, matrix representation of rigid-body rotations. Lagrange's equations. Holonomic and nonholonomic systems. Introduction to Hamiltonian mechanics. (3 cr; prereq 138) Sethna, Hsiao, Warner

202. Gyroscopic Systems. General theory of vibrations of dynamical systems in the neighborhood of steady motion. Gyroscopic systems. Application to gyroscopic stabilizers, gyro-compass, gyro-verticals, inertial navigation. Stability of solution by Lyapunov's direct method. Application to gyroscopic systems. (3 cr; prereq 201) Sethna, Goodman

210. Theory of Vibrations I. Lagrange's equations of motion for holonomic discrete dynamical systems for motions in the neighborhood of static stable equilibrium. Multiple degree of freedom systems. Transformation to principal co-ordinates. Free and forced motions. Advanced topics. (3 cr; prereq Math 33) Plunkett, Warner

211. Theory of Vibrations II. Dynamic behavior of machine elements and structures treated as continuous linear systems. Shear-beam vibrations of tall buildings, vibration of cables, beams, columns, and plates. Transmission and reflection of stress waves in elastic solids. (3 cr; prereq 193 or 210) Sethna, Plunkett, Warner

212. Theory of Vibrations III. Nonlinear systems. Methods in the phase plane, singular points. Response of one and two degrees of freedom systems with nonlinear restoring forces. Self-sustained oscillations. Methods of Van der Pol and Andronow and Witt. Asymptotic methods of Krylov, Bogoliubov, and Mitropol'skiy. (3 cr; prereq 193 or 210) Sethna, Plunkett, Warner

213. Advanced Topics in the Theory of Nonlinear Vibrating Systems. Vibrations of nonlinear, discrete, multiple-degree-of-freedom systems. Transient and steady state vibrations. Systems with slowly varying parameters. Passage through resonance. Nonlinear continuous systems. Beams and shafts with nonlinear material properties. (3 cr; prereq 212) Sethna

222. Theory of Perfectly Plastic Solids. Inelastic behavior, model materials. Yield criteria and flow rules. Energy principles. Contained plastic deformation. Plane strain. Slip-line fields. Applications to metal-forming processes. (3 cr; prereq 294 or ‡) Warner

223. Advanced Topics in Plasticity. Work-hardening models. Construction of constitutive equations, energy principles. Selected topics such as anisotropic plasticity, visco-plasticity, plastic wave propagation, stability, plastic structural analysis. (3 cr; prereq 222 or ‡) Warner

227. Theory of Elastic Stability. Different concepts of static stability and their interrelations. Dynamical stability criteria and relation to static stability. Bifurcation and snap-through buckling. Stability of elastic continua, energy criteria. Current research topics. (3 cr; prereq 180 or 294 or ‡) Warner

235-236-237. Theory of Mechanical Behavior of Solids with Application. Structure of solids and relationships to stress, strain, and rheological properties. Theory of flow and failure under simple and combined stress, impact, fatigue, and creep. Internal stress. Stress concentration. Relationships of laboratory properties to service performance. (3 cr per qtr; prereq 150)

241-242. Theory of Viscoelasticity. Viscoelastic constitutive laws, quasi-static and dynamic viscoelastic problems; propagation of viscoelastic waves and pulses. Correspondence principle, variational principle, stress analysis. Time and temperature equivalence. Anisotropic, nonhomogeneous viscoelastic analysis. (3 cr; prereq 180 or 294) Hsiao

264, 265, 266. Selected Topics in Mechanics and Materials. Topics of current interest. (0-3 cr per qtr; prereq ‡) Graduate staff

285. Continuum Mechanics. Review of matrices and Cartesian tensors. Analysis of stress. Kinematics; deformation, strain, rates of deformation and strain. Conservation laws: mass, momentum, energy; laws of motion. Constitutive equations: fluids, elastic and hyperelastic solids. Rate theory, stress flux, hypoelasticity. (3 cr; prereq 294 or Aero 201 or ‡) Warner

290. Theory of Plates and Shells. Stress analysis of medium-thick flat slabs. Finite difference and energy methods of analysis. Concentrated loads. Relation between theory and model tests. Membrane theory of shells. Flexure of cylindrical shells. Pressure vessels. (3 cr; prereq 180 or 294 and ‡)

291. Advanced Theory of Shells. Theory of surfaces. General bending equations of arbitrary thin shells. Determination of boundary conditions. Validity and examination of assumptions. Axisymmetric classical theory. Methods of solution of general bending theory. Shallow shells. (3 cr; prereq 290 and 294 or ‡)

292. Advanced Theory of Shells II. Deformation and strain. Compatibility equations. Constitutive equations. Some general theorems. Thermodynamics of elastic shells. Nonlinear theories. (3 cr; prereq 291)

294. Theory of Elasticity I. Fundamental principles and equations of theory of elasticity using cartesian tensors. Stress-strain relations for linear elastic crystals, anisotropic and viscoelastic materials. Principles of continuum mechanics illustrated by application to typical problems of stress analysis. (3 cr; prereq Math 33) Warner

295-296. Theory of Elasticity II and III. Generalized plane stress and plane strain. Theory of flexure and torsion, dislocations, thermal stresses, and three-dimensional problems. Analysis of contact stresses. (3 cr per qtr; prereq 180 or 294) Goodman, Warner

297, 298, 299. Mechanics and Materials Seminar. Discussion of recent work and current departmental research by students and staff. Review of current literature. (0-1 cr)

MEDICAL TECHNOLOGY

Professor
Ellis S. Benson, M.D., *head*
Ruth F. Hovde, M.S., *director*
R. Dorothy Sundberg, M.D., Ph.D.
Verna L. Rausch, M.S.
Andreas Rosenberg, Ph.D.
Edmond J. Yunis, M.D.
Jorge J. Yunis, M.D.

Associate Professor
Robert A. Bridges, M.D.
Esther F. Freier, M.S.
Lorraine M. Gonyea, M.S.
Paul H. Lober, M.D.

Assistant Professor
Patricia M. Bordewich, M.S.
Gloria M. Bradley, M.D.
Grace M. Ederer, M.S.
Herbert F. Polesky, M.D.

Graduate work in the field of medical technology is available for the qualified candidate who wishes to prepare himself for a career of teaching and investigation in the area of clinical laboratory. Regardless of ultimate aim each student spends a period of time in the clinical laboratories to familiarize himself with the aspects of methodology, teaching, and research. Each student is required to carry out a problem of independent research in one of the subareas of this field under the direction of his major adviser.

Prerequisites—For a major in medical technology certification as MT (ASCP) or eligibility for such certification is required in addition to a Bachelor's degree from an acceptable institution with sufficient prerequisite work and scholarly attainment in chemistry and biological sciences to justify graduate work in these areas. Previous experience in a clinical laboratory is desirable. For a minor in medical technology certification as MT(ASCP) is not required.

Minor—It is suggested that students who major in medical technology present a minor in one of the following fields: anatomy (hematology or cytology), physiological chemistry, physiology, microbiology, public health, zoology, or pathology.

Language Requirement—Reading knowledge of either French or German. In special cases another language may be substituted by petition.

Master's Degree—Offered under Plan A; in special cases Plan B may be followed by petition to the graduate faculty.

Minor in Medical Technology—Work for a minor is offered to students in allied sciences. Choice of particular courses to be presented in fulfillment of requirements will be made after consultation with the student's adviser.

110, 111.* Advanced Clinical Laboratory Techniques. Assignment on individual basis for observation, study, and practice in special problems; techniques and methodology in units of clinical laboratories (microbiology, chemistry, hematology, histology, or immunology). (5 cr per qtr) Staff

120x. Seminar: Medical Technology. Review and discussion of current literature; presentation and discussion of research being carried on in the department. (1 cr) Rausch

130, 131.* Elements of Administration in Medical Technology. Organization and role of the laboratory service in hospitals; job analysis and classification; personnel assignments and evaluation; plant, supplies, and equipment. 130: Lectures. 131: Assignment of specific problems in management. (2 cr per qtr) Ederer

140, 141.* Educational Administration in Medical Technology. Development, organization, and administration of educational programs in medical technology. 140: Lectures. 141: Clinical practice in techniques; analysis and construction of courses of study. (3 cr per qtr) Hovde, Rausch

145. Development of Medical Technology. Current problems. (3 cr) Hovde

150x. Selected Topics in Microbiology. Advanced seminar; topics assigned for conferences and reading. (Cr ar; may be taken 1 or more qtrs) E Yunis

151x. Selected Topics in Chemistry. Advanced seminar; topics assigned for conferences and reading. (Cr ar; may be taken 1 or more qtrs) Evans, Benson, Freier

152x. Selected Topics in Hematology. Advanced seminar; topics assigned for conferences and reading. (Cr ar; may be taken 1 or more qtrs) Sundberg, Gonyea

153x. Selected Topics in Immunology. Advanced seminar; topics assigned for conferences and reading. (Cr ar; may be taken 1 or more qtrs) E Yunis

173, 174. Analytical Techniques in Laboratory Medicine. (2 cr per qtr) Benson, Rosenberg

185, 186, 187. Clinical Chemistry Seminar. (1 cr per qtr) Benson and staff

MEDICINE

(Including Divisions of Internal Medicine and Dermatology)

For staff and courses of study offered, see the *Bulletin of the Graduate Programs in Medicine, Dentistry, and Pharmacy.*

METALLURGICAL ENGINEERING

Professor

Gust Bitsianes
Strathmore R. B. Cooke
James E. Lawver
Morris E. Nicholson
Richard A. Swalin, *head, director of graduate study*

Associate Professor

Iwao Iwasaki
Henry S. Jerabek
John M. Sivertsen
Louis E. Toth

Assistant Professor

Y. P. Gupta

Prerequisites—For major work, adequate preparation in undergraduate subjects and in the sciences fundamental to metallurgical engineering, in addition to general admission requirements. For minor work, the prerequisites to the courses to be pursued, and approval of the graduate faculty in the major field.

Language Requirement—For the Master's degree, none. For the Ph.D. degree, either (a) two foreign languages selected from German, French, and Russian (other languages may be considered on petition) or (b) upon petition, one of the above languages and a special research technique. Students working toward the Ph.D. degree must either complete or show substantial progress toward completion of one language or the special research technique in their first year of residence.

Master's Degree—Either a Master's degree with designation or an undesignated Master's degree is offered. Students who have a B.S. in metallurgy or in metallurgical engineering have the option of obtaining either the designated or the undesignated M.S. degree. Students who have a B.S. degree in other fields, e.g., geology, physics, chemistry, etc.) may choose either (a) to make up the deficiencies in the basic engineering curriculum and proceed normally to the designated M.S. degree in metallurgical engineering, or (b) proceed directly to the undesignated M.S. degree.

Plan A and Plan B are allowed for students working toward either Master's degree.

Doctor's Degree—Work leading to the Ph.D. degree is offered.

101, 102, 103. Introduction to the Science of Materials. Relation between atomic and electronic structure of metals, semiconductors, insulators and polymers and important properties of materials. (3 cr per qtr; prereq Phys 50) Toth

101A-102A. Science of Materials Laboratory. (1 cr per qtr; prereq 101, 102)

103A. Science of Materials Laboratory. (3 cr; prereq ¶103)

103B. Science of Materials Laboratory. Experimental determination of mechanical properties of plastics, metals, rock; photoelasticity, resistance strain gauges, analysis of experimental data. (2 cr; prereq MM 37)

106. Principles of Process Metallurgy. Material and heat balances in metallurgical processes, combustion of fuels, heat utilization. (3 cr; prereq 8 cr in inorganic chemistry) Bitsianes

107. Principles of Process Metallurgy. Phases in pyrometallurgical systems. Roasting, agglomeration, matte and reduction smelting. (3-4 cr depending on lab; prereq 106) Bitsianes

107A. Process Metallurgy Laboratory. Techniques and calculations involving the unit processes. Temperature and fluid flow measurements; agglomeration, reduction, simple smelting and refining systems; associated heterogeneous reactions. (1 cr; prereq 106 or ‡) Bitsianes

108. Principles of Process Metallurgy. Converting, metal refining, retorting, hydrometallurgical processes, electrolytic methods. (3 cr; prereq 107) Bitsianes

110. Mineral Dressing. Theory and practice of comminution. Volumetric and gravimetric sizing. Principles of the movement of solids in fluids. Laboratory investigation of crushing, grinding, size analysis, and size of liberation of ores. (3 cr) Cooke

111. Mineral Dressing. Principles of ore beneficiation of gravity, magnetic, and electrostatic processes. Material balances. Laboratory examination and concentration of ores. (3 cr; prereq 110) Cooke

112. Mineral Dressing. Principles of flotation in ore concentration. Theory of frothing, collecting, depression, activation, conditioning. Integration of processes into flowsheets. (3 cr; prereq 111) Cooke

113-114. Metallurgical Plant Engineering. Basic methods used in selection of metallurgical-plant equipment, problems of scale-up from pilot-plant and laboratory data; integration of equipment into a working plan and its economics, construction, and operation. (3 cr; prereq 110, ¶111) Dorenfeld

122. Hydrometallurgy. Application of physiochemical principles to leaching of ores and concentrates, to phase separation and purification, and to recovery of metals or their compounds from leached phases. (3 cr; prereq 112) Cooke

123. Hydrometallurgy. Integration of operations and processes on a plant basis. Applications in nonferrous metallurgy. (3 cr; prereq 122) Cooke

127. Electric and Magnetic Separation of Minerals. Electric separation of dielectric minerals using electrostatic fields and separation of conductors from insulators by corona discharge. Laboratory methods for determining electric properties of minerals and laboratory experiments using high and low intensity magnetic separators. (2 cr; prereq 112) Lawver

128. Techniques of Mineral Processing Research I. Experimental design and data analysis with applications of digital computers. Experimental methods of determining optimum conditions; path of steepest ascent; response surface methodology; evolutionary operation; sampling theory; the laboratory notebook and industrial patent law; report writing. (3 cr; prereq PCh 101 or ¶ME 99 or MinE 126 or ‡) Lawver

129. Techniques of Mineral Processing Research II. Introduction to experimental techniques. Physiochemical methods: solution preparation; absorption spectrophotometry; emission spectroscopy; radiotracer techniques; electrochemical and electrokinetic measurements; chromatography; surface area determinations. (3 cr; prereq PCh 101 or ¶, Phys 50 or ‡) Cooke

130. Techniques of Mineral Processing Research III. Physical methods: optical microscopy; differential thermal and thermogravimetric analysis; electron microscopy; X-ray diffraction and fluorescence; electron probe microanalysis; electrical and magnetic properties of solids; preparation of a graduate thesis. (3 cr; prereq Phys 50 or ‡) Staff

134. Metallurgical Unit Processes. Physiochemical principles. Slag-metal equilibriums, kinetics of metallurgical reactions, slag constitution. (3 cr; prereq 108) Bitsianes

135.* Metallurgical Unit Processes. Gas-solid processes. Blast furnace smelting, control of slag-metal and gas-solid reactions. Oxygen enriched blast and high top pressure. (3 cr; prereq 11) Bitsianes

136.* Metallurgical Unit Processes. Integration of operations and processes on a plant basis. Applications in nonferrous metallurgy. (3 cr; prereq 108) Bitsianes

138.* Advanced Process Metallurgy. Application of physical chemistry to some advanced problems in metallurgical engineering. Heterogeneous chemical reactions. (2 cr; prereq 134) Bitsianes

141, 142, 143. Special Problems in Metallurgical Engineering. Laboratory investigation of problems involved in metallurgical unit processes. (Cr and hrs ar; prereq 108) Bitsianes

153-154-155. Physical Metallurgy. Solidification and transformations in metals and alloys. Their influence on structure and properties. Cold working and annealing of metals. (3 cr per qtr; prereq 103 or ‡) Jerabek, Nicholson

153A-154A-155A. Laboratory in Physical Metallurgy. (1 cr per qtr; prereq 153-154-155) Jerabek, Nicholson

161. Corrosion of Metals. Electrochemical theory and mechanism of corrosion, generalized film theory. Influences of structure, composition, and mechanical factors on metallic corrosion. Inhibitors, oxidation, corrosion protection. (2 cr; prereq 56, PCh 101 or 101H) Nicholson

167. Control of Mechanical Properties in Metals and Alloys. Mechanical properties of metals and alloys discussed in terms of dislocation behavior. Attention to control of mechanical properties through manipulation of microstructure by metal processing. (3 cr; prereq 155) Nicholson

168. Principles of Metal Fabrication. General principles of fabrication from a metallurgical standpoint. Techniques for reactive metals. Vacuum melting, casting and cladding of reactive metals such as uranium. Rolling and swaging. Vacuum heat treatment. Testing and examination of materials. (3 cr; prereq 155) Nicholson

169. Analysis of Metallurgical Problems. Specialized metallurgical subjects: embrittlement of steels, residual stresses, wear, fatigue in metals. Seminar procedure. (3 cr; prereq 155 or ‡) Jerabek

173. Crystalline Properties of Metals. Introduction to geometry and properties of metal crystals. Topics: X-ray diffraction, electrical and thermal conductivity, Hall effect, optical properties, and elastic and plastic behavior of metals. (3 cr; prereq 103) Sivertsen

174. Modern Theory of Metals and Alloys. Free electron theory of metals and application. Imperfection in crystals. (3 cr; prereq 173 or ‡) Sivertsen

175. Imperfections in Metals. Theory of imperfections and their effects on properties of metals. (3 cr; prereq 174 or ‡) Gupta

180-181.* Thermodynamics and Kinetics of the Solid State. Theory of liquids, heterogeneous equilibria, free energy-composition diagrams and reaction kinetics. (3 cr per qtr; prereq PCh 103 or course in thermodynamics) Gupta

182. Theory of the Structure of Metals and Alloys. Introduction to electronic theory of structure and cohesive properties. Development of the wave mechanical description of the energy band structure, density of states curves, and Brillouin zone structure of various metallic crystal systems. Application to understanding of cohesive properties of metals and alloys, and relationship to observed structures. (3 cr; prereq 103 or ‡) Sivertsen

201, 202, 203.* Research in Process Metallurgical Engineering. (Cr ar) Bitsianes

210, 211, 212.* Seminar: Metallurgical Engineering. (Cr ar)

213, 214, 215. Seminar: Physical Metallurgy. (Cr ar) Staff

220.* Flotation Theory. Application of the principles of physical chemistry to study of flotation frothers, collectors, activators, and depressants and to pulp systems. (3 cr) Cooke, Iwasaki

222. Surface Chemistry of Flotation. Thermodynamics and kinetics of adsorption as applied to flotation systems. Electrical double layer theory, and techniques of electrokinetic measurements. Theory of flocculation and dispersion of mineral suspensions. (3 cr) Iwasaki

250. Thermodynamic Properties of Solids: Classical and Statistical Mechanics Applied to Study of Properties of Solids. (3 cr; prereq 180 or ‡) Swalin

251-252. Kinetics of Solid State Reactions. Application of the atomistic concepts to study of nucleation, diffusion, and phase transformations. (3 cr per qtr; prereq 182 or ‡ for 251, 251 or ‡ for 252) Swalin

255. Transformations and Microstructure. (3 cr; prereq 155, 182 or ‡) Sivertsen, Nicholson

260. Dislocation Theory of Crystals. Theory of slip, plastic flow, fracture, etc. (3 cr; prereq 175 or ‡) Staff

261-262. Theories of Mechanical Behavior of Solids. Dislocations and crystal structure, elastic theory of interaction between dislocations and dislocation mobility. Theories of work-hardening, recovery, creep, fatigue, and fracture. (3 cr; prereq 101 or ‡) Gupta

263. Advanced X-ray Diffraction of Metals. Reciprocal lattice, structure factor, Fourier analysis, diffuse scattering and low angle scattering. (3 cr; prereq 155 or ‡) Sivertsen

271, 272. Structure and Cohesion of Metals and Semiconductors. Basic physical theory of bonding in metals, alloys, and semiconductors, stability of phases and elastic constants of these materials. Crystal structures of the various systems discussed and related to fundamental parameters such as sizes of atoms and electronic structure of the crystal. Topics include applications of Tight Bonding Approximation, Wigner-Seitz Method, etc., to problems of calculating equilibrium structures, heats of solution and energies of formation of defects. (3 cr per qtr; prereq PCh 118, 119, Phys 109, Met 182) Sivertsen

280. Topics. Temperature dependence of resistivity, thermal conductivity, and specific heats; general equations for electron scattering by phonon-electron interactions and imperfections, experimental low temperature techniques, classical and quantum theories of superconductivity, type II superconductors, applications of superconductors, low temperature X-ray work, and low temperature magnetic measurements. (3 cr; prereq 102 or ‡) Toth

285. High Temperature Properties of Materials. Fundamental studies of transition metal carbides, nitrides, oxides, borides, and silicides. Phase diagrams, crystal structure similarities and thermodynamical and electrical properties. (2 cr; prereq 181 or ‡) Toth

290, 291, 292. Selected Topics in Physical Metallurgy. (Cr ar) Staff

MICROBIOLOGY

Professor

Dennis W. Watson, Ph.D., *head*
S. Gaylen Bradley, Ph.D.
Gerhard K. Brand, M.D.
Robert A. Good, M.D., Ph.D.
Wendell H. Hall, M.D., Ph.D.
James J. Jezeski, Ph.D.
Robert K. Lindorfer, Ph.D.
Louis H. Muschel, Ph.D.
Joseph C. Olson, Ph.D.
Edwin L. Schmidt, Ph.D.
Henry M. Tsuchiya, Ph.D.
Lewis M. Wannamaker, M.D.

Associate Professor

Dwight L. Anderson, Ph.D.
Robert W. Bernlohr, Ph.D.
Martin Dworkin, Ph.D.
Gerald M. Needham, Ph.D.
Palmer Rogers, Ph.D.
John A. Ulrich, Ph.D.

Assistant Professor

Alan B. Hooper, Ph.D.
Russell C. Johnson, Ph.D.
Yoon Berm Kim, M.D., Ph.D.
Peter G. W. Plagemann, Ph.D.
James T. Prince, M.S.

Language Requirement—For the Master's degree, one foreign language. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and the option of a collateral field of knowledge. Acceptable languages are French, German, and Russian.

Master's Degree—Offered under Plan A.

Doctor's Degree—Work leading to the Ph.D. degree is offered.

100s. Microbiology for Dental Students.** Morphology; methods of staining; culture media; methods of identification; principles of sterilization and disinfection; antibiotics; bacteria and disease; fundamentals of immunology; oral flora; bacteriology of oral infections, dental caries, alveolar abscess, and periodontal infection; relationship of oral infections to other focal and general infections. (6 cr) Anderson

102s. Medical Microbiology.** Pathogenic bacteria, fungi and viruses, especially in their relationship to disease; principles of infection, pathogenesis, and immunity; microbiological techniques for laboratory diagnosis and antibiotic determinations. (4 cr; for other than med students; prereq 116)

103s. Soil Microbiology. Methods for enumeration and study of microflora and microfauna. Biochemical activities of soil populations. (4 cr; prereq 53 or 153, 8 cr in organic chemistry and ‡) Schmidt

105f-106w. Principles of Infectious Disease.** Medical bacteriology, immunology, mycology, and virology inclusive of factors that produce an infectious process. Principles and techniques that make possible diagnosis, treatment, and prevention of specific infectious disease. (6 cr per qtr; prereq Anat 103, MdBc 100 or 101, or BioC 120) Brand, Watson, and staff

110s. Microbial Genetics. Genetic mechanisms in the bacteria, bacteriophages, fungi, protozoa, and algae. Mutagenesis; selection; adaptation; cytoplasmic inheritance; patterns of genic recombination; fine structure of genetic material. (3 cr; prereq 53 or 153, or ‡; offered 1966-67 and alt yrs) Bradley

111s. Experimental Microbiology.** Advanced laboratory study in comparative morphology, taxonomy, and physiology of bacteria. For microbiology majors and others interested chiefly in biological and chemical aspects of microbes. Stress enrichment, isolation, identification, cultivation, structure, and function of microorganisms. (5 cr; prereq 53 or 153, 121 and ‡) Staff

112s. General Mycology. Physiology; genetics; development; ecology; evolution; taxonomy; economic importance of the yeasts, molds, actinomycetes, and other fungi. (3 cr; prereq 53 or 153, or ‡; offered 1967-68 and alt yrs) Bradley

116w. Immunology. Host-parasite interactions; nature of antigens and antibodies; chemical basis of serologic specificity; qualitative and quantitative aspects of antigen-antibody reactions; theories of antibody production; cellular antigens and blood grouping; nature of complement and its role in immunologic phenomena; mechanisms of hypersensitivity; hypersensitivity-like states and immunologic diseases; homotransplantation and tumor immunity; mechanisms of natural and acquired immunity. (3 cr; prereq 53 or 153) Muschel

116Aw. Immunology Laboratory. (2 cr; prereq ¶116)

121w. Physiology of Bacteria. Chemical and physical organization of bacteria as related to function; growth; energy metabolism including oxidations and fermentations; nutritional requirements; antimicrobial agents; autotrophic mechanisms; and microbial differentiation. (3 cr; required of all microbiology majors; prereq 53 or 153, 8 cr in organic chemistry or biochemistry) Rogers

124f. Biology of Viruses. Structure, composition, and properties of bacterial and mammalian viruses; their interaction with cells and effect on host cell metabolism; biochemistry of viral replication; techniques used in study and diagnosis of viral infections; viral tumorigenesis. (3 cr; prereq 53 or 153, and 121) Plagemann

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** Microscope required. Students may obtain use of microscope by purchasing $3 microscope cards from the bursar.

152f,w,s. Special Problems. (Cr ar; prereq ‡)

153f. Biology of Microorganisms.** Lectures, demonstrations, and laboratory exercises in taxonomy, anatomy, physiology, biochemistry, and ecology of microbes. Fundamental properties of bacteria. (4 cr, §53; prereq 5 cr in biological sciences, OrCh 61, 62 or ‡) Dworkin

201f,w,s. Research in Microbiology. Graduate students with the requisite preliminary training may elect research, either as majors or minors. (Cr and hrs ar) Staff

202f,w,s. Diagnostic Microbiology. Laboratory procedures for isolation and identification of microorganisms from patients. Work is carried out in the diagnostic microbiology laboratories of the hospital. (Cr ar; prereq grad student in microbiology, ‡) Watson, staff

203f,w,s. Seminar. (1 cr) Dworkin

205f,w,s. Advances in Immunology. Research reports: evolution and mechanisms of immune response, cellular and humoral aspects of hypersensitivity, immunological tolerance, autoimmunity and its relation to disease, and other topics. (1 cr per qtr) Watson, Good, Muschel, and staff

206s. Laboratory Methods, Applied Animal Cell Culture and Virology.** Laboratory exercises on preparation of animal cell cultures; study and laboratory diagnosis of viral and rickettsial infections. (3 cr; prereq 124 or ¶124, ‡; offered 1967-68 and alt yrs) Staff

207w. Advanced Medical Microbiology. (2 cr; prereq ‡) Brand

222. Physiology of Bacteria Laboratory. Techniques employed in study of bacterial physiology and metabolism. (3 cr; prereq 121, grad in microbiology, others by consent; offered 1st term SS only) Rogers

223f. Bacterial Metabolism. Advanced treatment of metabolism: enzymes; biological energy; fermentation; respiration; nitrogen metabolism. (3 cr; required of all Ph.D. candidates in microbiology, open to others by consent; prereq 121 or equiv, introductory biochemistry) Bernlohr

MIDDLE EASTERN LANGUAGES

Assistant Professor

Anwar G. Chejne, *chairman*
Jonathan S. Paradise

The following are offered as courses in a minor program or as related fields (in linguistics and comparative philology, area studies, comparative literature), but, for the present, no graduate degrees are offered.

Arabic

Arab 101-102-103. Advanced Arabic. Reading and analysis of both early classical texts and modern writing. Structure, syntax, and style emphasized. (3 cr per qtr; prereq 73) Chejne

Arab 105. Structure of Arabic. Descriptive analysis of the main structure of Arabic, both classical and colloquial. (3 cr; prereq 2 yrs of Arabic or ‡; offered when feasible)

Arab 151, 152, 153. Directed Readings. For advanced students who wish to work on special problems. (1-3 cr per qtr; prereq 53 or ‡) Chejne

Arab 154-155-156. Seminar: Development of the Arabic Language and Literature. 154: The early state of the Arabic language from pre-Islamic times to middle of 8th century.

** Microscope required. Students may obtain use of microscope by purchasing $3 microscope cards from the bursar.

155: Development in the Golden Age of the Abbasid. 156: Decline of the language and its revival in modern times. (3 cr per qtr; prereq ‡) Chejne

Arab 161. Hispano-Arabic Literature and Culture: History of Islamic Spain. (3 cr; prereq ‡) Chejne

Arab 162. Hispano-Arabic Literature and Culture: Arab Philosophy in Spain. (3 cr; prereq ‡) Chejne

Arab 163. Hispano-Arabic Literature and Culture: Hispano-Arabic Literature. (3 cr; prereq ‡) Chejne

Arab 191-192-193. Honors Course: Research. (1-3 cr per qtr; prereq 153 or ‡) Chejne

Aramaic

101-102-103. Aramaic. Introductory course; fundamentals of grammar and fluency in reading of Biblical and Ancient Aramaic, including Aramaic parts of Daniel and Ezra, inscriptions and papyri from Syria, Egypt, Mesopotamia, and Persian Empire. For students preparing for Biblical studies, ancient history majors, and students specializing in Semitic languages. (3 cr per qtr; prereq Heb 53 or ‡)

Hebrew

101-102-103. Advanced Biblical Hebrew. Exegesis of a Biblical text with attention to results of historical, linguistic, and archaeological research. For majors and others adequately prepared to read the Bible in Hebrew. (3 cr per qtr; prereq Heb 53 or ‡) Paradise

104-105-106. Post-Biblical Literature. Selections from various genres of post-Biblical literature, including philosophical, literary, legal, and religious texts. (3 cr; prereq 53 or ‡) Toledano

114. Introduction to Comparative Study of the Semitic Languages. (3 cr; prereq 1 yr of 2 Semitic languages; may be ¶Heb 3) Paradise

151-152-153. Northwest Semitic Inscriptions. Fundamentals of Ugaritic alphabet cuneiform script, morphology, and syntax; epigraphy, linguistic changes, style, and literary relations of Hebrew, Moabite, Phoenician, and Punic inscriptions. (3 cr per qtr; prereq Heb 53 or ‡) Paradise

MINERAL ENGINEERING

Professor

Strathmore R. B. Cooke
Charles Fairhurst, *director of graduate study*
Eugene P. Pfleider

Associate Professor

Adrian C. Dorenfeld
W. David Lacabanne
Donald H. Yardley

Prerequisites—For major work, adequate preparation in undergraduate subjects and in the sciences fundamental to mineral engineering, in addition to general admission requirements. For minor work, the prerequisites to the courses to be pursued, and approval of the major department.

Language Requirement—For the Master's degree, none. For the Ph.D. degree, either (a) two foreign languages selected from German, French, and Russian (other languages may be considered on petition); or (b) upon petition, one of the above languages and a special research technique. Students working toward the Ph.D. degree must either complete or show substantial progress toward completion of one language or the special research technique in their first year of residence.

Master's Degree—Either a Master's degree with departmental designation or an undesignated Master's degree is offered. Students who have a B.S. in mineral engineering have the option of obtaining either the designated or the undesignated M.S. degree. Students who have a B.S. degree in other fields (e.g., geology, physics, chemistry, etc.) may choose either (a) to make up the deficiencies in the basic engineering curriculum and proceed normally to the designated M.S. degree in mineral engineering, or (b) proceed directly to the undesignated M.S. degree.

Only Plan A will be allowed for students working toward an undesignated M.S. degree, whereas either Plan A or Plan B will be permitted for students working toward an M.S. degree with departmental designation.

Doctor's Degree—Work leading to the Ph.D. degree is offered.

111,° 112,° 113.° Principles of Mineral Engineering: I, Exploration; II. Development and Exploitation; III, Earth Fluids and Flow. Principles and techniques of exploration, factors and concepts involved. Sampling design, combining theory, geostatistics. Mining systems; unit operations, drilling, explosives, and transportation. Sedimentary rock and earth fluids characteristics. Fluid flow through reservoir rocks and aquifers. Energies and mechanisms of petroleum production. (3 cr per qtr) Yardley, Lacabanne

121. Mine Plant Engineering. Basic engineering principles in design and selection of mine and petroleum plant equipment. Calculations involving compressed air, pumping, transmission of gases and fluids, electrical equipment, and power systems. (3 cr; prereq Phys 114 or ‡) Dorenfeld

122. Mine Plant Engineering. Basic engineering principles in design and selection of mine plant equipment. Calculations involving power transmission and drilling, transporting, and hoisting of materials. (3 cr; prereq 121, MM 35 or ‡) Dorenfeld

123. Mine Air Conditioning. Mine gases, dust control, and physical properties of air; measurement of air properties. Design of ventilation, heating, and refrigeration systems. (3 cr; prereq 112) Lacabanne

126°-127.° Operations Analysis in Mineral Engineering I-II. Investment characteristics, capital costs; problems of variations products specifications. Statistical methods, tests of significance, correlation techniques; applications to cost estimates, sampling, mine and mill operations, blending, automation, and optimization techniques. (3 cr per qtr; prereq 122 or ‡) Dorenfeld

131°-132.° Rock Mechanics I, II. Elementary analysis of stress and strain. Rock stresses in mining. Design and layout of tunnels and mine workings. Rockbursts, subsidence. Techniques of underground stress measurement. Elementary blasting theory. Laboratory investigation of physical behavior of rocks. (3 cr per qtr; prereq MM 37 or ‡) Fairhurst

133.° Rock Mechanics III. Theories of blasting. Hydrodynamic theory of detonation. Calculation of explosion pressure. Design of blasting patterns. (3 cr; prereq MM 37)

139. Engineering Field Study. Study of mining and petroleum operations, mine and petroleum plants, and metallurgical plants in selected regions. (3 cr; prereq ‡) Staff

141. Mineral Economics I. Examination and valuation of mining and oil properties. Geologic factors and mineral titles. Sampling and reserve estimates. Analysis of costs and profitability. Taxation, depreciation, and depletion. Present worth computations and mine financing. (3 cr; prereq 113 or ‡) Pfleider

142.° Mineral Economics II. Minerals in national and world affairs, their importance and distinctive features. Distribution, demand, and conservation of strategic supplies. Marketing and prices. State and national policies affecting development. Analysis of mineral data. (3 cr; prereq Geo 62 or ‡) Pfleider

144-145.° Mine Systems Analysis. Systems design in exploration, development, and exploitation of a mineral property. Integration of concepts from geology and geophysics, rock mechanics, mine or petroleum plant engineering, and mineral economics and valuation principles to a specific problem chosen by student. Preparation of report. (2 cr for 144, 4 cr for 145; prereq 142 or ‡) Pfleider and staff

151, 152, 153.* Special Mining Engineering Problems. Literature survey or research work on mining problems. (Cr and hrs ar; prereq 112) Staff

155. Surface Mining Engineering. Unit operations of drilling, blasting, loading, and transportation of surface rocks and soils. Equipment productivity, selection, and cost estimating. Design of open pits and quarries. Economics and organization. (3 cr; prereq 112 or 131 or ‡) Pfleider

156. Gravity Flow of Fragmented Materials. Index, strength, and flow properties of fragmented materials. Flow–no flow design principles and techniques for gravity bins and drawpoints. Rate of discharge formulas, model consideration. Engineering problems and laboratory exercises. (2 cr) Pfleider

160.* Geology and Technology of Nonmetallic Rocks and Minerals. Geologic and geographic setting, genesis, evaluation, exploitation, processing, and marketing of industrial rocks and minerals. Unique problems associated with this group of mineral materials. (3 cr; prereq 112 or ‡; offered 1966-67 and alt yrs) Yardley

161-162. Geological Engineering Analysis. Comprehensive analysis of a geological engineering or rock mechanics problem. Involves integration of concepts of rock and soil mechanics, geology and geophysics, mineral engineering and economics, in a specific problem chosen by the student and staff. Preparation of a professional report. (1 cr for 161, 3 cr for 162) Fairhurst, Yardley

171. Fluid Flow Through Porous Media I. Introduction; petrophysics of porous rocks and aquifers; porosity, permeability, surface areas; linear, radial, and spherical flow; incompressible and compressible fluids; Darcy's Law; units, combination flows; etc. (2 cr; prereq 113 or ‡) Lacabanne

171A. Fluid Flow Laboratory I. Core analyses; porosity, permeability, saturation measurements; linear and radial flows with liquids and gases; liquid vertical flows; etc. (1 cr; prereq 171 or ‡) Lacabanne

172. Fluid Flow Through Porous Media II. Flow possibilities; Darcy's generalized equations; vertical flow equations; units; Kozeny equation; fracture and channel flow; diffusivity equation and unsteady state flow; electrical and acoustical properties of rocks—porosity and connate water relationships; etc. (3 cr; prereq 171 or ‡) Lacabanne

172A. Fluid Flow Laboratory II. Capillaries and networks; Kozeny relationships—also electrical relationships; internal surface area measurement methods; pore size distributions; capillary pressures; electrical properties of rocks, formation factors, relationships to porosity and water saturations; water resistivities; etc. (1 cr; prereq 172 or ‡) Lacabanne

173. Fluid Flow Through Porous Media III. Behavior and flow of oil, gas, and water in reservoirs; reservoir flow energies and mechanisms; evaluation of reserves, material balance equations; rock compressibility effects on recoveries; mobility ratios; fractional flow equations; etc. (2 cr; prereq 172 or ‡) Lacabanne

180.* Geochemical Exploration. Application of geochemical techniques and principles to the search for ore bodies. Laboratory work on geochemical methods for determination of total and specific heavy metal content of rocks, soil, water, and plants. (3 cr; prereq ‡) Yardley

185.* Selected Topics in Mineral Exploration. Exploration programming in relation to theories of ore genesis. Analysis of effects of contract requirements on exploration decisions. Theory of ore sampling and combining. Statistical analysis of grade estimates. Searth theory in exploration. (3 cr; offered 1966-67 and alt yrs) Yardley

201, 202, 203.* Seminar: Mineral Engineering. (Cr ar) Fairhurst, Pfleider, and staff

210.* Engineering Report. Detailed study and report of the actual operations of a mine. (Cr and term ar) Pfleider

212, 213, 214.* Mining Research Problems. (Cr ar) Staff

240.* Advanced Concepts in Drilling of Rocks. Distintegration and comminution by sound waves and gases at ultrahigh velocities and temperatures. Cutting action of percussion and rotary bits by shear, tensile, and compressive forces. (3 cr; prereq ‡) Fairhurst

241.* Advanced Mineral Economics I. Study and analysis of mineral resources as related to national and world requirements. Presentation of assigned topics and class discussion. Invited lectures. (3 cr; prereq 142 and Geo 156 or 157 or equiv...Econ 2T recommended...or ‡) Pfleider

251-252.* Advanced Rock Mechanics I, II. Analysis of stress and strain. Rock behavior under stress. Theories of rock failure in drilling and comminution. Folding and faulting; hydra-frac process. Original experimental investigations. Critical analysis of methods of rock testing. Model analysis. (3 cr per qtr; prereq MM 180) Fairhurst

MUSIC

Professor
Dominick J. Argento
Paul Fetler
Heinrich Fleischer
Paul M. Oberg
Johannes Riedel, *director of graduate study*
Roy A. Schuessler, *chairman*
Bernhard D. Weiser

Associate Professor
Frank P. A. Bencriscutto

Assistant Professor
Robert T. Laudon

Prerequisites—Candidates for graduate work must have a working knowledge of piano and performing ability in some phase of instrumental or vocal music, plus 30 undergraduate quarter credits in one of the following branches of music: (a) history and literature, (b) theory and composition, (c) piano pedagogy, or (d) music education. Placement tests in music theory, music literature, and applied music are required of all entering students.

Language Requirement—For the master of fine arts degree, none. For the Master's degree, a reading knowledge of French or German. Substitution may be made by petition when a different language is needed for an individual research problem. For the Ph.D. degree, either (a) two foreign languages, or (b) one language and the option of a special research technique or a collateral field of knowledge. When two languages are offered, French and German are acceptable.

Master of Fine Arts Degree—The applicant for admission to the master of fine arts program must submit to the chairman of the Music Department a tape containing examples of his performance in the medium he wishes to emphasize. Applicants who find it convenient to arrange for personal auditions at the Music Department may do this in lieu of the tape. No recommendation concerning admission will be made on an application until the tape has been received and evaluated in the Music Department and the completed application for admission to the Graduate School has been received in the Graduate School office.

The candidate must complete a program of approximately 2 full years of graduate credit, 45 of which must be earned in graduate courses at the University of Minnesota. He must execute and leave a record of a creative project (production, recital, or exhibition) which will be accompanied by a supporting paper that deals with the planning and/or execution of the creative work. A minimum of 9 credits will be required in history or literature of music, and the department requires a minimum of 9 credits in areas of study outside the major department. The individual program must be approved by the departmental M.F.A. committee. The candidate will be subject to final written and oral examinations.

Admission to candidacy is limited to a selected group of students with a Bachelor's degree from an approved university or college or the equivalent

and to those who provide evidence of exceptional promise as creative artists in one or more of the following subfields: applied music, conducting, and church music.

Master's Degree—Offered under both Plan A and Plan B. The thesis subject and major work may be chosen from either the historical, theoretical, or music education subfields. An original composition may be offered in place of the usual research thesis under Plan A. Under Plan B, courses from the subfields of music not used for the concentration may be taken as related work, except that all Plan B students must present at least one field of 9 credits outside the various music subfields.

Doctor's Degree—Work leading to the Ph.D. degree with thesis is offered with emphasis on music history and literature, theory and composition, or music education. Students with marked creative ability may substitute an original composition for full orchestra for the usual research thesis.

100x. Advanced Applied Music. Advanced literature in piano, voice, organ, and orchestral instruments. (2 or 4 cr; prereq entr exam) Staff

101A, B, C. Voice Production for the Theatre. Development of the voice for both speaking and singing in the theatre through singing techniques. (2 cr per qtr; prereq grad stud in theatre arts and ♯) Schuessler

104-105-106.* American Music. From colonial times to present through reading and record listening. American Indian music, European folk music on this continent, origin and development of jazz and contemporary American music. (3 cr per qtr; prereq 36 or 9 cr in American history or American studies or ♯) Riedel

107. Georg Friedrich Handel: Life and Works. Musical culture in middle and northern Germany, 17th and 18th centuries. The oratorio in Italy, France, Germany, and England. G. F. Handel's work with emphasis on his oratorios. Handel and England. (3 cr; prereq 36 or ♯, grad in music or music education; offered 1967-68 and alt yrs) Riedel

108.* Heinrich Schütz: Life and Works. Influenced by political events; Protestant hymn and psalm literature, its musical elaborations in his works; his importance in fields of madrigal and monody, sacred concerto and cantata, and passion; Schütz compared to Bach. (3 cr; prereq 6 cr in music history or history of art or German literature or political history to 1700, or ♯; offered 1967-68 and alt yrs) Riedel

109. Lasso and Palestrina. Council of Trent; influence on writing and performance of sacred music of 16th century. Madrigal, mass, and motet writing as exemplified in their works; Lasso's cosmopolitan and Palestrina's *a cappella* styles of writing; *Palestrina Style* of 17th and 18th centuries; *Caecilianism* of 19th and 20th centuries. (3 cr; for majors in music, arts, history; prereq 6 cr in music history or Renaissance and baroque art, or political history to 1700, or general history of Western philosophy, or ♯; offered 1966-67 and alt yrs) Riedel

110. Music Bibliography. General reference sources. Music bibliographical materials in English, other languages; bibliographical drills in music history, theory and composition, music education, applied music. (3 cr; prereq one of the following: 36, 56, 99, or ♯) Riedel

112, 113, 114. History of Vocal Art. Significant schools of singing from 1600 to present. (2 cr per qtr; prereq 18 cr in 12 and 62 or ♯) Schuessler

115, 116, 117. Vocal Literature. Preparation and performance of representative solo vocal works from major and minor composers. (2 cr per qtr; prereq 12 cr in 12 or ♯) Schuessler

118, 119, 120. Piano Literature. Keyboard literature suitable for piano performance from end of 16th century through present; its background and development. Performance illustrations by instructor, recordings. (2 cr per qtr; prereq 12 cr in 11 or ♯; offered 1966-67 and alt yrs) Weiser

121-122-123. Advanced Harmony. Chromatic harmony through analysis of representative 19th- and 20th-century works. (2 cr per qtr; prereq 6T) Argento

124-125-126.* History of Opera. Opera as music and drama: production, styles, cultural background, from late 16th century to present—modern repertoire, broadcast by the Metropolitan Opera Company. (3 cr per qtr; prereq 9 cr in history of music or history of art or history of theatre or European history from 1600, or ♯) Argento

127-128-129.* Composition. Original work in various forms. (2 cr per qtr; prereq 99 and 123) Fetler, Argento

130.* Symphonies of the Classical Era. Through Mozart and Haydn: evolution of form and style in relation to contemporary thought and art through the French revolution. (3 cr; prereq 6 cr in music history or art history or political history since 1750 or English or German literature since 1750, or ♯; offered when feasible) Riedel

130A. Early Romantic Music. (1800-1848) Literary and musical influences; form and subjects of Beethoven; orchestral, chamber, piano music; opera; Lied, choral music. (3 cr; prereq 36 or ♯; offered 1966-67 and alt yrs) Riedel

131. Symphonies of Beethoven. Evolution of Beethoven's symphonic form and style as a reflection of intellectual, political, and artistic currents of the Napoleonic era. (3 cr; prereq 6 cr in music history or art history or political history since 1750 or English or German literature since 1750, or ♯; offered when feasible)

131A. Late Romantic Music. (1848-1885) Neoclassicism, Brahms; Wagnerian music drama; nationalism in music of Russia, Bohemia, Scandinavia, Spain; mid-19th-century French music. (3 cr; prereq 36 or ♯; offered 1966-67 and alt yrs)

132. Symphonies of the Romantic Era. Schubert, Schumann, Mendelssohn, Berlioz, Liszt, Brahms, Franck, Dvorak, Tschaikowsky, Bruckner, Richard Strauss; their relation to dominant romantic trends of the 19th century. (3 cr; prereq 6 cr in music history or art history or political history since 1750 or English or German literature since 1750, or ♯; offered when feasible) Riedel

132A. Neoromantic Music. (1885-1917) Music of Bruckner, Mahler, Sibelius, Strauss, Schönberg, Reger, Elgar, Puccini, Leoncavallo, Charpentier, Franz, Cornelius, Wolf; impressionism. (3 cr; prereq 36 or ♯; offered 1966-67 and alt yrs) Riedel

133. Baroque Performance Practices. Ornamentation, phrasing, articulation, and improvisation in the music of the period of 1550-1759. A study of music instruction books of this era leading to analysis and performance of baroque music in baroque style. (3 cr; prereq 6T, 36, or ♯, ability to perform with some facility; offered when feasible) Laudon

134-135-136.* History of Church Music. Trends. Relationship of music to various theologies and liturgies. (3 cr per qtr; prereq 36 or ♯) Riedel

137-138-139. Keyboard Harmony. Practical ear training as applied to the piano; chorales are transposed into all keys in four parts and expanded chords by melodic and harmonic analysis; modulation. (1 cr per qtr; prereq 6T) Argento

140. Interpretation of Choral Masterpieces. Musical and vocal techniques necessary for presentation of great choral compositions from Renaissance to 20th century. (3 cr; prereq 6T or ♯; offered when feasible)

140E. Interpretation of Choral Masterpieces. A short-term modification of 140. (3 cr; offered when feasible)

141-142-143. Orchestration. Scoring instruments of the orchestra for ensemble combinations and full orchestra. (2 cr per qtr; prereq 6T) Argento

144-145-146. Bach Through Beethoven. The transition from late baroque to galant and classical styles. (3 cr per qtr; prereq 36; offered 1967-68 and alt yrs) Laudon

147, 148, 149. Opera Workshop. Opportunity for student to prepare and perform operatic roles—standard and contemporary. A union of musical and dramatic interpretation is emphasized, and scheduled private instruction is given in addition to ensemble work. All projects and roles sung in English language. (2 cr per qtr; prereq ability to sing an aria satisfactorily) Knowles

150. Organ Literature. Development of organ literature and playing from 14th century to present. The mutual influence of organ construction and organ composition; various national schools of organ playing. Demonstration on the organ. (2 cr; prereq grad organ and musicology students) Fleischer

151-152. Introduction to Musicology. Scope, aims, methods, and resources of research in musicology including fields of acoustics, psychology, sociology, and theory. (3 cr per qtr; prereq 110 or ‡; offered 1967-68 and alt yrs) Riedel

154-155-156.* Music in the Middle Ages and Renaissance. Monophonic music from Gregorian chant to English madrigal school. (3 cr per qtr; prereq 36; offered 1967-68 and alt yrs) Riedel

157, 158, 159. German Lieder. Selected songs as regards interpretation and style. 157: Schubert, Mozart, Beethoven, 158: Schumann, Brahms, Franz. 159: Wolf, Strauss, Mahler. (2 cr per qtr; prereq 18 cr in 12 or 11, Ger 2, or ‡)

161-162. Band Arranging. Scoring for band instruments; creative arrangements for marching or concert bands. (3 cr per qtr; prereq 6T, 143 or MuEd 65 or ‡; offered 1967-68 and alt yrs) Bencriscutto

164-165-166. Music in the Baroque Era. Development of the vocal, instrumental, and sacred styles of the baroque era. (3 cr per qtr; prereq 36; offered 1966-67 and alt yrs) Laudon

167su, 168su, 169su. Technique and Production of Opera and Operetta. The singer prepares and performs roles in opera and operetta. Special projects including stage direction; musical direction; and accompanying-coaching are offered for the nonsinger. (3 cr; prereq singers, ‡; 167, 1965; 168, 1966; 169, 1967) Knowles

170-171-172. Piano Pedagogy I. Group teaching of children both at beginning and advanced levels in the following situations: the studio piano teacher; pre-piano classes or keyboard experience; piano in public schools. Both demonstration and lecture classes and a required laboratory set-up to afford practical, on-the-spot experience and training in teaching children. (2 cr per qtr; prereq 2 yrs piano, 2 yrs theory, or ‡)

175. Training in Advanced Musicianship. Dictation of melodic, harmonic, rhythmic, two- and three-part contrapuntal materials; score reading, both vocal and instrumental; training in tonal memory. (3 cr; prereq 6T) Fetler

177.* Analysis of Contemporary Music. Twentieth-century styles and techniques including works of Bartok, Hindemith, Stravinsky, Schönberg, and others. (3 cr; prereq 6T) Fetler

180-181-182. Piano Pedagogy II. Group teaching of adults both at beginning and advanced levels in the following situations: the piano minor, the piano major, the music education piano major, the nonmusic major, in college teaching, as well as in adult education and extension classes along with the public school teacher. Demonstration and lecture classes and a required laboratory set-up to afford practical, on-the-spot experience and training in teaching adults. (2 cr per qtr; prereq 2 yrs piano, 2 yrs theory, or ‡)

185-186-187. Collegium Musicum. Provides opportunity for student to realize in performance scores from the various periods of our musical culture, medieval through present. This course is intended to be taken in conjunction with music history. Music studied there will be performed by the Collegium. (1 cr per qtr; prereq ‡)

190. Hymnology. History of hymn texts and tunes. Byzantine and Roman hymns. Lutheran hymn. Anglican hymn. Baptist, Congregational, Methodist, Presbyterian, Unitarian, and other hymns. History of hymn books. History of hymn settings. (3 cr; prereq 6 cr in Mus 34, 35, 36 or Art 56, 57, 58 or Phil 11 or Phil 50, 51, 52 or Engl 66, 67, or ‡) Fleischer, Riedel

197-198-199. Advanced Counterpoint. Bach's *Art of the Fugue;* practice in technique of writing three- and four-voice fugues; contrapuntal devices and problems; analysis of polyphonic examples of various periods. (2 cr per qtr; prereq 99) Fetler

200-201-202.* Basis of Musical Expression. (3 cr per qtr; prereq 146; offered when feasible) Oberg

203. Notation of Polyphonic Music. History of notation, both vocal and instrumental; transcriptions of original works, written in black notation, white mensural notation, keyboard and lute tablatures, problems of transcribing and editing. (3 cr; prereq ‡; offered 1966-67 and alt yrs) Riedel

204x. Graduate Applied Music. (12 cr upon completion of 3 qtrs and presentation of complete grad recital; prereq entr exam; minimum of 12 hrs practice per wk) Staff

205-206-207. Notation of Polyphonic Music. History of notation, both vocal and instrumental, from Middle Ages through the baroque era; transcriptions of original works written in black notation, white notation, keyboard and lute tablatures; problems of transcribing and editing. (3 cr per qtr; prereq ‡)

209-210-211.° Advanced Topics. (3 cr per qtr; prereq 76) Oberg, Fetler, Fleischer, Riedel, Schuessler, Weiser

212x.° Special Problems. (3-9 cr per qtr; prereq 110) Oberg, Fetler, Fleischer, Riedel, Schuessler, Weiser

215. Advanced Conducting. Application of conducting techniques to music from 16th century to contemporary times by analysis of stylistic and technical characteristics of each historical period. (3 cr; prereq ‡)

216-217-218. History of Music Theory. From antiquity to 20th century. Ancient and medieval treatises; instruction and performance books of Renaissance and baroque eras; counterpoint, harmony, and analysis books of 19th and 20th centuries. (3 cr per qtr; prereq ‡)

227-228-229.° Seminar: Composition and Orchestration. (3 cr per qtr; prereq grads who have completed an undergrad major sequence in music theory and composition, incl 99, 123, 129, 143, 199) Fetler

For music education courses, see index.

NUCLEAR ENGINEERING

In a broad sense, nuclear engineering encompasses the processing, separation, development, and testing of materials for nuclear reactors; the design and operation of nuclear reactors for research, isotope production, breeding, power, and heat generation; the utilization as well as the disposal of radionuclides and fission products; and the exploitation of nuclear energy sources.

Although the Graduate School does not offer a degree in nuclear engineering, a graduate student may prepare himself for a career in nuclear engineering through a proper choice of courses in existing majors, and through use of the special facilities for the study of heat transfer, metallurgy, neutron physics, gamma irradiation, radiochemistry, servomechanism and control, and reactor simulation.

A student interested in nuclear engineering should consult with the graduate faculty of the major of his choice concerning a suitable program of study. Departments participating in the Nuclear Engineering Committee include Mechanical Engineering, Chemistry, Physics, Chemical Engineering, Electrical Engineering, Metallurgical Engineering, and the School of Public Health.

The University of Minnesota is a participant in the Argonne National Laboratory, and through this affiliation supplementary instruction and research may be arranged. Recipients of the AMU-ANL and the AEC special fellowships in nuclear science and engineering may take their graduate work at the University of Minnesota in one of the above-mentioned departments.

NUTRITION

Professor

Joseph T. Anderson (Physiological Hygiene)
John D. Donker (Animal Science)
Francisco Grande (Physiological Hygiene)
Lester E. Hanson (Animal Science)
Lavell M. Henderson (Biochemistry, Biological Sciences)
Ancel Keys (Physiological Hygiene)
Irvin E. Liener (Biochemistry, Biological Sciences)
Robert J. Meade, *vice chairman* (Animal Science)
Lura M. Morse (Nutrition, Home Economics)
Max O. Schultze (Biochemistry, Biological Sciences)
Robert J. Sirny, *chairman* (Nutrition, Home Economics)
Paul E. Waibel (Animal Science)
Jesse B. Williams (Animal Science)

Associate Professor

Margaret D. Doyle (Nutrition, Home Economics)
David C. Snetsinger (Animal Science)
John F. Van Pilsum (Biochemistry, Medical Sciences)

Assistant Professor

Richard D. Goodrich (Animal Science)
Jay C. Meiske (Animal Science)
Alvin L. Melliere (Animal Science)
Donald E. Otterby (Animal Science)
John D. Smith (Animal Science)
Ruth E. Stief (Nutrition, Public Health)
Patricia B. Swan (Nutrition, Home Economics)

Prerequisites—A strong foundation in biological sciences including one quarter of microbiology, college mathematics through calculus, the equivalent of a year of general chemistry, a year of organic chemistry, a course in quantitative analysis, and a minimum of two quarters of college physics. Deficiencies must be removed before the student can become a candidate for a degree. For minor work, the student must satisfy the nutrition graduate faculty that he has an adequate background. Most students preparing for graduate study in nutrition will find it advantageous to become proficient in at least one foreign language prior to entrance into the Graduate School.

Language Requirements—For the M.S. degree, none. For the Ph.D. degree, (a) two foreign languages or (b) one foreign language plus a special research technique or collateral field. Acceptable languages are French, German, Russian, and Spanish. In special cases, some other language may be substituted by petition.

Master's Degree—Offered under Plan A and Plan B.

Doctor's Degree—For a major study, the student will be required to develop and demonstrate a general competence in nutrition, including a comprehensive knowledge of basic biochemistry and statistics. In addition, the student will be expected to develop a minor or coherent program in a field(s) of study closely allied to nutrition, e.g., biochemistry, histology, embryology, anatomy, microbiology, physiology, and zoology. Thesis work can be conducted in the area of (a) human nutrition, (b) nonruminant nutrition (laboratory rat, swine, and poultry), or (c) ruminant nutrition. General competence in nutrition will be required of the student with a nutrition minor.

The following is a listing of courses from which selections for major and minor programs are commonly made; other courses are also available. Detailed descriptions of all courses can be seen in the course listings under the indicated departments.

AnHu 166. Introduction to Animal Nutrition. (3 cr; prereq 37, BioC 52 or ‡; also offered SSI 1969) Smith

AnHu 213x.° Research in Animal Husbandry. (3-9 cr per qtr; in nutrition area) Staff

AnHu 222w.° Energy in Animal Nutrition. (3 cr; prereq BioC 52 (152) or ‡...BioC 143 recommended; offered 1966-67 and alt yrs) Donker

AnHu 223s.° Protein and Amino Acid Nutrition. (3 cr; prereq BioC 52 (152) or ‡...BioC 143 recommended; offered 1966-67 and alt yrs) Meade

AnHu 224w.° Vitamin Nutrition. (3 cr; prereq BioC 142 or ‡; offered 1967-68 and alt yrs) Waibel

AnHu 225s.° Mineral Nutrition. (3 cr; prereq BioC 52 (152) or ‡...BioC 142 recommended; offered 1967-68 and alt yrs) Snetsinger

AnHu 226f.° Ruminant Nutrition. (3 cr; prereq BioC 52 (152) or ‡...MicB 121, 223 recommended; offered 1966-67 and alt yrs) Meiske

BioC, MdBc 141-142. General Biochemistry. (3 cr per qtr; prereq ¶145-146 except with △, 1 yr organic chemistry and cr in physical chemistry or ¶PCh 101, 107, or 90 and ‡) Liener, Kirkwood

BioC 143. Metabolic Reactions. (3 cr; prereq 142 or ‡) Gander

BioC 145-146. General Biochemistry Laboratory. (3 cr per qtr; prereq ¶141-142; 4 cr in analytical chemistry and ‡) Glass, Lovrien and Gander

BioC 147. Advanced Biochemical Techniques. (3 cr; prereq 145-146 or MdBc 145-146, ¶BioC 143 and ‡) Warner

BioC 204. Tracer Techniques. (3 cr; prereq ‡, 143 or MdBc 144, 146 or MdBc 146...MeAg 127 recommended) Kirkwood

BioC 224. Vitamins. (3 cr; prereq 143 or ‡) Schultze

DyHu 199x. Special Problems. (1-3 cr per qtr [may be repeated]; prereq ‡) Donker, Otterby, Williams

DyHu 124. Dairy Cattle Nutrition. (3 cr; prereq AnHu 36) Otterby

DyHu 218. Review of Advances in Nutrition and Feeding of Dairy Cattle. (3 cr; prereq ‡; offered 1967-68 and alt yrs) Donker

HE 170. Nutrition Principles. (3 cr; prereq 40, BioC 1A, Phsl 51) Morse

HE 171. Maternal and Child Nutrition. (3 cr; prereq 170, HEEd 90) Doyle

HE 172. Current Developments in Nutrition. (3 cr; prereq 31, 40, BioC 1A, Phsl 51, or ‡) Stmy

HE 173. Diet Therapy. (4 cr; prereq 170...35 or BioC 52 recommended) Verstraete

HE 176. Advanced Nutrition. (4 cr; prereq 170 and 35 or BioC 52) Swan

HE 178. Clinical Problems in Nutrition. (2-4 cr [2 cr at St. Paul and/or 2 cr at Rochester]; prereq 170, 35 or BioC 52) Ross, Jones

HE 179. Readings in Nutrition. (2 cr; prereq 170) Staff

HE 270-271. Principles of Human Nutrition. (3 cr per qtr; prereq 170, ‡) Staff

HE 279x. Seminar: Nutrition. (1 cr; prereq ‡) Staff

HE 295-296x.° Home Economics Problems. (1-5 cr per qtr; in nutrition area; prereq ‡) Staff

MdBc 101w,su. Biochemistry. (8 cr; prereq physics, physical and organic chemistry) Armstrong, Gray, Ungar

Poul 153s. Poultry Nutrition. (3 cr; prereq BioC 51 or ‡) Waibel

Poul 215x.° Research in Poultry Nutrition. (Cr ar; prereq ‡) Snetsinger, Waibel

PubH 191.° Science of Human Nutrition. (3 cr; prereq ‡) J Anderson, Keys

OBSTETRICS AND GYNECOLOGY

For staff and courses of study offered, see the *Bulletin of the Graduate Programs in Medicine, Dentistry, and Pharmacy.*

OPHTHALMOLOGY AND OTOLARYNGOLOGY

For staff and courses of study offered, see the *Bulletin of the Graduate Programs in Medicine, Dentistry, and Pharmacy.*

PATHOLOGY

Professor
A. B. Baker, M.D., Ph.D.
Ellis S. Benson, M.D.
James R. Dawson, Jr., M.D., *head, director of graduate study*
Jesse E. Edwards, M.D.
Franz Halberg, M.D.
Robert Hebbel, M.D., Ph.D.

Associate Professor
John I. Coe, M.D.
Paul H. Lober, M.D., Ph.D.
Nathaniel A. Lufkin, M.D.
Lee W. Wattenberg, M.D.

Prerequisites—Graduate students who desire to take their major work in pathology must present credits for the equivalent of the first 2 years' work of the Medical School of this University. A degree with designation, such as M.S. in pathology, is awarded only to those who have an M.D. degree.

Language Requirement—For the Master's degree, one foreign language. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and the option of a collateral field of knowledge. French, German, and Russian are acceptable languages.

Master's Degree—Offered only under Plan A.

Master's Degree with Designation in Pathology—Given only after 3 years of work.

Doctor's Degree—The Ph.D. degree with designation in pathology may be awarded after completion of 3 or more years in graduate work and presentation of a thesis of high quality.

101. Pathology. General pathology. (8 cr; prereq completion of 1st yr in Med School or equiv) Dawson, Hebbel, and staff

102. Pathology. Special pathology. (8 cr; prereq 101) Dawson, Hebbel, and staff

104x. Autopsies. (Cr ar; prereq 102) Dawson, Hebbel

105. Diseases of the Kidney. (3 cr; prereq 102) Hebbel

106. Diseases of the Heart. (1 cr; prereq 102) Edwards

110x. Seminar: Pathology. (1 cr per qtr; prereq 102) Dawson

111x. Conference on Autopsies. (1 cr per qtr; prereq 102) Dawson

112. Diagnosis of Tumors. (Cr ar; prereq 102) Hebbel

113x. Surgical Pathology. (Cr ar; prereq 102) Hebbel

114. Diseases of the Liver. (1 cr; prereq 102) Staff

115. Advanced Neuropathology. (Cr ar, §NPsy 210; hrs ar) Baker

116. Problems in Neuropathology. (Cr ar, §NPsy 143; prereq 102; hrs ar) Baker

117. Neuropathology. (Cr ar, §NPsy 143; hrs ar) Baker

119. Survey of Neuropathology. Examination of specimens from current autopsies. (Cr ar, §NPsy 212; hrs ar)

120. Diseases of the Lungs. (1 cr; prereq 102) Dawson

121. Diseases of the Alimentary Tract. (1 cr; prereq 102) Hebbel

122. Basic Science of Cancer. (4 cr; prereq MdBc 100 or equiv) Wattenberg

140f,w,s. Seminar: Experimental Pathology. (Formerly CBio 140) (1 cr) Halberg

141f,w,s. Problems in Experimental Pathology. (Formerly CBio 141) (Cr and hrs ar) Halberg

150x. Problems in Pathology. (Cr and hrs ar; prereq 102, △) Staff

201x. Research. (Cr and hrs ar; grad students with necessary preliminary training may elect research, either as majors or minors in pathology)

207f,w,s. Research in Experimental Pathology. (Formerly CBio 207) (Cr and hrs ar) Halberg

PEDIATRICS

For staff and courses of study offered, see the *Bulletin of the Graduate Programs in Medicine, Dentistry, and Pharmacy.*

PHARMACEUTICAL CHEMISTRY

Professor

Ole Gisvold, Ph.D., *head, director of graduate study*
Frank E. DiGangi, Ph.D.
Taito O. Soine, Ph.D.

Associate Professor

Philip S. Portoghese, Ph.D.

Pharmaceutical chemistry involves the applications of the principles and processes of the various areas of chemical science to inorganic and organic medicinal agents. The synthesis of compounds in accordance with molecular structure-biological activity concepts or as congeners of medicinal agents that are often of natural origin constitute the medicinal chemistry phase of pharmaceutical chemistry, which also is concerned with the phytochemistry of natural products used for medicinal purposes.

Prerequisites—Graduate work leading to the M.S. and Ph.D. degrees with a major in pharmaceutical chemistry is open to students who have shown exceptional scholarship and ability in undergraduate courses of this or some other college of pharmacy of equal standing. Consideration will be given to applications of students who are not graduates in pharmacy but whose pattern of undergraduate work includes training in such allied or related subjects as would qualify them to do graduate work successfully with a major in pharmaceutical chemistry.

Language Requirement—For the Master's degree, one foreign language (German would be routinely acceptable). For the Ph.D. degree, either (a) two foreign languages (German and French would be routinely acceptable) or (b) one foreign language and the option of a collateral field of knowledge.

Master's Degree—In general, offered under Plan A. Plan B may be followed by petition.

Doctor's Degree—Graduate work leading to the Ph.D. degree is offered to students prepared for advanced work in pharmaceutical chemistry.

161-162-163. Organic Medicinal Agents. Sources, production, properties, reactions, structure-activity relationships, and uses of natural and synthetic organic compounds—both simple organic compounds (hydrocarbons, alcohols, amines, etc.) and vitamins, hormones, alkaloids, organometallics, etc. (3 cr per qtr; prereq OrCh 62) Gisvold and staff

164-165-166. Special Analytical Methods. Food, Drug, and Cosmetic Act and many of the official analytical methods of the U.S.P., N.F., and A.O.A.C. Analytical procedures involving instrumental methods. (3 cr per qtr; prereq 55, OrCh 63) Portoghese and staff

173. Special Problems in Pharmaceutical Chemistry. Analysis, synthesis, and phytochemistry of medicinal agents. (Cr ar; prereq ‡) Staff

201-202-203.* Medicinal and Natural Chemistry Seminar. (1 cr per qtr; required of all majors in pharmaceutical chemistry) Staff

204x. Selected Topics. (3 cr on completion of 3 qtrs) Staff

205-206-207.* Advanced Medicinal Chemistry. Natural and synthetic sources of medicinal agents. Theoretical bases of biological responses to applied agents. Correlation of molecular structure with biological activity. (3-5 cr per qtr; prereq 163 and OrCh 63 or ‡; offered 1967-68 and alt yrs) Staff

208.* Carbohydrates and Glycosides. Origin, isolation, characterization, and chemistry. (3-5 cr; prereq OrCh 63 or ‡; offered 1966-67 and alt yrs) Gisvold

213x. Pharmaceutical Chemistry Laboratory Techniques. (Cr ar; prereq OrCh 63 or ‡) Portoghese

214x. Research in Pharmaceutical Chemistry. Study and experimental investigation of topics in the area of natural products and synthetic organic medicinal agents. (Cr ar; prereq OrCh 63 or ‡) Staff

PHARMACEUTICAL TECHNOLOGY

Professor

Edward G. Rippie, Ph.D., *head, director of graduate study (pharmaceutical technology)*

Associate Professor

Hugh F. Kabat, Ph.D., *director of graduate study (hospital pharmacy)*
Robert H. Miller, Ph.D.

Assistant Professor

John D. McRae, Ph.D.

Pharmaceutical technology offers a selection of courses in physical pharmacy and hospital pharmacy. The pharmaceutical technology program with emphasis in physical pharmacy is designed for the student who desires to prepare himself for a career in education, industry, or research. The hospital pharmacy program, leading to a master of science degree in hospital pharmacy, is designed for the student who desires a responsible supervisory and managerial position in the hospital pharmacy.

Program in Hospital Pharmacy

Prerequisites—A degree from a college of pharmacy and an exceptional scholarship record. Evidence of personal capability and fitness for work in the

hospital field is likewise necessary in each case and will be considered an essential requirement for admission.

Language Requirement—Knowledge of a foreign language may be waived upon petition to the Graduate School.

Minor Fields—The choice of minor fields of study may vary considerably depending on the research interest of the student. The selection of courses will be made after consultation with the student's adviser.

Master's Degree—Either Plan A or Plan B is acceptable.

Program in Pharmaceutical Technology

Prerequisites—A degree from a college of pharmacy and an exceptional scholarship record. Consideration will also be given to applicants who are graduates of institutions other than colleges of pharmacy provided their undergraduate courses satisfy the prerequisites for the graduate courses in pharmaceutical technology. The record must show completion of mathematics courses through differential equations and statistics. These courses can be completed after admission to the Graduate School. In addition, 1 year of physical chemistry is prerequisite to a number of required courses in the department.

Language Requirement—For the Master's degree, one foreign language. For the Ph.D. degree, either (a) two foreign languages or (b) with the consent of adviser one foreign language and the option of a collateral field of knowledge.

Minor—The choice of the particular courses to be presented in fulfillment of a minor in graduate work will be made after consultation with the student's adviser.

Master's Degree—Offered under both Plan A and Plan B.

Doctor's Degree—Graduate work toward the Ph.D. degree is offered.

165.* Cosmetics and Dermatological Preparations. Pharmaceutical aspects of cosmetics and dermatological preparations. (3 cr; prereq 56) Miller

166-167.* Pharmaceutical Manufacturing. Production and control of pharmaceutical preparations on a pilot plant scale. Formula development and product stabilization. (3-5 cr per qtr; prereq PhmC 163, PhmT 56 or ‡) Miller

168.* Preparation of Parenteral Products. Principles and procedures involved in manufacture of parenteral products. (3 cr; prereq ‡) Kabat

170. Hospital Pharmacy Administration I. The history, classification, organization, and functions of the departments in a hospital in relation to the pharmacy service. (2 cr; prereq 69 or ‡) Kabat

171. Hospital Pharmacy Administration II. The development, organization, responsibility, and administration of pharmacy services in a hospital. (3 cr; prereq 170 and ‡) Kabat

172. Hospital Pharmacy Survey. (1 cr; prereq 171 and ‡) Kabat

173.* Special Problems in Pharmaceutical Technology. Problems in formulation, production, and evaluation of pharmaceutical products. (Cr ar; prereq ‡) Staff

201x.* Seminar: Pharmaceutical Technology. (1 cr; required of majors in pharmaceutical technology) Staff

203-204.* **Advanced Analytical Methods.** Special procedures for control of foods, drugs, and cosmetics, e.g., sampling techniques and design of experiments for control of shelf-life, storage conditions, loss of potency, etc. (3-4 cr per qtr; prereq PhmC 165, PCh 103, or ‡; offered when demand warrants) Rippie

206. Stabilization of Pharmaceuticals. Application of physicochemical principles (e.g. chemical kinetics) to elucidate and minimize stability problems in pharmaceutical systems. (3 cr; prereq PCh 117) McRae

213x.* **Research Problems.** Experimental investigation of problems in pharmaceutical technology. (Cr ar; prereq PhmC 163 or ‡) Staff

215-216. Pharmaceutical Development. Theoretical and practical problems involved in new product development including F.D.A. regulations, new drug application procedures, patents, and production and control on a pilot plant scale. (5 cr per qtr; prereq 167 or ‡; offered when demand warrants) Miller

218-219. Extraction, Distribution, and Partition Systems. Theory and practice of extraction of liquids and solids, countercurrent distribution, solvent and solute effects and chromatography. (3-5 cr per qtr; prereq PhmC 163 or ‡; offered when demand warrants) Miller

PHARMACOGNOSY

Associate Professor
Herbert Jonas, Ph.D., *head, director of graduate study*

Assistant Professor
Lee C. Schramm, Ph.D.

Prerequisites—A degree from an accredited college of pharmacy and an exceptional scholastic record. Consideration will also be given to applicants who are graduates of institutions other than colleges of pharmacy provided their undergraduate courses satisfy the prerequisites for the graduate courses in pharmacognosy.

Language Requirement—For the Master's degree, one foreign language, German or French. For the Ph.D. degree, (a) two foreign languages, one of which must be German (and as the second French or Spanish would be acceptable) or (b) with consent of adviser, one foreign language and the option of a collateral field of knowledge.

Master's Degree—In general, offered under Plan A. Plan B may be followed by petition.

Doctor's Degree—Work toward the Ph.D. degree is offered.

151. Pesticides and Plant Growth Regulators. Their use in cultivation and preservation of medicinal plants and their products. (3 cr; prereq 3, Phcl 57 or ‡) Staff

152-153. Metabolism. Biochemistry and physiology of drug-producing organisms. Chemical and physical methods for production and analysis of their medicinal constituents. (3 cr per qtr; prereq 3 or ‡) Schramm and staff

154-155. Microscopy and Microchemical Methods. Their use in study of drug-producing organisms and their constituents. (3 cr per qtr; prereq 3 or ‡) Schramm and staff

160. Intermediate Pharmacognosy. Enzymes, biological and fermentation products, insecticides, fungicides, and herbicides. (3 cr; prereq 3 or ‡) Jonas and staff

165. Application of Radionuclides. Properties and utilization of radioactive substances of of importance in biology, pharmacy, public health, and civil defense. (3 cr; prereq ‡) Jonas and staff

166. Extra Laboratory Course in Radionuclide Techniques. Demonstration and participation experiments in fundamental isotope techniques and applications. (2 cr; prereq 165 or ¶165) Jonas and staff

167. Advanced Course in Radionuclides. An advanced lecture course. (3 cr; prereq 165 or ‡) Jonas and staff

168. Laboratory Course in Advanced Radionuclide Techniques. (2 cr; prereq 167 or ‡) Jonas and staff

173. Special Problems in Pharmacognosy. Problems dealing with the botany, biochemistry, and physiology of medicinal plants and microorganisms and their products. Problems of radioisotope applications. (Cr ar; prereq ‡) Staff

201-202-203.* Advanced Pharmacognosy. Advanced studies in pharmacognosy of living organisms producing medicinally important substances. (3-5 cr per qtr; prereq 162 or 163, and ‡) Staff

204x. Research in Pharmacognosy. (Cr ar; prereq ‡) Staff

PHARMACOLOGY

Professor
Raymond N. Bieter, M.D., Ph.D.
Edward J. Cafruny, M.D., Ph.D.
Norman O. Holte, D.D.S.
Gilbert J. Mannering, Ph.D.
Amedeo S. Marrazzi, M.D.
Frederick E. Shideman, M.D., Ph.D., *head*
Lawrence C. Weaver, Ph.D.
Wallace F. White, Ph.D.

Associate Professor
Frank T. Maher, M.D., Ph.D.
Jack W. Miller, Ph.D.
Akira E. Takemori, Ph.D.

Assistant Professor
Nelson D. Goldberg, Ph.D.
Harvey J. Kupferberg, Ph.D.
Travis I. Thompson, Ph.D.
Ben George Zimmerman, Ph.D.

Pharmacology is a broad science which considers the interactions between chemical substances or drugs and living organisms or life processes at all levels of organization. Facilities are available for most types of training and research in this field. For those primarily interested in toxicology or psychopharmacology appropriate programs are provided. Excellent opportunities exist for co-operative research with the clinical departments of the Medical School.

Graduate training in the field of pharmacology usually is oriented toward the Ph.D. degree, either as a major or a minor subject. The M.S. degree is offered only under special circumstances. A number of graduate fellowships, research assistantships, teaching assistantships, or traineeships are usually available.

Prerequisites—In addition to fulfilling requirements for admission to the Graduate School students should be well grounded in the biological and physical sciences.

Major—For a major the student is required to complete each of the medical courses prerequisite to, and including, the major courses in general pharmacology (103 and 104). These include courses in physiology and biochemistry. Additional requirements are Phcl 106, 201, 202, 203, 204, and 205 and such other courses as may be indicated by the major adviser.

Minor—To meet the requirements for a minor in pharmacology, the student must satisfactorily complete course work representing 22 credits. These courses must include Phcl 103, 104, 204, and 205.

Language Requirement—For the Master's degree, one foreign language—French or German. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and a collateral field of knowledge. Routinely ac-

ceptable languages for the Ph.D. are French, German, Italian, Russian, and Spanish.

Master's Degree—Offered only under Plan A.

Doctor's Degree—Work toward the Ph.D. degree is offered.

101-102.† General Pharmacology. Lectures and laboratory exercises on the action and fate of drugs. Limited to students of dentistry and pharmacy. (8 cr) Zimmerman, Cafruny, Holte, Kupferberg, Mannering, Marrazzi, Miller, Shideman, Takemori

103-104.† General Pharmacology. Lectures and laboratory exercises on the action and fate of drugs. (10 cr; prereq Phsl 106, 107, or equiv and MdBc 100, 101, or equiv) Shideman, Cafruny, Holte, Kupferberg, Mannering, Marrazzi, Miller, Takemori, Zimmerman

105. Forensic Medicine and Medical Jurisprudence. Lectures on legal aspects of medicine and on laws governing practice of medicine. (1 cr; prereq enrollment in Medical School or ‡) Mannering, McCoid

106. Toxicology. Lectures on the chemistry, mechanisms, action, and physiological disposition of substances toxic to man and animals. (2 cr; prereq ‡) Mannering, Hammond

108. Dental Therapeutics. (1 cr; prereq 101, 102) Holte and staff

109x. Problems in Pharmacology. (Cr and hrs ar; prereq ‡) Shideman and staff

162x. Biological Assay of Drugs. (3 cr; prereq 101 and 102 or ‡) White

201. Advanced Pharmacology: Physiological Disposition of Drugs. Principles underlying absorption, distribution, metabolism, and excretion of drugs. (3 cr; prereq 101 and 102 or 103 and 104 or ‡; offered 1967-68 and alt yrs) Miller, Mannering, and staff

202. Advanced Pharmacology: Pharmacodynamics. Lectures and laboratory exercises on physiological, biochemical, and behavioral effects of drugs utilizing modern techniques. (3 cr; prereq 101 and 102 or 103 and 104 or ‡; offered 1966-67 and alt yrs) Takemori, Zimmerman, and staff

203x. Research in Pharmacology. (Cr and hrs ar; prereq 103 and 104 or ‡) Shideman and staff

204x. Seminar: Selected Topics in Pharmacology. (3 cr on completion of 3 qtrs; prereq 101 and 102 or 103 and 104 or ‡) Cafruny and staff

205x. Seminar: Survey of Current Pharmacological Literature. (3 cr on completion of 3 qtrs; prereq 101 and 102 or 103 and 104 or ‡) Marrazzi and staff

206x. Seminar: Psychopharmacology. Selected topics on behavioral aspects of drug action. (3 cr on completion of 3 qtrs; prereq ‡) Shideman, Thompson, and staff

PHILOSOPHY

Professor
May Brodbeck, *director of graduate study*
Herbert Feigl
Grover E. Maxwell
Karl H. Potter, *chairman*
Francis V. Raab
D. Burnham Terrell

Associate Professor
Homer E. Mason
Gareth B. Matthews

Assistant Professor
Douglas E. Lewis
Jeffrie G. Murphy

Graduate Major in Philosophy

Prerequisites—To be accepted as a graduate major in philosophy, the applicant must present a satisfactory undergraduate record including 18 Upper Division credit hours in philosophy with a grade average of B or above. In special cases provisional registration may be arranged.

Subfields of Specialization—The following classification of philosophical studies is adopted for the purpose of these regulations: (a) history of philosophy; (b) logic; (c) metaphysics and epistemology; (d) ethics; (e) philosophy of science; (f) philosophy of religion; (g) aesthetics; (h) social and political philosophy.

Language Requirement—Students are required to choose the languages they will study in fulfillment of the language requirement from the following four: Greek, Latin, French, German. For the M.A. degree, one of these languages is required; for the Ph.D. degree, two are required.

Master's Degree—Offered either under Plan A or Plan B. Candidates under either plan must pass three written examinations: one in history of philosophy, and two others in subfields selected by the student from those listed above, at least one of which must be (b), (c), or (d).

Doctor's Degree—The student shall, with the approval of his adviser, choose a thesis field, which must be one of the subfields of specialization listed. He is also responsible for preparing himself adequately in the following four subfields, which are cardinal to all philosophical work: history of philosophy; logic; metaphysics and epistemology; ethics. The student must pass a written examination in each of these four subfields; and a further examination either in one other of the subfields of specialization listed above, or in one of the other specialized subfields specified by the graduate faculty in philosophy in its *Instructions for Graduate Students*.

Graduate Minor in Philosophy

Prerequisites—Registration as a graduate minor in philosophy is permitted only upon consultation with a graduate adviser in the department.

Master's Degree—The general requirements of the Graduate School must be satisfied.

Doctor's Degree—The general requirements of the Graduate School must be satisfied.

Note—For major work in American Studies see the index.

101f. Principles of Philosophy. Topics: knowledge, meaning, truth, reality, mind and nature, human values, and action. (4 cr; prereq grad who has not had 1; offered when feasible)

103w. Eighteenth-Century Philosophy. Philosophic background of 18th-century enlightenment; rationalist and empiricist currents; deism; optimism; great chain of being. Readings from works of Locke, Hume, Voltaire, Diderot, Pope, and others. (3 cr; for history and literature students as well as philosophy majors; offered when feasible)

105f. Introduction to American Philosophy: Puritanism to Pragmatism. Puritanism, the Revolutionary period, transcendentalism, and evolutionism. Among philosophers discussed: Edwards, Paine, Emerson. (3 cr; especially for students of American history and literature)

106w. American Philosophy from William James. Among philosophers discussed: Peirce, James, Dewey, Lewis. (3 cr; prereq 1 or 1 qtr history of philosophy or ‡) Potter

107. Philosophy in Modern Literature. Survey of basic philosophical ideas in modern civilization as expressed in major works of literature. (3 cr; prereq major or minor in philosophy or literature, or ‡; offered when feasible) Terrell

108w. Political and Social Ethics. Ethical principles, theoretical and practical, at the basis of the social order. (3 cr; prereq 3, or ‡; offered 1967-68 and alt yrs) Raab, Mason

109f. History of Ethics: British Moralists. Ethical theory as it developed in Great Britain during the 17th through the 19th centuries. Hobbes and the reaction against him, Butler, the Moral Sense Theory and Hume, Intuitionism and Utilitarianism, Sidgwick. (3 cr; prereq 3 or 1 qtr history of philosophy or ‡; offered 1967-68 and alt yrs) Terrell

110f. History of Ethics: Selected Classical Moralists. Study of one or more systems of moral philosophy outside of the British tradition (see 109), e.g., Plato, Aristotle, Stoics and Epicureans, Aquinas, Kant. Specific topics announced in the *Class Schedule.* (3 cr; prereq 3 or 1 qtr history of philosophy or ‡; offered 1966-67 and alt yrs) Staff

112f. Plato. Philosophy of Plato based on analysis of major dialogues. (3 cr; prereq 50 or ‡) Cohen

114w. Aristotle. Philosophy of Aristotle based on analysis of selected passages from his major works. Particular attention given to his relationship to Plato. Survey made of Aristotelian tradition in Western philosophy. (3 cr; prereq 1 qtr history of philosophy or ‡)

116. Plato and Aristotle. Comparative presentation of metaphysics and epistemology of Plato and Aristotle; the problem of universals. (3 cr; prereq 50 or ‡; offered when feasible) Cohen, Matthews

118. Medieval Philosophy. Selected topics in the writing of several medieval philosophers (e.g., Augustine, Anselm, Aquinas, Scotus, and Ockham). (3 cr; prereq 50, 51 or ‡) Matthews

120. Rationalism. Philosophies of Descartes, Spinoza, and Leibniz. (3 cr; prereq 52 or ‡; offered when feasible)

121. Descartes. Analysis of philosophical works of Descartes. (3 cr; prereq 52 or ‡; offered 1966-67 and alt yrs) Lewis

122. Spinoza. Philosophy of Spinoza, based primarily on analysis of his *Ethics.* (3 cr; prereq 52 or ‡; offered when feasible)

123. Leibniz. Philosophy of Leibniz based on analysis of selected philosophical writings. (3 cr; prereq 52 or ‡; offered when feasible) Lewis

129. Locke. Detailed study of the *Essay Concerning Human Understanding.* (3 cr; prereq 52 or ‡; offered 1967-68 and alt yrs) Lewis, Terrell

130. Berkeley. Detailed study of Berkeley's philosophical works. (3 cr; prereq 52 or ‡; offered 1966-67 and alt yrs) Lewis, Terrell

131. Hume. Detailed study of Hume's *Treatise* and *Inquiry.* (3 cr; prereq 52 or ‡) Terrell

132. Later Empiricism. Major developments in empiricist traditions, principally in Great Britain, between Hume and Russell. (3 cr; prereq 52 or ‡; offered when feasible) Terrell

134. Kant. Philosophy of Kant based on analysis of selected passages from his major works. (3 cr; prereq 52 or ‡) Mason, Murphy

136. Brentano. The philosophy of Franz Brentano, and its significance in the background of contemporary philosophy. (3 cr; prereq 52 or ‡; offered when feasible) Terrell

137w. Kierkegaard. Detailed examination of the major philosophical works of Kierkegaard. (3 cr; prereq 1 qtr history of philosophy or ‡) Mason

138. Contemporary Existentialism. Selected topics in the writings of existentialist philosophers since Kierkegaard. (3 cr; prereq 52 or 53 or 137 or ‡; offered 1966-67 and alt yrs) Mason

140. Survey of Contemporary Philosophy. Current systematic and critical philosophies, especially idealism, naturalism, realism, pragmatism, positivism as represented by their principal exponents. (3 cr; prereq 52 or ‡) Staff

141f, 142w, 143s. Studies in Contemporary Philosophy. Intensive studies of the works of selected individual philosophers. Usually a single philosopher studied each quarter, the philosophers studied varying from year to year. Specific topics will be announced in the *Class Schedule*. (3 cr per qtr; prereq 52 or ‡) Staff

150s. Ethical Theory. Distinguishing characteristics of a moral judgment; application of moral judgments to motives, acts, and persons; moral freedom and responsibility; moral relativity, skepticism, and the justification of moral standards; examination of representative systems. (3 cr; prereq 3 or ‡) Staff

151w. Principles of Aesthetics. Sample topics: standards of evaluation; aesthetic experience; representation, meaning. (3 cr; prereq 3 cr in philosophy or ‡)

154f. Elements of Symbolic Logic. Systematic introduction to modern logic. Topics include dimensions of language; calculus of propositions, classes, and relations; applications to foundations of mathematics. (4 cr; prereq 2 or ‡) Brodbeck

155w. Intermediate Symbolic Logic. Axiomatic development of logic; properties of deductive systems; modal and many-valued logics; application to philosophical problems. (3 cr; prereq 154) Brodbeck

156s. Philosophy of Logic. Selected issues, including application of logic to philosophical problems: logic and reality; logical truth; relation of logic to mathematics; theory of descriptions; theory of types; paradoxes; identity; intensionality. (3 cr; prereq 155 or Math 112A or ‡) Brodbeck

157. Metaphysics. Some recent attempts to discover general principles characteristic of the universe. (3 cr; prereq 1 qtr history of philosophy, or ‡) Brodbeck

158. Theory of Knowledge. Analysis of the logical structure and experiential roots of knowledge. Topics: meaning, validity, truth, reason and experience, induction, criteria of objectivity, and reality. (4 cr; prereq 2 or ‡) Feigl

160. Philosophy of Science. Meaning, methods, and implications of modern science through examination of basic concepts, presuppositions, and procedures. Topics: description, explanation, prediction, experimentation; space, time, number, matter, energy; causality, probability, statistics; organic life, evolution, mind. (4 cr; prereq 2 or ‡) Feigl

162. Philosophy of Language. Contemporary attempts to deal with philosophical problems about language. Special attention to the concept of meaning. Some attention to notions of language found in various forms of philosophical analysis. (3 cr; prereq 2, or 6 upper division cr in philosophy or ‡; offered when feasible) Mason

164. The Logic of the Social Sciences I. Philosophical examination of foundations of behavioral sciences in general; their concepts, laws, and theories; concrete illustrations from these sciences; problems of value and objectivity; logical nature of social philosophies and ideologies; role of social scientist in a democratic society. (3 cr; prereq 15 cr in social science, psychology, education, history, or philosophy, or ‡) Brodbeck

165. The Logic of the Social Sciences II. A closer and more specific study of items introduced in preceding course, with greater attention to logical methods and problems peculiar to each of the specialized social sciences. (3 cr; prereq 164; offered when feasible) Brodbeck

167. Philosophy of History. Examination of various philosophical interpretations of history, with particular reference to philosophical aspects of historical methods. (3 cr; prereq 6 cr in philosophy or 10 cr in history; offered 1966-67 and alt yrs) Mason

168w. Philosophy of Law. The concept of law with a special focus on contemporary discussion. Sample topics: the definition of law: law, morality, and custom; legal reasoning: causation and responsibility. (3 cr; prereq 1 and 2 or ‡; offered 1966-67 and alt yrs) Murphy

171. Philosophies of India I. Basic concepts of the Hindu, Buddhist, and Jain philosophies of life, as found in ancient and modern sources. Introduction to Indian theory of philosophical argumentation and inference. (3 cr; prereq 5 cr in philosophy or 3 cr in courses pertaining to India or ‡) Potter

172. Philosophies of India II. Introduction to problems of systematic inquiry in India; analyses of causation, freedom, and knowledge in Buddhism, Jainism, Nyaya-Vaisesika, Purva-Mimamsa, Samkhya, and the various Vedantas. (3 cr; prereq 171 or ‡) Potter

182. Philosophy of Religion. Discussion of ground and sanctions of religion, according to various philosophies. (3 cr; prereq 6 cr) Matthews

190f, 191w, 192s. Seminar: Philosophy. Topics to be arranged according to students' interests. (3 cr per qtr; prereq 9 cr or ‡) Staff

193f, 194w, 195s. Seminar: History and Philosophy of Theology. (3 cr per qtr; prereq ‡)

210, 211, 212, 213. Seminar: Moral Philosophy. Systematic study of concepts and problems relating to ethical discourse. (3 cr per qtr; prereq 150) Staff

217, 218, 219. Seminar: Social and Political Philosophy. Especially for advanced political science, history, or sociology majors or minors. (3 cr per qtr; prereq ‡)

223, 224, 225, 226. Seminar: Epistemology. Problems in theory of knowledge. Consult *Class Schedule* for topics to be discussed during any given year. (3 cr per qtr; prereq 158 or ‡) Staff

227, 228. Seminar: Logical Theory. Selected topics in the philosophy of logic. (3 cr per qtr; prereq 154 and 155 or ‡) Brodbeck

230, 231, 232. History of Philosophy, Advanced. Primarily for graduate students who have had no previous courses in the history of philosophy. Philosophy majors who have taken 50-51-52 may enroll with permission. (3 cr per qtr)

233, 234, 235. Seminar: Philosophy of Religion. The conceptual structure of religion. (3 cr per qtr; prereq 182 or ‡)

241, 242, 243. Seminar: Philosophy of the Physical Sciences. (3 cr per qtr; prereq ‡) Feigl

244, 245, 246. Seminar: Philosophy of Psychology. (3 cr per qtr; open to advanced grad students in philosophy or psychology with written consent) Feigl

247, 248, 249. Seminar: Logic of the Exact Sciences. (3 cr per qtr; prereq ‡) Feigl, Maxwell

250, 251, 252. Seminar: Philosophy of the Social Sciences. (3 cr per qtr; prereq ‡) Brodbeck

260, 261, 262, 263. Seminar: Metaphysics. Topics in metaphysics. Consult *Class Schedule* for topics to be discussed during any given year. (3 cr per qtr; prereq 157 or ‡) Staff

268-269. Seminar: Studies in Aesthetics. Problems in aesthetics. Consult *Class Schedule* for topics to be discussed during any given year. (3 cr per qtr; prereq ‡)

300-301-302. Departmental Seminar. Faculty and graduate students and occasional visitors present portions of work in progress on various topics. (2 cr per qtr; prereq passed written preliminary examinations for the Ph.D. in philosophy)

350, 351, 352. Research in History of Philosophy. (Cr ar; prereq ‡)

360, 361, 362. Research in Philosophy of Science. (Cr ar; prereq ‡) Feigl, Maxwell, Brodbeck

PHYSICAL MEDICINE AND REHABILITATION

For staff and courses of study offered, see the *Bulletin of the Graduate Programs in Medicine, Dentistry, and Pharmacy.*

PHYSICS

Professor
J. Morris Blair
Warren B. Cheston
Robert J. Collins
George D. Freier
Stephen Gasiorowicz
George W. Greenlees
Morton Hamermesh, *head*
Edward L. Hill
Norton M. Hintz
Paul J. Kellogg
Homer T. Mantis
Edward P. Ney
Alfred O. C. Nier
Hendrik J. Oskam
William T. Peria
Otto H. Schmitt
Hiroshi Suura
Karel M. van Vliet
Frank Verbrugge
Clifford N. Wall
John R. Winckler

Associate Professor
Benjamin F. Bayman
Mark Bolsterli
Hans W. J. Courant
Donald A. Geffen
Clayton F. Giese
Russell K. Hobbie
Walter H. Johnson, Jr.
Lewis H. Nosanow
Peter Signer
C. J. Waddington
William R. Webber
James H. Werntz, Jr.
William Zimmermann, Jr., *director of graduate study*

Assistant Professor
Ronald E. Brown
Allen M. Goldman
Carl H. Poppe
Yau-Chien Tang
Walter V. Weyhmann

Prerequisites—For major work, differential and integral calculus and 2 years of college physics. For minor work, differential and integral calculus and 1 year of college physics.

Language Requirement—For the Master's degree, reading knowledge of French, German, or Russian. It is desirable that the language requirement be fulfilled before graduate work is begun. For the Ph.D. degree, reading knowledge of two languages chosen from French, German, and Russian. Other languages or a research technique may be considered on petition.

Master's Degree—Offered under either Plan A or Plan B. Phys 171A-171B-171C or 181A-181B-181C are required. Alterations of this requirement may be made only after consultation with the chairman of the graduate faculty in physics.

Doctor's Degree—Candidates for the Ph.D. degree will be expected to pass qualifying examinations as determined by the chairman of the graduate faculty in physics before admission to the preliminary examination. As part of each program for the Ph.D., Phys 171A-171B-171C, 181A-181B-181C and one advanced seminar sequence are required.

Note—For courses in biophysics and geophysics, see index.

100-102-104.* Mechanics, Electricity and Magnetism. Theoretical course designed to prepare students for advanced work. (4 cr per qtr, §100A or §MM 138 for 100; prereq 9 or 14 or 23, Math 32 or 106 for 100; 100 or MM 138 for 102; 102 for 104)

100A-101A-102A.* Introduction to Analytic Mechanics. Analytic course in Newtonian mechanics; conservation principles. Topics: particle dynamics in one, two, and three dimensions—the central force problem; dynamics of a system of particles including general motion of a rigid body and normal mode analysis of coupled systems; moving co-ordinate systems; mechanics of continuous media-wave motion and elementary hydrodynamics; general co-ordinates and Lagrange formulation of mechanics. Mathematics beyond the prerequisites is developed as required. (3 cr per qtr, §100 for 100A, §100 or §MM 138 for 101A; prereq 9 or 14 or 23, Math 32 or 106 for 100A, majors in fields other than physics may use MM 138 as prereq for 102A)

103A-104A-105A.* Introduction to Electric and Magnetic Fields. Classical theory of electric and magnetic fields making free use of vector algebra and vector calculus. Maxwell's equations developed from basic experimental laws in form applicable both to free space and to material media. Wave solutions for these equations discussed, with application to simple situations. (3 cr per qtr; prereq 9 or 14 or 23, Math 32 or 106 for 103A)

107-109-111. Atomic and Nuclear Physics. Interpretation of experimental phenomena. Kinetic theory, Maxwell-Boltzmann distribution, special relativity, the nuclear atom, atomic and molecular structure and spectra, black-body radiation, wave mechanics, nuclear physics, modern developments in classical physics, astrophysics, particle physics. (3 cr per qtr, §50 or 51; prereq 9 or 14 or 23, Math 32 or 106, ‡ if taken out of sequence)

108-110-112.° Principles of Modern Physics. Combines elementary quantum mechanics with its historical background and applications to atomic and nuclear physics. Origin of quantum theory, electrons and quanta, atomic structure, particles and waves, the theory of quantum mechanics, one-electron atoms, exclusion principle, multi-electron atoms, X-rays, scattering and nuclear physics. (3 cr per qtr; prereq 51, ¶Math 153 or 108)

113. Techniques of Nuclear Physics. Statistics of random events; interactions of photons, charged, and neutral particles with matter; detection devices; beam handling; measurement and analysis of cross sections. (3 cr)

114-116-118.° Elementary Physical Investigation. Problems, either experimental or theoretical, of special interest to student. Written report. (Cr ar; prereq △)

120-121-122.° Experimental Atomic and Nuclear Physics. Techniques and methods used in physics research laboratories. Experiments with vacuum gauges and equipment; mass spectroscopy; x-ray diffraction; health physics; detection of charged particles, neutrons, and gamma rays; measurement of several fundamental atomic constants. (3 cr; prereq 51 or ¶107 or ¶108, ♯; 1 or 2 qtrs may be taken in any order)

123.° Thermodynamics. Formulation of basic laws of thermodynamics concerning temperature, energy, and entropy; application to simple systems. (3 cr; prereq 9 or 14, Math 26A or 106)

124.° Statistical Mechanics. Introduction to transport phenomena; principles of statistical mechanics with applications to equilibrium properties of classical and quantum systems. (3 cr; prereq 123 or ♯)

125.° Introduction to Solid State Physics. Structure; thermal, magnetic, and dielectric, and electronic properties of crystalline solids. (3 cr; prereq 124 or ♯)

131.° Geometrical Optics. Fundamentals of ray optics and its applications to optical instruments and their components. (3 cr; prereq 15 cr in physics, Math 23 or 44)

133.° Physical Optics. Wave theory of interference, diffraction, polarization and double refraction and their applications. (3 cr; prereq 15 cr in physics, Math 23 or 44)

133A. Physical Optics Laboratory. Parallel to 133. (1 cr; prereq ¶133)

134.° Experimental Optics. Laboratory. Spectrometry, optics of compound lenses, photometry, absorption, interferometry, and polarized light. (3 cr; prereq 15 cr in physics, Math 23 or 44)

136.° Spectrum Analysis. Laboratory. Measurement of wave lengths, intensities, and absorption coefficients in the infrared, visible, and ultraviolet regions of the spectrum. (3 cr; prereq 15 cr in physics, Math 23 or 44)

144.° Electrical Measurements. Ballistic and current galvanometers, magnetic flux measurements, potentiometers, D.C. and audio-frequency A.C. bridges, elementary D.C. and A.C. circuit theory. (4 cr; prereq 9 or 14 or 23, Math 31 or 55)

146.° Physics of Vacuum Tubes and Associated Circuits. Characteristics of vacuum tubes, power supply and amplifier circuits; applications to physics research. (4 cr; prereq 144 or ♯)

148.° Application of Electronic Circuits. Use of tubes and transistors in amplifier, oscillator, and pulse generating circuits employed in physics research. (4 cr; prereq 146 or ♯)

Zool 155, 156, 157.° Biophysics. (3 cr per qtr; prereq 28 cr distributed between physics and biology, and ♯...physical chemistry and general physiology recommended; schedule uncertain, consult dept)

165.° Introduction to Physics of the Atmosphere. Survey of physical processes which determine the mean state of the atmosphere. Topics in radiative transfer and thermodynamics reviewed in preparation for discussion of heat budget and temperature distribution of the atmosphere. Atmospheric properties and phenomena treated include: formation of clouds and precipitation, convection and stability, atmospheric electricity and ozone. (3 cr; prereq 50, Math 32 or 106)

166.° Meteorology I. Quantitative description of large-scale atmospheric motions. Basic equations of meteorological hydrodynamics introduced and applied in actual weather situations. (3 cr; prereq 165 or ♯)

167.° Meteorology II. Theoretical meteorology. Critical examination of mathematical models used to describe large-scale flow processes; energy transformations in atmospheric flow; atmospheric turbulence and eddy transport. (3 cr; prereq 166, vector analysis or ♯)

171A-B-C.° Classical Physics. Classical mechanics, special theory of relativity, and classical electrodynamics. Application of advanced mathematical techniques to these subjects. (4 cr per qtr; prereq 104 or both 102A and 105A, Math 153 or 108, ♯; 3 lect hrs and 1 prob session per wk)

181A-B-C. Quantum Mechanics. Development from first principles. Schrödinger equation, angular momentum, scattering, matrix representations, spin, approximation methods, interaction with the electromagnetic field, systems of identical particles, applications to atomic systems. (4 cr per qtr; prereq 110 or equiv, Math 153 or 108 or equiv, ♯; 3 lect hrs and 1 prob session per wk)

190.° Introduction to Elementary Particle Physics. Discussion and analysis of experiments used to study properties of elementary particles and the theoretical ideas currently being used to interpret the experimental results. (3 cr; prereq 181B, ♯)

192.° Atomic and Molecular Structure. A discussion with emphasis on interpretation of quantum numbers and selection rules in terms of symmetry. Experimental data summarized and compared to the theoretical predictions. (3 cr; prereq 181C or ♯; offered 1966-67 and alt yrs)

194. Introduction to Contemporary Problems in Cosmic-Ray and Space Physics. Cosmic rays, their characteristics, and their motion in the interplanetary and interstellar medium. Topics in x-ray and radio astronomy. Primarily for students specializing in other branches of physics. (3 cr; prereq ♯; offered 1966-67 and alt yrs)

196. Propagation and Detection of High Energy Particles and Electromagnetic Radiation. The first quarter of the cosmic ray sequence; may be taken by students in other branches of physics. It treats the propagation of energetic particles and electromagnetic radiation through different types of matter, relativistic collisions, considerations relating to particle counting and detection, and various types of detectors. (3 cr; prereq 112, 171C or ♯)

198. Introduction to Astrophysics. The fundamental physics required for understanding astrophysics. Equations of state of normal and degenerate matter, physics of energy generation by nuclear processes, stellar opacity, equations of stellar structure, and cosmic astrophysics. (3 cr; prereq 110 and 124 or equiv, or ♯; offered 1966-67 and alt yrs)

Special prerequisites are noted for certain courses below. Seminars, special topics courses, and research may be taken more than once for credit.

201A-B-C.° Dynamics of Fluid Motion. (3 cr per qtr)

204.° Equilibrium Statistical Mechanics. Equilibrium properties of macroscopic classical and quantum systems. Simple interacting systems, phase transitions and the effects of external fields. (3 cr; prereq 181C or ♯)

205.° Transport Theory. Transport and relaxation phenomena in classical and quantum systems. Irreversible thermodynamics, the Boltzmann equation and linear response theory. (3 cr; prereq 181C or ♯)

206.° Introduction to Plasma Physics. Magnetohydrodynamics and the properties of collisionless plasma, with applications to the magnetic field of the earth and sun and to the trapping of a plasma. Transport phenomena and the effect of collisions. (3 cr; prereq 171C or ♯; offered 1967-68 and alt yrs)

208.° Symmetry and Its Applications to Physical Problems. Use of symmetry methods (group theory) to study systems too complicated for exact solution. Applications to atomic, molecular, nuclear, solid-state and elementary particle physics. (3 cr; prereq ¶181C or ♯)

209A-B.° General Relativity. Introduction to the physical basis of general relativity, to its mathematical formulation, and to its cosmological implications. (3 cr per qtr; prereq 171C or ‡; offered when demand warrants)

210A-B-C.° Seminar: Theoretical Physics. (Cr ar)

211.° Advanced Quantum Mechanics. Advanced topics in nonrelativistic quantum mechanics with emphasis on the use of second quantization to treat many-body and radiating systems. Diagrammatic and Green's function techniques introduced. (3 cr; prereq 181C or ‡)

212.° Relativistic Quantum Mechanics. Relativistic wave equations and their properties under Lorentz transformations. Application of relativistic perturbation theory to particle interactions with the electromagnetic field. Invariant interactions of elementary particles. (3 cr; prereq 211 or ‡)

213.° Relativistic Quantum Field Theory. Renormalization theory, analytic properties of amplitudes, reduction formulas and dispersion relations. (3 cr; prereq 212 or ‡)

216.° Many-Body Theory. Infinite systems of bosons and fermions using Hartree and Hartree-Fock approximations; diagrammatic techniques and Green's function methods. (3 cr; prereq 211 or ‡)

218A-B-C.° Principles of Mathematical Physics. (3 cr per qtr; prereq 173, ¶Math 208 or ¶263 or equiv)

220A-B-C.° Seminar: Nuclear Physics. (Cr ar)

225.° Nuclear Structure. Methods of investigating the properties of bound states of atomic nuclei. Interpretation of these properties in terms of phenomenological models (cluster models, independent-particle models, pairing theory, collective vibrations and rotations). Introduction to infinite nuclear matter. (3 cr; prereq 181C or ‡)

226.° Nuclear Reactions and Scattering. Continuum states of atomic nuclei. The two-nucleon problem and nuclear forces. Dynamics of nuclear reactions with emphasis on reaction mechanisms and the use of reactions to obtain information on nuclear structure. (3 cr; prereq 181C or ‡)

227.° Advanced Topics in Nuclear Physics. Possible topics: theory of nuclear matter, beta- and gamma-ray spectroscopy, nuclear fission, etc. (Cr ar; offered when demand warrants)

230A-B-C. Seminar: Solid-State and Low-Temperature Physics. (Cr ar)

231A-B.° Solid-State Physics. (Same as EE 200A-200B) Fundamental properties of crystals; the dynamics of the lattice and of electrons in a periodic structure. Effects of electric and magnetic fields on metals. (3 cr per qtr; prereq ¶181B-181C and 125 or ‡)

232.° Magnetism. (Same as EE 200C) Properties of magnetic materials in relation to exchange interactions and elementary spin excitations. (3 cr; prereq 231B or ‡)

233.° Superconductivity. Properties of superconductors discussed and analyzed using the concept of a macroscopic wave function; the relation of this approach to the microscopic theory. (3 cr; prereq ‡; offered 1966-67 and alt yrs)

234.° Techniques of Low-Temperature Physics. Introduction to low-temperature phenomena and the techniques used to obtain these temperatures. (3 cr; prereq ‡; offered 1967-68 and alt yrs)

235.° Liquid and Solid Helium. Introduction to experiment and theory concerning the behavior of liquid and solid helium. The superfluidity of He^4, the Fermi liquid theory of He^3, He^3-He^4 mixtures and solid helium. (3 cr; prereq ‡; offered 1967-68 and alt yrs)

236.° Magnetic Resonance in Solids. Discussion of behavior of spins in static and time-varying fields with applications to the study of solids. Interactions between spins, relaxation processes, and atomic diffusion. (3 cr; prereq ‡; offered when demand warrants)

238.° Advanced Topics in Solid-State and Low-Temperature Physics. Possible topics: theory of superconductivity, theory of superfluidity, properties of systems at millidegree temperatures, collective effects in magnetic systems, etc. (Cr ar; offered when demand warrants)

240A-B-C.° Seminar: Elementary Particle Physics. (Cr ar)

241A-B.° Elementary Particle Physics. Properties of stable and unstable elementary particles and their strong and weak interactions. Scattering and production of particles at high and low energies. Electromagnetic form factors. Experimental evidence on the nature of the weak interactions: symmetry violations and selection rules on the decays of the strange particles. The role of currents in the weak interactions. (3 cr per qtr; prereq 213 or ‡)

243.° Advanced Topics in Elementary Particle Physics. Possible topics: potential scattering and complex angular momentum, current commutation rules and sum rules, the Bethe-Salpeter equation, the Lorentz group, quantum electrodynamics, etc. (Cr ar; offered when demand warrants)

250A-B-C.° Seminar: Cosmic-Ray and Space Physics. (Cr ar)

251A-B.° Cosmic-Ray and Space Physics. Properties of energetic particles in both the solar-terrestrial and astrophysical environments. The earth's radiation belts, the effects of the earth's magnetic field on charged particles, the energy and charge spectrum of cosmic rays, the structure and evolution of the galaxy, the motion of particles in the galactic and intergalactic medium and topics in x-ray and radio astronomy. (3 cr per qtr; prereq 112, 171C, 196 or ‡)

253A-B.° Plasma Physics. Study of the properties of plasmas at an advanced theoretical level. Transport phenomena, radiation from plasma, thermonuclear machines and their instabilities, and waves in magnetized plasma. (3 cr per qtr; prereq 206; offered 1967-68 and alt yrs)

254.° Advanced Topics in Plasma Physics. Possible topics: theory of waves and instabilities in hot plasma, etc. (Cr ar; offered when demand warrants)

256.° Advanced Topics in Atmospheric Physics. Possible topics: radiative transfer in planetary atmospheres, atmospheric electricity, atmospheric tides and oscillations, properties of water substance, numerical modeling of atmospheric flow. (Cr ar; offered when demand warrants)

258A-B-C.° Astrophysics. Stellar structure, stellar evolution and various topics in cosmic astrophysics. Electron and nuclear degeneracy, stellar opacity, nuclear physics of energy generation, the equations of stellar structure and their solutions, the theoretical basis for the Hertzsprung-Russell diagram, cosmic electromagnetic radiation, and cosmology. (3 cr; prereq ‡; offered 1967-68 and alt yrs)

260A-B-C.° Seminar: Mass Spectroscopy. (Cr ar)

270A-B-C.° Seminar: Atmospheric Physics. (Cr ar)

301A-B-C.° Research in Physics. (Cr ar)

PHYSIOLOGICAL HYGIENE

Professor

Joseph T. Anderson, Ph.D.
Francisco Grande, M.D.
Ancel Keys, Ph.D., *head*
Henry L. Taylor, Ph.D.

Minor—It is suggested that students who major in physiological hygiene present a minor in one of the following fields: epidemiology, physiological chemistry, psychology, or internal medicine.

Language Requirement—For the Master's degree, French or German. In exceptional cases Spanish or Russian may be substituted by petition. For the Ph.D. degree, two foreign languages (French and German).

Master's Degree—Offered only under Plan A. Attention of the student is also directed to the field of nutrition.

Doctor's Degree—Members of the physiological hygiene staff who are appointed to the graduate faculty in physiology or biochemistry (College of Medical Sciences) or nutrition may advise students majoring in those fields. In addition, in exceptional cases, physiological hygiene may be employed as the major field. The programs of students in this field will not include physiology as a minor field and will incorporate an interdisciplinary group of subjects within the major. Plans of study of these students should be drawn up early in their course of study and be submitted to the dean of the Graduate School.

PubH 191. Science of Human Nutrition. Surveys, nutritional status, malnutrition. (3 cr; prereq ‡; offered when demand warrants) Anderson, Grande

PubH 192. Physiology of Exercise. Muscular efficiency, training, deconditioning, effects of exercise on physiological systems. (Cr ar; prereq Phsl 106, 107 or equiv, and ‡; offered when demand warrants) Simonson, Taylor

PubH 195. Public Health Aspects of Cardiovascular Disease. (3 cr; prereq ‡) Keys, Grande, and staff

PubH 202x. Seminar: Physiological Hygiene. Nutrition, tests and measurements of human physical fitness, gerontology, adaptation in health and disease, circulatory dynamics, and related topics. (1 cr)

PubH 220x. Readings in Problems of Physiological Hygiene. (Cr ar; prereq ‡)

PubH 290x. Research in Physiological Hygiene and Related Areas. (Cr ar)

PHYSIOLOGY

Professor
Charles Edwards, Ph.D.
Francisco Grande, M.D.
Eugene D. Grim, Ph.D.
Franz Halberg, M.D.
John A. Johnson, Ph.D.
Ancel Keys, Ph.D.
William G. Kubicek, Ph.D.
Nathan Lifson, M.D., Ph.D.
Victor Lorber, M.D., Ph.D.
Carlos Martinez, M.D., Ph.D.
Ernst Simonson, M.D.
Henry L. Taylor, Ph.D.
Carlo A. Terzuolo, M.D.
Maurice B. Visscher, M.D., Ph.D., *head, director of graduate study*

Associate Professor
Marvin B. Bacaner, M.D.
H. Mead Cavert, M.D., Ph.D.
Irwin J. Fox, M.D., Ph.D.
Rodney B. Harvey, M.D., Ph.D.

Assistant Professor
James S. Beck, M.D., Ph.D.
Jui S. Lee, Ph.D.
Richard L. Purple, Ph.D.

Lecturer
Maurice W. Meyer, Ph.D.

Prerequisites—For a major or minor in physiology, acceptable background in mathematics, physics, chemistry, and morphology.

Minor—Students majoring in clinical subjects who desire a minor in physiology must have had the courses in these branches usually required of medical students.

Language Requirement—For the Master's degree, one foreign language. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and the option of a collateral field of knowledge. Acceptable languages are French, German, and Russian.

Master's Degree—Offered under both Plan A and Plan B, the latter by petition.

Doctor's Degree—Work for the Ph.D. degree is offered to candidates whose background of training is approved by the graduate faculty. The requirements for the minor program can be satisfied either by the use of a conventional minor or, in appropriate instances, the use of a supporting program.

100. General Physiology. For high school teachers in biological sciences and for those who wish an introduction to modern physiological science. (4 cr; prereq college algebra, 1 yr chemistry, college physics; offered first summer term)

106-107.† Human Physiology. (7 cr for 106, 8 cr for 107; prereq organic chemistry, zoology, and neuroanatomy; students may register for lect without lab) Visscher and staff

112x. Hemodynamic Measurements. Demonstrations and student participation in the setting up, calibration, and use of modern tools for measurements of blood pressure, blood flow, cardiac output, circulation time, oxygen saturation of blood, blood volume, and vasomotor control of vascular beds. For students specially interested in cardiovascular problems. (3 cr; limited to 10 students; prereq ‡)

113x. Problems in Physiology. Arranged with qualified students. Topics assigned for laboratory study, conferences, and reading. (Cr ar; may be taken 1 or more qtrs; prereq 107) Visscher and staff

201f,w,s. Literature Seminar. (1 or 2 cr by ar; prereq 107 or equiv) Staff

202.° Readings in Physiology. Topics selected for each student, written reviews prepared and discussed. (Cr and hrs ar) Visscher and staff

203.° Research in Physiology. (Cr and hrs ar) Visscher and staff

204.°° History of Physiology. (Cr and hrs ar)

210.°° Selected Topics in Permeability. Advanced seminar. (Cr and hrs ar; prereq 107 or equiv, ‡) Lifson, Johnson, Grim

211.°° Selected Topics in Heart and Circulation. One or more seminars in the advanced physiology of heart and circulation. (Cr and hrs ar; prereq 107 or equiv, ‡) Visscher, Bacaner, Fox

212.°° Selected Topics in Respiration. Advanced seminar. (Cr and hrs ar; prereq 107 or equiv, ‡) Lee, Meyer

216.°° Selected Topics in Neurophysiology. Advanced seminar. (Cr and hrs ar; prereq 107 or equiv, ‡) Terzuolo, Edwards

219. Recent Advances in Microcirculation and Lymphatics. (Cr and hrs ar; prereq 107 or equiv) Lee, Meyer

220. Methods of Analysis. Topics selected from: control theory, compartment analysis, tracer analysis, thermodynamics of irreversible processes, construction and use of models. Applications in physiology. (3 cr; prereq calculus through introduction to differential equations, physical chemistry, or ‡) Beck

227.°° Methods in Physiology. (Cr and hrs ar; prereq 107 or equiv, ‡) Staff

230s.°° Transport Process in Biology. Relatively systematic coverage of biological transport processes; kidney and G.I. tract. (3 cr; prereq 107 within past 8 yrs) Grim, Johnson, Lifson

231.°° Transport Process in Biology. Continuation of 230. (2 cr) Grim, Johnson, Lifson

234.°° Respiration, Acid-Base Chemistry, and Electrolyte Metabolism. (3 cr; prereq 107 within past 8 yrs)

°° Students should consult the department for offerings during any specific quarter.

235. Bioenergetics of Cardiac Contraction.** (3 cr; prereq 107 within past 8 yrs) Cavert, Lorber

236. Renal Hemodynamics.** (Cr ar; prereq 107 within past 8 yrs) Harvey

237. Biophysical Aspects of Nerve Function.** (3 cr; prereq 107 within past 8 yrs) Edwards, Terzuolo

238. Neural and Humoral Control of Circulation.** (3 cr; prereq 107 within past 8 yrs) Grande

PLANT PATHOLOGY AND PHYSIOLOGY

Professor
Clyde M. Christensen
Carl J. Eide
David W. French
Helen Hart
Milton F. Kernkamp, *head, director of graduate study*
Thomas H. King
Thor Kommedahl
Albert J. Linck
Roy D. Wilcoxson

Associate Professor
Neil A. Anderson
Bill W. Kennedy
Chester J. Mirocha
John B. Rowell
Eduard J. Stadelmann
Theodore W. Sudia

Assistant Professor
Ernest E. Bantrari
Lucas Calpouzos

Instructor
Matthew B. Moore

Prerequisites—To major in either plant pathology or agricultural plant physiology, a general background in basic sciences and in mathematics is necessary; and it is expected that a student will make up deficiencies in any such course before he becomes a candidate for an advanced degree. Deficiencies can be scheduled after consultation with the major adviser.

To minor in either plant pathology or plant physiology, a student must satisfy the graduate faculty that he is adequately prepared.

Course Requirements—In addition to courses in plant pathology and plant physiology, courses in other fields of agricultural or biological sciences may be applied toward an advanced degree for either major, minor, or supporting program of study, if the adviser approves. A student majoring in these fields will continue studies during at least one summer.

Language Requirement—For the Master's degree, one foreign language. For the Doctor's degree, the requirement may be met by either (a) two foreign languages, or (b) one foreign language plus a collateral field of study or a special research technique.

Master's Degree—Offered under Plan A; rarely under Plan B.

Doctor's Degree—Work for the Ph.D. degree is offered in plant pathology or in plant physiology.

Plant Pathology

101. Nematodes in Relation to Plant Diseases. Nematodes as plant pathogens; nematode taxonomy, morphology, life cycle, biology, and control; pathogenicity and host-parasite relationships; alone and in combination with other plant pathogens. (3 cr; prereq 1, 51, or 120 and 6 cr in zoology or Biol 2, or ‡) Kernkamp

** Students should consult the department for offerings during any specific quarter.

105. Introduction to the Study of Fungi. Structure, habits, classification, and identification of fungi. (3 cr, §106, §107; prereq 9 cr in botany or Biol 2 or ‡) Christensen

106, 107.* Mycology. Morphology and taxonomy of fungi. (3 cr per qtr; prereq 1 or 51 or 105 or equiv) Anderson

109. Physiology and Biochemistry of Fungi. Physiological and biochemical processes in fungi with major emphasis on elucidation of metabolic pathways. (3 cr; prereq BioC or ‡; offered 1966-67 and alt yrs; course begins in spring 1967) Mirocha

112, 113. Plant Pathology. Diseases of ornamental plants, vegetable crops, fruit crops, field crops, and trees. Lectures, conferences, laboratory, and field work. Laboratory and field work continues throughout the summer. (2 cr per qtr; prereq 120 and 105 or equiv) Kommedahl, other staff

117. Virus Diseases of Plants. Nature of plant viruses and virus diseases; methods for studying virus diseases. (3 cr; prereq 1 or 51 or 120; offered 1967-68 and alt yrs, or when demand warrants) King

118. Bacterial Diseases of Plants. Bacteria as plant pathogens; representative types; techniques used in studying bacterial diseases of plants. (3 cr; prereq 1 or 51 or 120 and 3 cr in bacteriology; offered 1966-67 and alt yrs) Eide

119. Principles of Plant Disease Control. General consideration of principles and practices. (3 cr; prereq 1 or 51 or 120) King

120x. Introductory Plant Pathology for Advanced Students. (See PlPa 1). General plant pathology. (3 cr, §1 or §51; prereq 14 cr in plant sciences or ‡) French, Moore

141. Insects in Relation to Plant Diseases. (Same as Ent 141) Insect transmission and dissemination of plant pathogens; plant-insect relationships; habits of principal insect vectors—practical control methods. (3 cr; prereq 5 cr in entomology and 5 cr in plant pathology or their equiv, or ‡) Wilcoxson, Peterson

156. Study of Fungi for Advanced Students. General characteristics of fungi; cultural and taxonomic procedures and practices. (6 cr; prereq 9 cr in botany, or ‡; offered only at Itasca Biology Session) French

201x.* Research in Nematology. Taxonomy or ecology of plant parasitic and free-living terrestrial or aquatic nematodes. (Cr ar; prereq 101 or ‡) Kernkamp

203x.* Research in Plant Pathology. Special assignment of work in laboratory and field problems in pathological research. (Cr ar)

207x.* Problems in Mycology. Research along such lines as taxonomy of natural groups, fungus flora of particular regions, localities, or habitats; investigation of fungi involved in industrial or natural processes; morphology or physiology of special forms. (Cr ar; for minor or major, prereq 105, 106, 107) Christensen, Anderson

211. History of Plant Pathology. Development of plant pathology as a science. (2 cr; offered 1966-67 and alt yrs, or when demand warrants) Sudia

213x.* Seminar. Critical review of progress and problems in plant pathology. (1 cr) Staff

215. Genetics of Plant Pathogens. Physiologic specialization, sexuality, hybridization, maturation, and similar phenomena in plant pathogens; practical implications. (3 cr; prereq 1 or 51, 105 or equiv, and Agro 131; offered 1966-67 and alt yrs) Kernkamp, Anderson

216. Physiology of Host-Parasite Relationships. Physiological and biochemical changes in plants that occur during the infection process and disease development. The nature of resistance, susceptibility, and parasitism. (3 cr; prereq 105, 120, BioC 51 or ‡; offered 1967-68 and alt yrs; course will begin spring 1968) Mirocha

217. Ecology of Plant Pathogens. Effect of environment on plant pathogens and plant disease epidemics. (3 cr; prereq 1 or 51 or 120, 105 or equiv) Wilcoxson

218. Principles of Plant Pathology. Systematic consideration of basic factors governing development of plant diseases. (3 cr; prereq 1 or 51, 105 or equiv, MicB 53, and 6 addtl cr in plant pathology) Eide

Agricultural Plant Physiology

136. Physiological Basis of Chemical Action. Entrance, movement, and metabolism of chemicals of agricultural importance in plants. (3 cr; prereq Bot 194 or ‡, offered 1967-68 and alt yrs) Linck

137. Animal Diseases and Poisonous Plants. (Same as VMC 137) Systematic study of important plants poisonous to animals; identification, toxicology, diagnosis, and treatment. (3 cr; prereq ‡) Kommedahl

162. Environmental Physiology of Plants. Effects of physical factors of the environment on physiological processes important in growth and development of economic plants. (3 cr; prereq Biol 1-2 and Bot 140 or equiv; offered winter 1967-68 and alt yrs) Sudia

164. Mineral Nutrition of Economic Plants. Mineral requirements of plants; role of minerals in plant metabolism. (3 cr; prereq Biol 1-2 and Bot 140 or equiv; offered in 1966-67 and alt yrs) Sudia

166. Water Relations of Economic Plants. Water economy of plants. Absorption, translocation, transpiration, and osmotic relations of economic plants. (3 cr; prereq Biol 1-2 and Bot 140 or equiv; offered 1966-67 and alt yrs) Sudia

167. Physiology of the Plant Cell. Characteristics of the living state, elements of the cell, general aspects of cell metabolism, carbon assimilation, development of the cell, polarity, differentiation, and irritability of the cell and cellular movements. (3 cr; prereq plant physiology, plant anatomy, inorganic and organic chemistry or biochemistry; offered 1966-67 and alt yrs) Stadelmann

168. Experimental Protoplasmatology. Physical and physiochemical properties of living protoplasm in plant cells, including viscosity, wall attachment, permeability, primary and secondary fluorescence, vital staining and changes in these qualities in harmful and harmless environment. (3 cr; prereq plant physiology, cytology, organic chemistry or biochemistry and exper in light microscopy; offered fall 1967 and alt yrs) Stadelmann

182. Plant Physiology. The plant cell and its organelles, metabolism including photosynthesis, and genetic control of physiological processes, with emphasis throughout on the dynamic aspects of these processes. (3 cr; prereq cellular metabolism or equiv)

183. Plant Physiology. Membrane phenomena, water relations, mineral metabolism, and translocation in plants. (3 cr; prereq Biol 2 or 51, OrCh 42 or 62, physics)

184. Plant Physiology. The growth of higher plants, including regulation by hormones, light, and temperature. (3 cr; prereq Biol 2 or 51, OrCh 42 or 62, physics)

186. Measurement of Plant-Environment Interactions. A laboratory course dealing with measurements using intact plants, including water balance, plant-radiation interactions, and gas exchange between plants and the environment. (1-4 cr; prereq PCh 90, ‡)

187. Methods of Plant Analysis. A laboratory course dealing with techniques of sample preparation, fractionation of plant material, and isolation and determination of compounds ocurring in plants. (1-4 cr; prereq AnCh 57, 8 cr in biochemistry, ‡)

188. Research Perspectives in Plant Physiology. A laboratory course in which the student undertakes a well-defined research problem of limited scope. (1-4 cr; prereq ‡)

251x. Seminar: Plant Physiology. Critical review of progress and problems in plant physiology. (1 cr) Staff

254x. Research Problems in Plant Physiology. Special assignment of work in plant physiology. (Cr ar) Staff

259. History of Plant Physiology. Development of plant physiology from 17th to 20th centuries. Collateral readings required. (2 cr; prereq 2 qtrs botany and 1 qtr physiology; offered 1966-67 and alt yrs) Sudia

280. Radioisotope Techniques Applied to Biology. Lecture and laboratory course on uses of radioisotopes in biological research and problems in their use and measurement. (3 cr; prereq course in nuclear physics; enrollment limit)

281. Growth and Differentiation of Plants. Nature and characterization of plant growth, with analysis of physiological changes which occur during the growth and differentiation of plants; hormonal control of growth processes. (3 cr; prereq Bot 184; offered 1967-68 and alt yrs)

282. Advanced Topics in Plant Metabolism. Treatment in depth of one or more topics selected from the following: respiratory pathways, including modifications; organic acid metabolism; nitrogen metabolism; sulfur metabolism. Content of course will vary with instructor and may include topics not listed. (3 cr; prereq Bot 182; offered 1967-68 and alt yrs)

283. Structural Physiology. Discussion of the interrelationship of chemical composition, physiological activity, and ultrastructure of biological systems. (3 cr; prereq ‡)

284. Ecological Physiology. The organization, collection, and interpretation of physiological data so that it may have ecological significance particularly at the community level. (3 cr; prereq ‡)

285. Photosynthesis. Detailed survey of the present state of knowledge of photosynthesis. (3 cr; prereq Bot 182; offered 1966-67 and alt yrs)

Special Academic Year Institute Courses

190-191. Biological Concepts I and II. Review of biological principles with concentration on newer developments in the field from both the cell and organismal viewpoints. (4 cr per qtr; prereq 25 cr in biological science)

192. Advances in Biology. Seminar on special topics in biology to provide for concentrated study of selected topics in the field and participation by students and staff. (1 cr)

193. Scientific Research Method. Philosophy of research and research methods, with intensive coverage of one or more BSCS blocks for further use of these blocks by secondary school teachers of biology. (3 cr; prereq 25 cr in biological science)

POLITICAL SCIENCE

Professor
Harold W. Chase
David Cooperman
Robert T. Holt
Benjamin E. Lippincott
Charles H. McLaughlin
Mulford Q. Sibley
Francis J. Sorauf, Jr., *chairman*
John E. Turner, *director of graduate study*

Associate Professor
Charles H. Backstrom
William H. Flanigan
Edwin Fogelman
Samuel Krislov
Robert E. Riggs
Burton M. Sapin

Assistant Professor
Eugene Eidenberg
Walter W. Klein
David E. RePass
Thomas M. Scott

The graduate faculty of the Department of Political Science offers instruction leading to the M.A. and Ph.D. degrees. It is directed toward educating career political scientists for teaching, research, and public service. Instruction for graduate majors is conducted separately from undergraduate instruction, and course requirements for graduate degrees with major in political science must be satisfied by completion of courses open only to graduate students (200-level courses). Although course numbers are provided to permit registration of students for supervised individual reading and research, these can be used only in exceptional circumstances and with the explicit consent of the graduate adviser and the instructor; the department strongly desires that course requirements be satisfied by registration in organized seminars. Those who are inadequately prepared to enter particular seminars may in some cases be asked

to complete as additional work prerequisite undergraduate courses. All major programs, and all minor programs for the Ph.D., must be approved by a graduate adviser of the department.

Prerequisites—Courses in political science are open to all regularly enrolled graduate students who can meet course prerequisites. Before being accepted as a candidate for a graduate degree with a major or minor in political science, a student must satisfy his adviser that he is prepared for graduate work in the subfields proposed for specialization. Candidates must have a minimum of 27 undergraduate credits in the major, but in exceptional cases completion of courses in other social sciences may be accepted as part of the prerequisites.

A more detailed explanatory statement of prerequisites, subfields and subareas, and requirements for the M.A. and Ph.D. degrees may be obtained from advisers or the office of the department.

Language Requirement—For the Master's degree, one foreign language. A special research technique may be substituted upon recommendation of the major adviser and the approval of the department committee on graduate work. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge.

Areas of Study—Graduate instruction in the field of political science is offered in seven subfields, which for the purpose of stating degree requirements have been arranged in two groups. In each subfield seminars, ranging in number from 7 to 12, are offered. From five to seven of these are directed to particular areas within the subfields; in addition two or three research seminars are offered in each subfield on topics appropriate to the interests of staff and students. The principal groups and subfields are as follows:

Group I

1. Political theory
2. Comparative government and politics
3. International relations

Group II

4. Politics and behavior
5. American governmental systems and processes
6. Public administration (See regulations in paragraph following)
7. Public law

In those few cases in which courses are assigned to more than one subfield (Pol 241A-B, 242 in International Relations and in Public Law, Pol 262 in American Governmental Systems and Processes and in Public Law, students can offer them in satisfaction of course requirements in either subfield but not in both subfields. Both subfields may be offered, but other courses must be chosen to satisfy requirements in one of them.

Public Administration—Graduate training in public administration is under the jurisdiction of a separate unit, the Public Administration Center; for its curriculum see index. Graduate students entering after July 1, 1966 who wish to offer public administration as a subfield of concentration should enter the program of the Center.

Students enrolled in Ph.D. programs with major in political science may offer public administration as a major subfield other than the subfield of concentration. They may, alternatively, present public administration as part of a supporting program of study taking the place of a minor; in this case at least 9 quarter credits of the supporting program must be in a department or departments other than Public Administration. It is not permissible to offer public administration both as a major subfield and as a supporting program. Nor can it be offered as a collateral field of knowledge in substitution for a foreign language.

Students enrolled in M.A. programs with major in political science are not permitted to offer public administration as a minor field (Plan A) or related field (Plan B).

General Requirement—All candidates for graduate majors with major in political science must complete Pol 200 (Scope and Methods of Political Science, I), or present evidence of satisfactory completion of a similar course at another approved institution. Candidates for the M.A. degree under Plan A and for the Ph.D. degree must also complete Pol 201 (Scope and Methods of Political Science, II). Candidates for the M.A. under Plan B are advised to do so if they intend later to go on to the Ph.D. Whenever possible Pol 200 and 201 should be completed during the first year of graduate study.

Note—For information on work in public administration and international relations and area studies, see index.

Requirements for the Degree of Master of Arts

Plan A with Major in Political Science—The work leading to the Master's degree under Plan A consists of at least 3 quarters of graduate study, including: (a) in addition to Pol 200 and 201, at least 18 credits in political science including three seminars (9 credits) in each of two subfields; (b) at least 9 credits in the minor department comprising either a 9-credit course or a sequence of related courses totaling 9 credits; (c) a substantial thesis based upon independent research; (d) successful completion of a written preliminary examination in each of the subfields presented, and a final oral examination covering these subfields and the thesis.

Plan A with Minor in Political Science—Candidates for graduate degrees with political science as the minor must take at least one 9-credit course or a group of related courses lying in either one or two subfields and totaling 9 credits. Either 200-level or 100-level courses may be used.

Plan B with Political Science as the Field of Concentration—Candidates for the Master's degree without thesis must complete: (a) in addition to Pol 200 (and Pol 201, if taken) at least 21 to 27 credits in political science seminars chosen from either two or three subfields; (b) a minimum of from 18 to 24 credits of course work in at least two related disciplines; (c) research papers as

specified in the requirements of the Graduate School; (d) a final written examination covering the subfields presented and oral examination covering these and the research papers. Courses elected in political science together with those in the related fields should constitute an integrated plan of study. Normally at least two of the required research papers, if submitted in 3-credit courses, or one, if submitted in a 6- or 9-credit course, should be prepared for courses in the field of concentration.

Requirements for the Degree of Doctor of Philosophy

Major in Political Science—The candidate shall, with the approval of his adviser, choose and prepare himself for examination in three subfields of specialization. It is recommended that he present subfields drawn from both groups, but at least one subfield must be chosen from Group I. One subfield shall be designated as the thesis subfield or subfield of concentration. In it the candidate shall take a minimum of seven seminars (21 credits), ordinarily including two or three research seminars (6 to 9 credits). In each of the other two subfields the candidate will take a minimum of five seminars (15 credits), usually not including research seminars. These course requirements are in addition to Pol 200 and 201. A minor or supporting program of courses in one or more related disciplines (the number of credits to be in accordance with the regulations of the Graduate School) is also required; the courses should be selected to support the major program.

A full-time student taking four seminars per quarter and well prepared by undergraduate training for graduate work in political science can complete course work for the Ph.D. in approximately 2 years. Students who lack sufficient preparation will be expected to master a subfield by additional course work or independent study, as the adviser may determine.

Candidacy for the Ph.D. degree is achieved by completion of the prescribed course work and of written and oral preliminary examinations covering the subfields presented in the major field, and in the minor field or supporting program if required by it. The degree is then obtained after submission of an acceptable dissertation embodying independent research and a final oral examination devoted to the thesis and to relevant aspects of the subfield in which it is written.

Minor in Political Science—A candidate for the Ph.D. degree who elects political science as his minor shall prepare himself for examination in one or two subfields, completing courses at least sufficient to satisfy the minor requirements of the Graduate School. If he concentrates in one subfield he must include 9 credits of 200-level courses; if he chooses two subfields he must include one 3-credit 200-level course in each.

Written Examinations—The department requires all candidates for the Ph.D., whether majoring or minoring in political science, and all candidates for the M.A. with major in political science, whether under Plan A or Plan B, to take assembled written preliminary examinations in each of the subfields of specialization included in their political science programs. Successful completion of these examinations in each subfield (i.e., C+ or better in minor subfields, B or better in major subfields) is prerequisite to permission to take oral examinations. Assembled written examinations for Ph.D. candidates are

scheduled only during the fall and spring quarters; for M.A. candidates examinations will be given each quarter. No examinations are scheduled during the Summer Session. Announcement of the examinations will be made in the Official Daily Bulletin, after which students intending to present themselves must register in the department office, indicating the subfields to be offered. The Ph.D. candidate will be given two written examinations in each of his subfields. The first will be designed to test his knowledge of fundamental principles, methods, and relationships essential to a command of the subfield; the second will deal with areas within the subfield, offering sufficient alternatives to accommodate the area specializations of students. Candidates are expected to demonstrate a substantial knowledge of the subfields and areas chosen within them, not just the materials covered in courses.

Candidates for the M.A. degree will be given one preliminary examination in each subfield presented. These examinations will be more closely related to course work.

Further details concerning the administration of the written examinations, and reading lists suggestive of the literature to be covered in each subfield, are available in mimeographed form in the office of the Department of Political Science.

Curriculum—In the listing of courses which follows, 100-level courses are open to Upper Division and graduate students. Although graduate credit may be obtained in these courses, it cannot be offered in satisfaction of course requirements for graduate majors in political science; it is acceptable to the extent stated above in satisfying requirements for a minor field or supporting program, or as additional work prerequisite to 200-level seminars. The 200-level courses include seminars which may be offered in satisfaction of course requirements for majors.

GENERAL

200.* Scope and Methods of Political Science I. The field of political science; relation to other sciences; types of approach; research methods and techniques; bibliography. (3 cr; prereq ‡) Sorauf

201.* Scope and Methods of Political Science II. Contemporary trends and currents within political science; problems in analysis and theory; normative and empirical political science. (3 cr; prereq ‡) Flanigan

POLITICAL THEORY

160.* American Political Thought. From colonial times to present; Puritanism; Constitution; utopianism; Calhoun; history of anarchist, socialist, populist and syndicalist thought; social Darwinism; conservatism; political thought in law and literature. (3 cr; prereq B or 9 cr in social science or ‡) Cooperman, Shaw

161.* Problems of Democracy. Analysis of postulates and implications; moral foundations; democratic theory and the economic order; liberty and authority; equality; representation; spiritual order; democracy and practical politics; critics of democracy. (3 cr; prereq B or 9 cr in social science or ‡) Shaw

162.* Recent Political Thought. Main currents from Marx to present; Marx, Marxism and their critics; non-Marxist socialism; syndicalism; anarchism; Catholic and Protestant theories; conservatism; pacifism; political thought in law and literature. (3 cr; prereq B or 9 cr in social science or ‡) Cooperman

163.* Political Theory and Utopia. Selected great utopias from the viewpoint of the political theorist; idea of planning in ideal states; achievement of utopia; stability

and change in great utopias; problem of authority and law; anarchist, socialist, and conservative utopias; utopia and totalitarian ideology; utopia and democratic ideology. (3 cr; prereq B or 9 cr in social science or ‡; offered when feasible) Sibley, R Swanson

164.° Ancient Political Thought. Hebrew ideas, Moses to the second Isaiah; classical Greek thought: Plato and Aristotle; primitive natural law; Cynics and Stoics, theory in Roman Republic and Empire; first-century Christianity. (3 cr; prereq B or 9 cr in social science or ‡) Sibley

165.° Medieval Political Thought. Early Christianity and church fathers; moral theory and political theory; Empire and Church in ideology; Roman and canon law, theory of persecution; St. Thomas; 14th- and 15th-century conceptions; economics and politics. (3 cr; prereq B or 9 cr in social science or ‡) Sibley

166.° Early Modern Political Thought. Machiavelli: idea of sovereignty; Protestant conceptions; English Civil War; Hobbes, Spinoza, Locke; idea of progress; Godwin, Burke, Rousseau, rise of romanticism; German idealism. (3 cr; prereq B, or 9 cr in social science or ‡) Sibley

Note—In selecting courses to satisfy degree requirements no distinction is made between reading and research seminars in the subfield of political theory.

205Af, Bw, Cs.° Topics in the Development of Political Thought. Selected topics are examined each quarter. In general these will relate in 205A to ancient, in 205B to medieval, in 205C to modern political thought. Specific areas of concentration will be varied from year to year, e.g., Plato's outlook, development of natural law views, 13th-century political theory, development of modern anarchism, utilitarianism, Marxism, Hegelianism. (3 cr per qtr; prereq 164 for 205A, 165 for 205B, 166 or 162 for 205C or equiv or ‡) Sibley

208Aw-Bs.° Readings in the Classics of Politics. Plato, Aristotle, Machiavelli, Hobbes, Locke, Rousseau, Mill, Marx, Lenin, Hitler. (3 cr per qtr; prereq 164, 165 or ¶164, ¶165 or ‡) Lippincott

210Aw, Bs.° Topics in Twentieth-Century Political Thought. Selected aspects of 20th-century political thought; specific subjects will vary from year to year, e.g., traditional theory and its critics, socialist perspectives, conservatism and the radical right, the scientific revolution and politics, the Christian revolution and politics. (3 cr per qtr; prereq 162 or equiv or ‡) Lippincott

212Af-Bw-Cs.° Contemporary Political Theory. Intensive examination of selected empirical theories from the standpoint of their usefulness for political analysis: communication theory, game theory, systems theory, decision-making theory, conflict theory, structural-functional theory, etc. (3 cr per qtr; prereq ‡) Fogelman

214Af, Bw.° American Political Thought. Examination of major issues and thinkers (statesmen, novelists, academic men, etc.). Relation of political thought to problems of American culture. (3 cr per qtr; prereq 160 or equiv, grad major in American studies, or ‡) Sibley, Shaw

216Af, Bw, Cs.° Problems in Political Thought. Selected problems varied from term to term, e.g., liberty, authority, obligation, theory of democracy, relation of politics to law, socialism, religion and politics. (3 cr per qtr; prereq ‡) Lippincott, Sibley, Fogelman

219Af, Bw, Cs.° Individual Reading and Research in Political Theory and Development of Political Thought. (3 cr per qtr; prereq ‡) Lippincott, Sibley, Fogelman

COMPARATIVE GOVERNMENT AND POLITICS

141-142.° European Government and Politics. Britain, France, Germany, and Italy. Political institutions in their social setting; problems of power and responsibility, governmental stability; political decision making, government and the economic order. (3 cr per qtr; prereq B or 12 cr in social science or ‡) Schwarz

143.° Government and Politics of the Soviet Union. Analysis that seeks to explain rise of Bolshevism; sources and nature of its ideology; history of Communist regime; institutional character; organization of power, role of the party; foreign, economic, and cultural policies; significance for Western civilization. (3 cr; prereq B or 12 cr in social science or ‡) Turner

145.° Government and Politics of the Scandinavian Countries. (3 cr; prereq 6 cr or 12 cr in social science)

146.° Social Legislation and Social Institutions in the Scandinavian Countries. (3 cr; prereq 2 or Soc 1)

148f. Government and Politics of African Countries. Political institutions of sub-Saharan Africa countries in their social and cultural settings, influence of class and tribal structure; parties and elections; source and nature of ideologies; economic and social policies; major problems of foreign policy. (3 cr; prereq B or 12 cr in social science or ‡) Pirro

149f-150w.° Government and Politics of South Asia. Political institutions of South Asian countries in their social setting, sources and nature of ideologies; politics and class structure; parties and elections; economic and social policies. (3 cr per qtr; prereq 6 cr or 12 cr in social science or ‡) Blue

153.° Japanese Government and Politics. Constitutional and political development in Japan; political ideas, government, political parties, and problems. (3 cr) Benjamin

154.° Chinese Government and Politics. Constitutional and political development in China; political ideas, government, political parties, and problems. (3 cr) Turner

155.° Latin-American Government and Politics I. Analysis of factors such as colonial institutions, the economy, the social structure, which condition constitutional and political organization. (3 cr; prereq 2 or ‡) Klein

156.° Latin-American Government and Politics II. Survey of contemporary political systems; analysis of factors underlying political instability and political change in Latin America. (3 cr; prereq 155 or ‡) Klein

157.° Government and Politics of Developing Areas. Analysis of political problems of new nations; political consequences of the breakdown of traditional society and problems of developing new institutional forms and procedures. (3 cr; prereq C or 15 cr in any combination of economics, sociology, and/or anthropology) Blue

158.° Bureaucracy and Administration in Developing Countries. Analysis of administrative processes of developing nations; socio-economic influences upon administrative personnel; problems of planning; impact of technical assistance and programmed change upon traditional structures. (3 cr; prereq B or ‡) Klein

159Aw-Bs.° Comparative Governmental Systems: Principles and Problems. Application of the comparative method to study of politics with reference to Western and non-Western institutions; organization of political power in 20th-century state; parties and pressure groups; voting behavior, representation and legislation; policy making; bureaucracy; socio-economic bases of government. (3 cr per qtr; prereq 6 cr in any upper division comparative government course, or ‡) Holt

196s. Proseminar in East and South Asia. For description see course listing under the subfield International Relations.

Note—Graduate students who select comparative government as the field of concentration must complete seminar work in at least two culture areas. It is expected that a student will have completed some work in area courses before registering in the interarea analytical courses (228, 229, 230, 233).

220Af-Bw.° Government and Politics in Western Europe. Analysis of political institutions of Britain, France, Germany, and Italy; political development; social structures; ideologies, parties, and pressure groups; voting behavior. (3 cr per qtr; prereq 142 or equiv) Schwarz

221s.° Government and Politics of the U.S.S.R. Analysis of rise of Bolshevism; sources and nature of the belief system; development of Communist regime; institutional features; organization of power; role of the party; social, economic, and foreign policies. (3 cr; prereq 143 or equiv) Turner

222.° Government and Politics of Japan. Analysis of Japanese political institutions in their social setting: political development; ideologies; organization of political power; parties and pressure groups; socio-economic basis of political action. (3 cr; prereq 153 or equiv) Benjamin

223.* Government and Politics of China. Analysis of Chinese political institutions in their social setting: political development; ideologies; organization of political power; parties and pressure groups; socio-economic basis of political action. (3 cr; prereq 154 or equiv) Turner

224.* Government and Politics of India and Southeast Asia. Analysis of political institutions of India and selected countries of Southeast Asia in their cultural setting; political development; ideologies; relationship of social structure to political institutions; parties and pressure groups. (3 cr; prereq 150 or equiv or ‡) Blue

226.* Government and Politics in Latin America. Analysis of political institutions and processes, with emphasis upon selected countries: social and economic basis of politics; parties and interest groups; political instability and change. (3 cr; prereq 155, 156 or equiv or ‡) Klein

228.* Democratic Systems. Application of the comparative method to analysis of democratic systems; prerequisites for modern democracy; origin and development; socio-economic basis of politics; organization of power; role of parties and interest groups; patterns of voting behavior; nature and role of elites. (3 cr; prereq 142 or equiv) Blue

229.* Totalitarian Systems. Application of the comparative method to analysis of totalitarianism; origin and development; socio-economic basis of power and authority; institutional features; nature and role of ideologies; evolution of élite structures; role and functions of the party; economic and social policies; limitations upon totalitarianism. (3 cr; prereq 143 or 154 or equiv) Turner

230.* Politics of Developing Systems. Application of the comparative method to analysis of political development, especially of contemporary underdeveloped areas; factors that make for different theories of development. (3 cr; prereq 157 or equiv or ‡) Holt

232.* Comparative Methodology and Research Design. A study of the logic of comparative research design; conceptual requirements of cross-cultural research. (3 cr; prereq ‡) Turner, Holt

233A, B.* Research Seminar: Comparative Government and Politics. Group research upon selected topics under faculty guidance and supervision. (3 cr per qtr; prereq ‡) Turner, Holt, Fogelman, Klein

234Af, Bw, Cs.* Individual Reading and Research in Comparative Government and Politics. (3 cr per qtr; prereq ‡) Turner, Holt, Fogelman, Klein

INTERNATIONAL RELATIONS

171.* Scandinavian Foreign Policy. (3 cr; prereq 6 cr in history or political science or ‡; offered when feasible)

175.* Diplomacy. Nature, functions, historical development of diplomacy; relation to forms of government and power systems. Traditional diplomacy, diplomacy by conference and in international organizations, personal diplomacy, open and secret diplomacy. Essentials of diplomatic usage. Diplomatic agents. (3 cr) Penikis

176w.* U.S. Foreign Affairs Administration. Control of foreign relations; treaties and executive agreements; structure and function of foreign affairs agencies—Department of State, U.S. Information Agency, Central Intelligence Agency; Department of Defense, National Security Council; co-ordination of agencies; the Foreign Service and other overseas agencies. (3 cr) Penikis

177s.* U.S. Foreign Policy. Analysis of factors conditioning U.S. foreign policy: geographic and economic position, defense needs and dispositions, social structure, ideologies, psycho-cultural characteristics, technological revolution, public opinion, political participation; role of parties, interest groups, bureaucracy; leadership; decision-making processes. (3 cr) Penikis

180f-181w†-182s.* International Law (Peace). 180-181: Relation of international law to individuals, states, international community; jurisdictional problems; survey of principles developed in diplomatic practice, national courts, international adjudications. 182: Status of diplomatic agents and consuls, treaties, arbitration, treatment of aliens, pacific settlement. (3 cr per qtr) McLaughlin

183s.° International Law (Conflict). War and hostile measures short of war, military occupation, war crimes, neutrality, collective security sanctions. (3 cr; prereq 181 or ‡; offered when feasible) McLaughlin

184f.° International Politics I. State action in international relations; forms of state action; foreign policy-making analysis; capabilities analysis. (3 cr) Pirro

185w.° International Politics II. Analysis of systems of interaction among nation-states; balance of power, bipolar, and other types of international system; conflict and co-operation. (3 cr; prereq 184) Pirro

186s.° Regional International Systems. Examination and comparison of selected regional systems of interaction among nation-states, past and contemporary; stability and change. (3 cr; prereq 185) Pirro

187f.° International Organization I. The organization of interaction among nation-states; decision making in international organizations; comparison of national and international political institutions; world organization for collective security and peaceful settlement of disputes. (3 cr) Riggs

188w.° International Organization II. World organization for social, economic, cultural, and humanitarian co-operation; comparison of functional and political organizations; problems of international administration. (3 cr) Riggs

189s.° Regional International Organization. Analysis and comparison of selected regional international organizations; regional defense, social and economic co-operation; relationship between regional and world organizations, economic and political integration. (3 cr) Riggs

196s. Proseminar: East and South Asia. (Same as Anth 196, Geog 196, Hist 196, Ortl 196) Integrating course for students majoring in East and South Asia Area Studies program. (3 cr) Interdepartmental staff

235Af-Bw.° Seminar: International Politics. Major approaches and concepts employed in study of international political relations; international communications; international conflict; problems of research and development of theory. (3 cr per qtr; prereq 184 or 185 or ‡)

236s.° Research Seminar: International Politics. Supervised group research and research training in selected topics or problems. (3 cr; prereq ‡)

238Af-Bw.° Seminar: International Organization. Examination of universal and regional international organizations; organizational decision making and international administration; political and economic integration. (3 cr per qtr; prereq 187 or 188 or ‡) Riggs

239s.° Research Seminar: International Organization. Supervised group research and research training in selected problems or topics. (3 cr; prereq ‡) Riggs

241Af-Bw.° Seminar: International Law. Historical development of the relationship of economic, social, and political systems to systems of international law; analysis of relevant juristic concepts. (3 cr per qtr; prereq 181 or equiv) McLaughlin

242s.° Research Seminar: International Law. Supervised group research and research training in selected subjects or problems. (3 cr; prereq ‡) McLaughlin

245f.° Seminar: Diplomacy. Patterns of postwar diplomacy in bilateral relations, conferences, international agencies; problems of agency co-ordination, selection and training of personnel in foreign affairs administration. (3 cr; prereq 175 or 176 or ‡) Sapin

246w.° Seminar: Foreign Policy. Principal approaches to analysis of foreign policy; case studies in decision making in foreign relations; problems in defense and deterrence. (3 cr; prereq 177 or ‡) Sapin

247s.° Research Seminar: Diplomacy and Foreign Policy. Supervised group research in selected subjects or problems. (3 cr; prereq ‡) Sapin

249Af-Bw-Cs.° Individual Reading and Research in International Relations. (3 cr per qtr; prereq ‡) Staff

POLITICS AND BEHAVIOR

137f.* American Political Parties. Role and functions of the party in American government; party composition and organization; process of nomination and policy formulation; regulation of party organization and activities. (3 cr; prereq 2 or ‡) Backstrom

138s.* American Political Campaigns and Elections. Examination of national, state, and local campaigns and elections, including field work in local political parties and election campaigns. (3 cr; prereq 2 or ‡) Backstrom

167f-168w.* Political Behavior. Political personality and public opinion. Role of attitudes, interests, and values. Voting behavior and elections. Group and organizational behavior. Mass society, elite theory and group theory. Conceptual approaches and advanced analytic techniques. (3 cr per qtr) Flanigan or RePass

250.* Public Opinion and Political Participation. Description and analysis of public opinion, opinion leaders, and opinion elites; attitudinal and social determinants of voting behavior, campaign participation, and other political activity; analysis and interpretation of electoral decisions. (3 cr; prereq ‡) Flanigan or RePass

251.* Seminar: Political Parties. Party systems and subsystems; party organizational characteristics, goals, and incentives; distribution of power and authority within the party; chief party functions; party as an organizer of governmental power; determinants of party structure and role. (3 cr; prereq ‡) Sorauf

252.* Seminar: Interest Groups. Description and analysis of role of interest groups; leadership, maintenance of following, and representation of values; theories of groups, group behavior, and overlapping group membership; interest group relations with other political organizations. (3 cr; prereq ‡) Flanigan or Sorauf

255.* Seminar: Political Leadership and Decision Making. Theories of political leadership; social and cultural support of leaders; description and analysis of leadership recruitment and rejection; decision making, choice and bargaining in political organizations. (3 cr; prereq ‡; offered 1967-68 and alt yrs) Flanigan

256.* Seminar: Political Psychology and Socialization. Theories of political psychology, opinion formation, and attitude change; political style and ideology; processes of individual political development and socialization. (3 cr; prereq ‡; offered 1966-67 and alt yrs) RePass

258A-B.* Research Seminar: Politics and Behavior. A: Quantitative techniques of data collection and analysis; survey research methods; scaling, bloc analysis, and content analysis; aggregate statistical techniques; simulation. B: Advanced research topics. (3 cr per qtr; prereq ‡) RePass

259Af, Bw, Cs.* Individual Reading and Research in Politics and Behavior. (3 cr per qtr; prereq ‡) Sorauf, Backstrom, Flanigan, RePass

265.* Seminar: Community Power Systems. For description see course listing under the subfield American Governmental Systems and Processes.

AMERICAN GOVERNMENTAL SYSTEMS AND PROCESSES

107f.* The American Chief Executive. Constitutional powers and political roles of the President and governors; the chief executive and administration; executive relations with legislatures; party and popular leadership; presidential roles in crisis. (3 cr; prereq 2 or ‡) Eidenberg

108w.* Legislative Organization and Procedure. Congress and state legislatures at work. (3 cr; prereq 2 or ‡) Eidenberg

109s.* The Judicial Process. Structure of the American judiciary; selection of judges; the process of litigation; influences on judicial decisions; impact of and compliance with decisions; role of the Supreme Court in the American political system. (3 cr; prereq 2 or ‡) Sorauf, Krislov

115f.* State Government. The states in the American federal system; intergovernmental relations with national and local governments; governmental institutions and processes, with special reference to Minnesota. (3 cr; prereq 2 or ‡) Mitau

116.° Introduction to Community Politics. Political systems in their legal, political, social, and economic environments. Political behavior and decision making. (3 cr; prereq 2 or ‡) Scott

117.° Community Power Structures. Analysis of political elites and leadership in various kinds of communities. (3 cr; prereq 2 or ‡) Scott

118.° Metropolitan Government and Politics. Development of political and governmental problems in metropolitan areas. Analysis of politics of metropolitan reform. (3 cr; prereq 2 or ‡) Scott

120f.° Government and the Economic Order. Analysis of the relation of government to major areas of the economy; policy decision making. (3 cr; prereq 2 or ‡) Holt

121w.° Administrative Regulation. Administrative development of regulatory programs; problems of bureaucracy, interest groups, and safeguards. (3 cr; prereq 120 or 102 or ‡; offered 1967-68 and alt yrs) Krislov

122w.° Government and Domestic Public Policy. Federal, state, and local policy making in welfare, education, agriculture, labor, business. (3 cr; prereq 2 or ‡; offered 1966-67 and alt yrs) Gieske

130f. Administrative Process I. Organization theory and administrative behavior. Problems of centralization, rationality, bureaucratic processes. (3 cr; prereq 2 or ‡) Jernberg

131w. Administrative Process II. Analysis of budgeting, planning, and personnel administration. (3 cr; prereq 130) Jernberg

176w.° U.S. Foreign Affairs Administration. For description see course listing under the subfield International Relations.

260f.° Seminar: Legislative Process. National and state legislatures; their internal organization; party organizations and influences with legislatures; interest groups and other external influences; legislative roles and behavior; policy-making processes in American legislatures. (3 cr; prereq ‡) Backstrom

261w.° Seminar: Executive Process. The Presidency and the governorships, cabinets and staff aids; relations with legislatures; the executive as party and popular leader; the executive and administrative agencies. (3 cr; prereq ‡) Krislov, Eidenberg

262s.° Seminar: Judicial Process. Judicial systems and roles; selection of judges; organizing and supporting litigation; influences on judicial decisions; impact and enforcement of judicial decisions; courts and other institutions of government. (3 cr; prereq ‡) Sorauf, Krislov

263.° Seminar: Intergovernmental Relations. The American federal system; state-local relationships; interunit co-operation and conflict; metropolitan dispersal and integration. (3 cr; prereq ‡)

264.° Seminar: Local Government and Politics. Selection of local leadership; relationship of the political system to governmental forms and social institutions; role and impact of political institutions; policy making at the local level; studies in policy problems; the emerging metropolis. (3 cr; prereq ‡) Backstrom, Scott

265.° Seminar: Community Power Systems. Structure of influence in communities; methods and approaches to study of community power; determinants of power in the community. (3 cr; prereq ‡) Backstrom, Scott

266.° Seminar: Public Policy. Politics of the policy-making process; interest group, client, and constituent pressures; decision making and bargaining in policy making; topics in major areas of regulation, planning, fiscal, and welfare policy. (3 cr; prereq ‡; offered when feasible)

268A-B.° Research Seminar: American Governmental Processes. Research methods, techniques, and problems; selected topics. (3 cr per qtr; prereq ‡) Sorauf, Backstrom, Krislov, Scott, Eidenberg

269Af, Bw, Cs.° Individual Reading and Research in American Governmental Systems and Processes. (3 cr per qtr; prereq ‡) Sorauf, Krislov, Backstrom, Scott, Eidenberg

PUBLIC LAW

101f.° Principles of the American Constitution I. Nature of constitutions, judicial review, national-state and interstate relations. (3 cr; prereq 2 or equiv) Chase

102w.° Principles of the American Constitution II. Organization and powers of the national government. (3 cr; prereq 101 or equiv) Chase

103s.° Principles of the American Constitution III. Constitutional rights, due process and equal protection of the law. (3 cr; prereq 101 or 102 or equiv) Chase

109s.° The Judicial Process. For description see course listing under the subfield American Governmental Systems and Processes.

180f-181w†-182s.° International Law (Peace). For description see course listing under the subfield International Relations.

183s.° International Law (Conflict). For description see course listing under the subfield International Relations.

241Af-Bw.° Seminar: International Law. For description see course listing under the subfield International Relations.

242s.° Research Seminar: International Law. For description see course listing under the subfield International Relations.

262s.° Seminar: Judicial Process. For description see course listing under the subfield American Governmental Systems and Processes.

285.° Research Seminar: Judicial Process and Administrative Law. Supervised research and research training in selected topics or problems. (3 cr; prereq ‡) Krislov, Sorauf

290Af, Bw.° Seminar: Constitutional Law. (3 cr per qtr; prereq 101, 102, 103 or ‡) Chase

292s.° Research Seminar: Constitutional Law. Supervised research and research training in selected topics or problems. (3 cr; prereq ‡) Chase

295Af.° Fundamental Concepts of Public Law. State and law; coercion and consent; concepts of right and obligation; basis of property; contract, tort; vehicles of legal growth—legislation, administrative regulation, judicial action; separation and distribution of powers; domestic jurisdiction and the international legal community. (3 cr; prereq ‡) Krislov

295Bw, Cs.° Jurisprudence. Legal systems in relation to social systems. Examination of interests protected, extent of state intervention, institutional devices and procedures for doing justice and maintaining order, vehicles of legal change and growth, basic legal concepts, in kin-organized societies, political societies based on status, politico-economic societies based on contract, modern industrialized democratic societies. Limits of social control by law. (3 cr per qtr; prereq 295A and basic course in either constitutional, administrative, or international law) McLaughlin

299Af, Bw, Cs.° Individual Reading and Research in Public Law. (3 cr per qtr; prereq ‡) Chase, Krislov, McLaughlin, Sorauf

PSYCHIATRIC NURSING

For staff and courses of study offered, see the *Bulletin of the Graduate Programs in Medicine, Dentistry, and Pharmacy.*

PSYCHIATRY AND NEUROLOGY

For staff and courses of study offered, see the *Bulletin of the Graduate Programs in Medicine, Dentistry, and Pharmacy.*

PSYCHOLOGY

Professor
Ralph F. Berdie
John G. Darley, *chairman, director of graduate study*
Marvin D. Dunnette
George W. England
Norman Garmezy
Starke R. Hathaway
Vivian H. Hewer
James J. Jenkins
David L. LaBerge
Lloyd H. Lofquist
Howard P. Longstaff
Kenneth MacCorquodale
Paul E. Meehl
Gerhard Neubeck
Warren W. Roberts
Wallace A. Russell
William Schofield
Harold W. Stevenson
Edmund G. Williamson
Robert D. Wirt

Associate Professor
Peter F. Briggs
David P. Campbell
Irving I. Gottesman
A. Jack Hafner
Gordon T. Heistad
David T. Lykken
Manfred J. Meier
Norman Miller
Herbert L. Pick, Jr.
Wentworth Quast
Alan H. Roberts
Britton K. Ruebush
Leverne F. Snoxell
Auke Tellegen
Milton A. Trapold
Elaine C. Walster
Robert G. Warnken
Karl E. Weick, Jr.

Assistant Professor
James N. Butcher
John P. Campbell
Jan D. Duker
Paul W. Fox
Paul C. Goldin
Romine E. Matthews
James B. Overmier
Robert E. Phillips
Travis I. Thompson
John I. Yellott, Jr.

For information about the several fields of study within psychology and about financial aid and special admissions requirements, applicants should write directly to the Chairman, Department of Psychology.

Prerequisites—Courses in psychology are open to all regularly enrolled graduate students who can meet course prerequisites as listed in the *Class Schedule*. Before being accepted as a candidate for a graduate degree with a major or minor in psychology, a student shall satisfy his adviser that he is fully prepared to undertake graduate work in the subfields of proposed specialization. In certain cases completion of preparatory courses in the fundamental sciences may be accepted as part of the prerequisites.

Major and Minor—All candidates should consult advisers in both the major and minor fields.

In general it is expected that all graduate students in psychology, either major or minor, shall have 15 credits of prerequisite work in psychology.

Language Requirement—For the Master's degree, Plan A, one foreign language—French, German, Russian, or Spanish. For the Master's degree, Plan B, no foreign language. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge. When two languages are offered any combination of those listed above may be approved.

Master's Degree—Offered under both Plan A and Plan B.

Doctor's Degree—Work leading to the Ph.D. degree is offered.

For courses in child psychology see page 115.

100. Theories of Learning. Major theories of learning; basic issues of learning and performance in man and animals. (3 cr; prereq 75 except for students in Sequence A and grad students) LaBerge

101. Advanced Experimental Psychology: Human Learning. Discussion of current research topics and experimental techniques in the study of human learning, including verbal learning, memory, discrimination learning, concept formation, choice learning, and

probability learning. Class will design, execute, and analyze one or two experimental projects. (3 cr; prereq 2, 5, 70, or equiv) LaBerge, Jenkins

102. Advanced Experimental Psychology: Perception and Psychophysics. Modern approaches to study of perception and psychophysics; topics such as stimulus detection, recognition, discrimination, scaling, attention, stimulus generalization, reaction time and vigilance. Class will design, execute, and analyze one or two experimental projects. (3 cr; prereq 2, 5, 70, or equiv) LaBerge, Yellott

104. Human Learning A. Examination of major processes and variables involved in human learning; verbal and motor learning. Topics: information feedback, skill acquisition, retention and long-term memory, facilitation and interference, abilities and performance prediction. (3 cr; prereq 75 except for students in Sequence A and grad students) Fox

105. Human Learning B. Major processes involved in human learning; verbal and perceptual learning. Topics: discrimination learning, choice and probability learning, concept formation, and programmed learning. (3 cr; prereq 75 except for students in Sequence A and grad students) LaBerge

117. Analysis of Behavior. A systematic formulation of topics of psychology based upon a Skinnerian analysis. Scientific method, learning, motivation, and emotion. (3 cr; prereq 75 except for students in Sequence A and grad students) MacCorquodale

118. Verbal Behavior. An individual's verbal behavior in terms of his past history and current circumstances. (3 cr; prereq 117 or ‡) MacCorquodale

119. Analysis of Complex Behavior. Experimental analysis of complex behavior repertoires based upon the systematic formulation presented in Psy 117. Extension of these principles to development of an approximate system of analysis of large, continuous samples of behavior. Social as well as other complex sequences of human and other animal behavior. (3 cr; prereq 117 or ‡) Thompson

120-121.† Personality. Presentation and discussion of several major theories and concepts. (3 cr per qtr; prereq 9 cr) Tellegen

125-126.† Differential Psychology. Introduction to methodology. Quantitative studies of nature of psychological traits and influence of age, sex, heredity, and environment in causation of individual differences in ability and temperament. (3 cr per qtr; prereq 70, or 5 and 5 cr in statistics) Dunnette

127. Introduction to Behavioral Genetics. Survey of methodology appropriate to analyzing contribution of genetic and environmental factors to variance observed in normal and abnormal traits in man and animals. Emphasis on intelligence, neuroses, and psychoses. For all examples, the independent variable will be the genotype of an organism. (3 cr; prereq 125, 126) Gottesman

128-129. Psychology of Learning. Survey of experimental literature on classical conditioning and all types of instrumental learning. Critical evaluation of theories relevant to these types of learning. (3 cr per qtr; prereq 75 except for students in Sequence A and grad students for 128) Trapold

130x. Vocational and Occupational Psychology. Psychology of individual differences in intelligence, aptitudes, interests, and training, as related to vocational counseling psychology and problems of work adjustment. (3 cr per qtr; prereq 2 and 5 or 5 cr in statistics) Lofquist

132-133.† Psychology of Motivation. Classical and contemporary theories of motivation. Elaboration of basic drives into motives, acquisition of new drives and goals; dynamics of the elaborated drive structure. Motivation in complex situations involving set, level of aspiration, Zeigarnik effect, frustration, etc. (3 cr per qtr; prereq 9 cr) Russell

135. Counseling Psychology I: History and Theory. History of counseling psychology; theories of counseling; theories of vocational development, work, and work adjustment. (3 cr; prereq 9 cr or ‡) Lofquist

136. Counseling Psychology II: Tests and Measurements. Psychological tests and measurements; construction, selection, interpretation of selected objective instruments measuring intelligence, academic ability, special aptitudes, interest, and personality; testing of the adult. (3 cr; prereq 135, 125-126 or ¶ or ‡) Warnken

137. Counseling Psychology III: Interviewing. Dynamics of the counseling interview; interview techniques; diagnosis and appraisal; use of occupational information; psychological report writing. (3 cr; prereq 136 or ‡) Warnken

140. Social Psychology. Survey of theories and evidence. Effects of other persons, mass communications, social class, and group membership upon the individual's attitudes and behavior. (3 cr; prereq 2, 5, and 9 cr in social science) Miller

144-145.† Abnormal Psychology. Normal and abnormal behavior contrasted. Dynamics and determinants of personality maladjustments. (3 cr per qtr; prereq 9 cr or 6 cr plus Biol 2 or 12 cr in a social science) Phillips

147. Advanced Advertising Procedure. (Same as Mktg 147) Problems in advertising research, stressing both traditional and more recent techniques such as motivation research. (3 cr; prereq 156) Longstaff

148. Fundamentals of Physiological Psychology. Physiological and neuroanatomical mechanisms underlying behavior of higher vertebrates. Sleep, wakefulness, and attention processes. Effects of drugs on behavior. (3 cr; prereq 2, 5 or Biol 2 or ‡) Roberts

149. Neuropsychology of Motivation and Learning. Brain mechanisms of aggression, fear, pain, hunger, thirst, reproductive behavior, learning, and discrimination processes. (3 cr; prereq 148 or ‡) Roberts

150. Perception. Critical analysis of methods of investigation and data obtained in study of selected problems of perception: psychophysical methods, form perception, space perception, constancy, spatially co-ordinated behavior and attention. Emphasis primarily but not exclusively on visual perception. (3 cr; prereq 55, 70 or ‡) Pick

151. Animal Psychology. Historical, philosophical, and biological foundations; consciousness; motivation; learning; reasoning; judgment; abnormal behavior; social influences. (3 cr; prereq 2, 5 or equiv in another science) Roberts

156x. Psychology of Advertising. Psychological analysis of basic principles underlying advertising and selling. Consumer research is stressed. Research techniques for investigating advertising problems and analysis of consumer wants. (3 cr; prereq 2 and principles of economics) Longstaff

160x. Psychology in Personnel Work. Selection and retention of a stabilized personnel. The standardized interview; principles and technique of employment tests; methods of judging character qualities; rating scale; personnel classification methods; morale and its measurement. (3 cr; prereq 2, 5 or 3 cr in statistics, and principles of economics or ‡) Longstaff

161. Psychology of Individual Behavior in Industry. The measure of individual differences and applications of such measurements to problems of human behavior in industry. Employee selection and placement, training and personnel development, employee motivation and morale, and human factors in design of production systems. (3 cr; prereq 70 or 3 cr of statistics) Dunnette

162. Social Psychology of Organizations. Survey of theoretical and methodological issues in study of dyads and small groups in organizational environments. Social processes as constraints on organizational functioning. Experimental approaches to study of group processes in organizational settings. (3 cr; prereq 9 cr) Weick

163. Behavior of Organizations. Theory, simulation, and observation of intergroup and organizational processes. Survey of central concepts of organization, and critical analysis of underlying behavioral assumptions. (3 cr; prereq 162) Weick

168. Quantitative Methods in Psychology. Elementary set theory, probability theory, matrix algebra, difference equations, with applications to construction and evaluation of behavior models. (3 cr; prereq ‡) Yellott

169. Quantitative Models for Learning. Introduction to mathematical models for learning: stochastic operator models, stimulus sampling theory, models for stimulus detection and recognition. (3 cr; prereq 168 or ‡) Yellott

171-172†-173. Clinical Psychology. Theory and practice of personality appraisal, especially of deviant individuals and in a psychiatric context. Diagnostic interview and mental status; history taking; behavior ratings; psychological deficit; prediction; structured personality tests. (3 cr per qtr; prereq 145 and a course in mental measurement or statistics) Meehl, Meier, Schofield

190x.* **Project in Psychology.** Individual library study or experimental investigation. (Cr ar; prereq ‡) Staff

200. History of Psychology. Historical development of major movements and issues in psychology. Significant major European and American trends exemplified by selected readings from primary sources. (3 cr; prereq grad standing in psychology, educational psychology, or child psychology, or ‡) Russell

205. Introduction to Psychopharmacology. Lectures on basic principles of experimental psychology and pharmacology as they apply to basic drug-behavior research. (2 cr; prereq 1 course in each of the following: organic chemistry, physiology, experimental psychology and ‡) Thompson, Heistad, and Pharmacology staff

206. Seminar in Psychopharmacology. Selected topics in drug-behavior research. (1 cr; prereq 205 and ‡) Thompson, Heistad, and Pharmacology staff

207-208-209. Advanced Social Psychology. Discussion of theory and research concerning social influence processes. (2 cr per qtr; prereq ‡; offered 1966-67 and alt yrs) Weick, Miller, Walster

210,* 211,* 212.* **Research Problems.** (Cr ar) Graduate staff

213. Seminar: Philosophical Psychology. (3 cr; prereq course in logic or philosophy, Ph.D. candidate in psychology, ‡) Meehl

215, 216, 217. Seminar: Special Areas of Psychology and Related Sciences. Based on a syllabus of required and optional reading. Offered irregularly according to announcements in Official Daily Bulletin. (Cr ar)

218-219-220. Practicum in Rehabilitation Counseling Psychology. Counseling experience with physically and emotionally disabled clients in approved public and private rehabilitation agencies. (3 cr per qtr; prereq 137 and ¶234, or ‡) Lofquist, Matthews, Warnken

221, 222, 223. Seminar: Personality Research. Theoretical and methodological problems in contemporary research concerning the psychology of personality. (Cr ar; prereq ‡) Garmezy and staff

224, 225, 226. Seminar: Advanced Clinical Child Psychology. Topics and problems including brain dysfunction; parent personalities of disturbed children, among other disorders. (1 cr per qtr; prereq ‡) Hafner, Quast

227-228-229. Seminar: Vocational Rehabilitation Counseling. Topics and problems in vocational counseling of disabled and hospitalized persons. Specific disabilities and vocational implications. Role and responsibilities of the rehabilitation counselor. (1 cr per qtr; prereq ‡) Warnken

230, 231, 232. Field Work in Applied Psychology. (Cr ar; prereq written permission of inst) Berdie, Darley, Lofquist, Longstaff, Schofield, Warnken, Wirt, others

234. Case Analysis in Counseling Psychology. Analysis of interview, personal history, and test data as they affect hypothesis making in the counseling process. (3 cr; prereq 137 or ‡) Lofquist, Warnken

235-236-237. Counseling Psychology Practicum. Experience in use of psychological and related methods in dealing with individuals. (1-3 cr per qtr; prereq 137 and ‡) Berdie, Snoxell, others

240, 241, 242. Seminar: Student Personnel Work. Topics and problems relating to content, development, and co-ordination of comprehensive student personnel programs. (1 cr per qtr; prereq ‡) Williamson

243. Experimental Psychodynamics. Application of experimental methods to problems emphasized by the rise of clinical psychology. Relation of certain clinical concepts to learning and motivational theory. (3 cr; prereq 145 and 129 or 117 or ‡)

246. Psychoanalytic Theory. Discussion of classical psychoanalysis. (3 cr; prereq 145, 172)

247, 248, 249. Seminar: Mathematical Behavior Theory. Foundations of mathematical behavior theory; current research. (3 cr; prereq ‡) LaBerge, Yellott

250-251-252. Advanced Seminar: Vocational Rehabilitation Counseling. Advanced topics, research, and special disability problems in vocational counseling of disabled and hospitalized persons. (1 cr per qtr; prereq 229) Lofquist

253, 254. Research in Psychopathology. Review of theoretical and empirical status of specific areas in psychopathology; determinants of behavior disorder. (3 cr per qtr; prereq 145 or equiv, 1 yr grad study or ‡) Garmezy

255-256.† Experimental Psychopathology. Theory and research in psychopathology; critical evaluation of current experimentation in various behavior disorders. (3 cr per qtr; prereq CD 210-211-212 or ‡) Garmezy

257-258-259. Research Methods in Social Psychology. Discussion of research techniques in social psychology; critical examination of existing laboratory and field studies; participation in design and execution of original research. (3 cr per qtr; prereq ‡; offered 1967-68 and alt yrs) Weick, Miller, Walster

260-261-262.† Seminar: Industrial and Organizational Psychology. (2 cr per qtr; prereq 1 yr grad work or ‡) Dunnette

265-266-267. Seminar: Advanced Clinical Psychology. A practicum in diagnosis and evaluation of personality traits and structure in relation to occupational and social roles. (1 cr per qtr; prereq advanced statistics, 172, ‡; offered when feasible) Hathaway

270x. Advanced Psychological Measurement. Same as Psy 70, but graduate students must satisfy additional requirements by writing reports on advanced psychometric topics. (3 cr)

275-276-277. Seminar: Research in Counseling Psychology. Presentation and discussion of research being conducted by University personnel workers. Proposed, completed, and research in process. (1 cr per qtr; prereq ‡) Campbell

278-279-280. Marriage Counseling. History and development; theories of marital interaction; the clientele; the counselor as a person; diagnoses and use of tests and measurements; interviewing techniques; outcome variables. (3 cr per qtr; prereq ‡ and adviser) Neubeck

281, 282, 283. The Social Psychology of Marriage. (Same as Soc 281, 282, 283) (Cr ar; prereq ‡) Neubeck, Hey

284-285-286. Seminar: Psychology of Language. (3 cr per qtr; prereq ‡) Jenkins

292A, B, C. Professional Methods in Clinical Psychology I: Assessment. Presentation of theory and practice in clinical application of assessment techniques. Observation, administration, scoring, and interpretation is the focus of the laboratory experience. (4 cr per qtr; prereq students in clinical psychology program or ‡, ¶171-172) Butcher, others

293A, B, C. Professional Methods in Clinical Psychology II: Theories of Intervention. Lectures and demonstrations of contemporary theories of individual and group methods of psychological intervention in psychiatric and related disorders. (4 cr per qtr; prereq 292 or ‡) Meehl, others

294A, B, C. Professional Methods in Clinical Psychology III: Techniques of Intervention. Lectures, demonstrations, and supervised experience in the application of techniques in individual and group treatment methods with psychologically disturbed persons. (4 cr per qtr; prereq 293 or ‡) Meehl, others

296x. Internship in Clinical Psychology. (2-4 cr per qtr; prereq PhD candidate in clinical psychology program and permission of director of clinical psychology training program) Clinical Psychology staff

299. Tabulating Equipment Laboratory. Use of electric tabulating machines in treatment of research data. (1 cr; prereq PubH 110, 111, or equiv)

PUBLIC ADMINISTRATION

Professor
Orville C. Peterson
Albert H. Rosenthal
George A. Warp, *director and director of graduate study*

Assistant Professor
James E. Jernberg

Prerequisites—Courses in public administration are open to all regularly enrolled graduate students who can meet course prerequisites as stated in the

Class Schedule. Candidates for graduate degrees are accepted from a wide range of disciplines. A liberal education with emphasis upon the social sciences or a professional education in some field of recognized importance in government service is deemed most desirable as preparation for graduate study in public administration.

Master's Degree—Individually planned courses of study designed to prepare persons for administrative positions in the several fields of government service—national, state, and local—and leading to the degree of master of arts in public administration are offered to qualified graduate students with the approval of the graduate faculty of the Public Administration Center. Candidates will be expected to fulfill the general requirements of the Graduate School for the Master's degree under either Plan A or Plan B with the following exceptions:

Course of Study—In place of the regular major and minor requirements, an individual program of study, including courses drawn from one or more departments, will be planned for each student, in consultation with members of the graduate faculty. All candidates, however, must enroll in the graduate seminar in public administration (PA 270A-B-C). Candidates for the degree under Plan A must receive a grade of B or better in at least two-thirds of their course work and a grade not lower than C in all other courses offered for the degree.

Internships—Internships in appropriate governmental departments or agencies—national, state, or local—will be arranged for students who desire them.

Other Requirements—Candidates for this degree must have a reading knowledge of a foreign language or a working knowledge of the principles of governmental accounting or statistics. A foreign language is recommended for those who expect to do further graduate study. Routinely acceptable languages are French, German, and Spanish.

Examinations—All candidates will be required to pass a final comprehensive written examination in public administration and a final oral examination covering all course work offered for the degree and the thesis.

For further information concerning graduate work in public administration see the special bulletin, *Graduate Study in Public Administration,* or write to the Public Administration Center, University of Minnesota, Minneapolis, Minnesota 55455.

210. Foundations of Public Administration. Political and governmental factors which condition the structure and functioning of public administration in the United States. (3 cr) Jernberg

217.° Administrative History. Origins and development of administrative institutions and practices. Applicability of historical research to current adminstrative problems. (3 cr; prereq 270A or equiv) Warp

224.° Social Welfare Administration. Critical analysis of administration of social welfare programs; development of Social Security Act, intergovernmental context of administrative issues and problems, relation of program concepts to administrative feasibility, and accommodation of social welfare programs to general management functions of government. (3 cr) Rosenthal

240. Development Administration. Administration of economic, social, and political development; planning, organizing, and programming of change; technical assistance, synergistic interaction between government and industry, loans and subsidies, contracts, public enterprise; resources administration. (3 cr)

244.° Agricultural Administration. Contemporary administrative theories and processes applied to planning, organization, management, and evaluation of public agricultural programs, especially in developing countries. (3 cr; prereq 270A or equiv, ‡) Blackmore

247. Urban Development. Role and methods of the urban administrator in effecting change and in mobilizing both public and private community resources for urban development. (3 cr; prereq 280A or ‡)

265.° Intergovernmental Administrative Relations. Seminar examination and analysis of the evolution of intergovernmental relations in the United States and of special administrative problems and issues—with particular attention to the fields of housing, urban development, health, education, and welfare. (3 cr; prereq ‡) Rosenthal

270A.° Public Administration Seminar: Organization Theory and Administrative Behavior. Factors conditioning organization; theories of organization; models and typologies, leadership, authority, and decision making; communication; automation, operations research, and management systems. (3 cr; prereq △) Warp

270B.° Public Administration Seminar: Finance. Role of fiscal planning and management in the administrative process; organization for financial administration; revenue estimating and administration; budgetary theory; the budget process—planning, authorization, expenditure control; accounting and auditing; treasury management and debt administration; procurement; intergovernmental fiscal relations. (3 cr; prereq △) Jernberg

270C.° Public Administration Seminar: Personnel. Modern bureaucracies; history and background of personnel policy and administration in the United States; legal foundation and organization; position classification and compensation; recruitment and selection process; training; employment policies and morale; employee relations and organization; retirement systems. (3 cr; prereq △) Rosenthal

273.° Topics in Development Administration. Advanced analysis of selected topics. (3 cr; prereq ‡)

275.° Seminar: Comparative Public Administration. Examination of approaches to study of comparative public administration; critical analysis of methodological studies; development and testing of hypotheses from empirical data concerning several governments. (3 cr; prereq ‡)

278.° Administrative Law. Ethics in administration, executive control, legislative oversight, judicial review, administrative procedure, research. (3 cr; prereq ‡) Warp

280A.° Seminar: Local Administration. Intensive study of program development and administration; functions of law enforcement, traffic, fire, health and hospitals, welfare, parks and recreation, education and libraries, public works, public utilities, planning, housing, and urban renewal. (3 cr) Peterson

280B.° Seminar: Local Administration. Administrative relationships and processes in local government; accountability of administration; administrative measurement; personnel and financial administration; purchasing and contracting; legal service, administrative planning and research; reporting and public relations. (3 cr; prereq ‡) Peterson

281.° Law and Urban Affairs. Selected concepts, procedures, and other aspects of local government law of particular concern to local administrators and others interested in conduct of urban affairs. (3 cr) Peterson

282A-B-C.° Administrative Internship. Supervised field work in an approved local, state, or federal government agency; preparation of an acceptable formal report. (Cr ar; prereq △) Rosenthal or Jernberg

283A. Research Seminar: Public Administration. Examination of research methods and techniques. (3 cr; prereq ‡)

283B-C.° Research Seminar: Public Administration. Identification of research needs in an area of public administration; selection of a topic, development of a research design, collection of data, and preparation of a substantial report. (3 cr per qtr; prereq ‡)

284A-B-C. Individual Reading and Research in Public Administration. (3 cr per qtr; prereq #) Staff

Note—Credit in public administration may be granted for some courses offered in political science and in certain other disciplines.

PUBLIC HEALTH**

Professor
Gaylord W. Anderson, M.D., Dr.P.H., *director*
Richard G. Bond, M.S., M.P.H.
Donald W. Cowan, M.D., M.S.
Ruth E. Grout, M.P.H., Ph.D.
George S. Michaelsen, M.S.
Marion I. Murphy, M.P.H., Ph.D.
Theodore A. Olson, M.A., Ph.D.
Harold J. Paulus, M.S., Ph.D.
Leonard M. Schuman, M.D., M.S.
James W. Stephan, M.B.S.
Conrad P. Straub, M.C.E., Ph.D.
Stewart C. Thomson, M.D., M.S., M.P.H.

Associate Professor
Eleanor M. Anderson, M.P.H.
Allyn G. Bridge, M.D., M.P.H.
John O. Buxell, M.S., M.P.H.
Harry Foreman, M.D., Ph.D.
Velvl W. Greene, M.S., Ph.D.
Ruth von Bergen, M.P.H.
George E. Williams, M.D.

Assistant Professor
Clare L. Blanchard, M.P.H.
Norman A. Craig, M.P.H.
Delphie J. Fredlund, M.P.H.
Rita A. Kroska, M.S., M.P.H., Ph.D.
Marie J. McIntyre, M.S., M.S.(Hyg.)
Alma G. Sparrow, M.S., M.P.H.
Ruth Edna Stief, M.P.H.

Lecturer
Henry Bauer, Ph.D.
William A. Jordan, D.D.S., M.P.H.
Lee E. Schacht, Ph.D.

Language Requirement—For the Master's degree, knowledge of a foreign language may be waived on recommendation of the adviser. For the Ph.D. degree, reading knowledge of two foreign languages or of one foreign language and option of a special research technique or a collateral field of knowledge. Acceptable languages are: French, German, Norwegian, Russian, Spanish, or Swedish.

Minor—For the Master's degree, PubH 100A, B, and C and courses in statistics and either epidemiology or public health administration.

For the Ph.D. degree, PubH 100A, B, and C and 20 additional credits selected on the basis of the candidate's field of major study.

Master's Degree—Offered under both Plan A and Plan B. All candidates for this degree must take PubH 100A, B, and C.

Public Health Nursing—Programs under Plan B have public health (including public health nursing) as the major with social science as one related field and the other selected with reference to the student's specific goal. These programs admit qualified nurses with interest in supervision, teaching, or advanced practice. Emphasis in mental health, long-term patient care and rehabilitation, or school nursing is available.

Doctor's Degree—Work leading to the Ph.D. degree is offered for majors in biometry, environmental health, epidemiology, hospital administration, and

** Inquiries concerning other work in public health, including courses of study leading to the degrees of M.P.H., master of public health, and M.H.A., master of hospital administration, should be addressed to the Director of the School of Public Health, 1325 Mayo Memorial Building, University of Minnesota, Minneapolis, Minnesota 55455.

physiological hygiene. For further information on these programs, see the index reference.

100A. Elements of Public Health I. Occurrence and prevention of communicable, degenerative, and industrial diseases; protection of food, water, and milk; maternal and child health. (3 cr; prereq 3, or 50 and a course in bacteriology) G Anderson, Thomson, Schuman

100B, C. Elements of Public Health II and III. Group work on selected public health problems. (2 cr for B, 1 cr for C; prereq 100A) Staff

102.° Environmental Health. Methods for promoting man's health and comfort by controlling environment. (3 cr; prereq ‡) Bond, Buxell, Olson

102A. Environmental Health. General principles of urban and rural sanitation; problems encountered by official health agencies. (2 cr; prereq 100A or ¶100A and ‡) Bond, others

103. Public Health Bacteriology. Bacteriologic and serologic diagnosis, public health laboratory administration and methods. (Cr ar; prereq MicB 102, 116, ‡) Bauer

104.° Epidemiology I. Basic epidemiologic principles applicable to infectious and noninfectious disease; host-agent-environment complex; factors underlying spread of infectious disease; laboratory applications of statistical and epidemiologic methods. (3 cr; prereq 100A, 140, 180 or 110A-111A) Schuman

105.° Epidemiology II. Extension of epidemiologic principles to detailed study of selected diseases. (3 cr; prereq 104) Schuman

106.° Public Health Administration. Structure, basic functions, and activities of public health agencies. (3 cr; prereq 100A) G Anderson

107. Maternal and Child Health. Health needs and services for mothers and children in public health programs. (3 cr, §107A; prereq MD, DDS, nurses, or ‡, ¶100A) Bridge

107A. Maternal and Child Health Program. Community programs for major maternal and child health problems. (1 cr, §107; prereq hospital administrators and ‡) Bridge

108. Introduction to Statistical Decision Making in Management. Variation, frequency distribution; probability; significance tests; estimation; trends. Statistical approach to rational administrative decision making. Lectures and laboratory. (2 cr) Bearman, Weckwerth

109.° Institutional Sanitation. Sanitation practices in hospitals and other institutions. (3 cr; prereq hospital administrators or ‡ and 100A) Bond, Michaelsen

110A. Biometry I. (Formerly 110) Basic concepts in probability; binomial, Poisson and normal probability models; testing statistical hypotheses and estimation of parameters of probability models. (3 cr; prereq ¶111A, Math 10 or ‡) Bartsch

111A. Biometry Laboratory I. (Formerly 111) Application of concepts of probability to the development of probability models for random phenomena in the biological and medical sciences. (2 cr; prereq ¶110A) Bartsch

112A, B, C.° Public Health Engineering—Plan Examinations. 112A: Water supplies. 112B: Waste disposal systems. 112C: Swimming pools and plumbing. (1 cr per qtr, §114; prereq engineering degree, 102, and ‡) Bond, Buxell

113A, B, C.° Public Health Engineering—Field Investigations. 113A: Water supplies. 113B: Waste disposal. 113C: Swimming pools and plumbing. (2 cr per qtr, §114; prereq engineering degree, 102, and ‡) Bond, Buxell

114. Environmental Health Programs. Public health supervision of activities in urban and rural sanitation. (3 cr, §112, §113, or §116; prereq ‡) Bond, Buxell

115.° Food Sanitation. Sanitary problems in production, processing, and distribution of milk, meat, shellfish, and other foods; methods of public health supervision. (3 cr; prereq 100A and ‡) Olson

115A. Institutional Food Protection Programs. Public health implications in design, construction, and installation of food service equipment; sanitary controls in food preparation and service; regulatory controls by official public health agencies. (2 cr; prereq ‡) Bond

116.* Public Health Engineering Administration. Administrative organization of environmental health activities. (2 cr, §114; prereq ‡) Bond

117A, B, C.* Sanitary Biology. Plant and animal forms important in environmental sanitation, with special reference to disease vectors. (3 cr per qtr; prereq 100A or ¶100A or ‡) Olson

122. Public Health Administration Problems. Budgeting, program planning, and appraisal of public health procedures. (3 cr; prereq 106) G Anderson

123.* Topics in Public Health. Selected readings and problems. (Cr ar; prereq ‡) Staff

125. Public Health Education. Planning educational components of community health programs; group procedures; community organization; methods and materials. (2 cr; prereq ‡) Grout, Craig

125A. Public Health Education. Purposes; scope; methods and materials; planning, with special emphasis on hospitals. (1 cr; prereq hospital administrators or ‡) Grout, Craig

132. Mental Health Program. Community program for promotion of mental health and care of mentally ill persons. (1 cr; prereq 106 or ‡) Williams

133. Mental Health. Emotional factors underlying wholesome family relations or interfering with successful adjustment in family and community. (3 cr; prereq ‡) von Bergen, Williams

135. Conservation of Hearing. Detection, prevention, and amelioration of hearing impairments. (1 cr; prereq ‡) Boies and staff

136. Handicapped Children. Prevention and rehabilitation of handicapping conditions affecting children. Community activities related to emotional, physical, and intellectual handicaps. (Cr ar; prereq 107 and ‡) Bridge

137. Dental Health. Conditions resulting in tooth decay and loss; preventive and corrective measures; mouth hygiene; community programs for dental health. (1 cr; prereq ‡) Jordan

138. Hospital Engineering Problems. Application of environmental engineering, sanitation, and maintenance principles and techniques with reference to effective planning, administration, and operation of hospitals. (Cr ar; prereq ‡) Bond, Michaelsen, and staff, visiting lecturers

139. Advanced Field Practice in Public Health Nursing: Mental Health. Opportunity for increasing competence in public health nursing practice including use of behavioral and mental health concepts; seminar analysis concurrent with experience with public health nursing patients including psychiatric patients. (Cr ar; prereq ‡) von Bergen

140.* Vital Statistics I. Official sources; population changes; rates; trends; significant differences. (3 cr) Bearman

141. Social and Economic Aspects of Medical Care. Social and economic forces affecting administration and financing of medical care; sickness insurance, group hospitalization; concern of government in provision of medical care. (Cr ar; prereq ‡) Litman

145. Low Level Radioactivity and Radiation Measurements. Advanced isotope techniques designed for assay of low levels of radioactivity in environmental samples. Includes use of gamma spectrometry, liquid scintillation spectrometry, and low background anticoincidence beta counters. (3 cr; prereq ‡)

146. Radiological Health II. Biological effects of radiation covering radiation biochemistry, acute radiation syndrome, chronic effects, cellular and hematological aspects and mutagenic properties of radiation. (3 cr; prereq ‡)

147.* Environmental Radioactivity. Measurement, evaluation, and control of environmental radioactivity with special emphasis on radiation to the general population. Includes natural radioactivity, fallout, reactor environs, radioactive wastes, and radiation ecology. (3 cr; prereq ‡)

149. Public Health Aspects of Housing and the Residential Environment. Principles of healthful housing and their application in community planning and development. (3 cr; prereq ‡) Buxell

150A. Vital Statistics II. Demographic techniques and statistical inference for public health majors. (3 cr; prereq 140 with grade of B) Thornton

151. Health Aspects of Air Control in Hospitals. Basic considerations in control of natural and mechanical air flow in hospitals to avoid spread of infection, to control odors, and to promote patient care. (2 cr; prereq ‡) Michaelsen

152.° Industrial Hygiene Engineering. Field and laboratory methods used by industrial hygiene engineers in study and control of occupational health hazards. (3 cr; prereq ‡) Michaelsen

154.° Radiological Health I. Orientation in radiation effects and study and control of radiation hazards in laboratories, hospitals, and industrial plants. (Cr ar; prereq ‡)

155.° Introduction to Air Pollution Problems. (3 cr; prereq ‡) Paulus

156.° Air Pollution Surveys. Public health engineering phases of air pollution surveys. (2 cr; prereq 155 and ‡) Paulus

157. Radiation Protection Criteria for Hospital Design and Operation. Radiation protection methods in design, shielding, equipping, and operation of a radioisotope laboratory, X-ray, and other ionizing radiation facilities. (2 cr; prereq ‡) Michaelsen

158. Hospital Safety. Theories and practices in accident and fire prevention and control for hospitals and other medical care facilities. (3 cr; prereq ‡) Michaelsen, Scheffler

159. Chemical Laboratory Safety. Principles of accident and fire prevention in chemical laboratories. (1 cr; prereq ‡) Scheffler

160. Principles of Administration in Hospitals. Lectures, seminars, and field trips in hospital administrative principles; top management and board of trustees, policy formation, human relations. (6 cr) Stephan

161. History and Development of Hospitals. Functions; ownership and control; promoting and building new hospitals; integrated service; national associations and foundations. (3 cr) Stephan

162-163. Principles of Organization and Management of Hospitals. Departmental structures and functions; organizational principles and practice. (3 cr for 162, 6 cr for 163) Stephan

164. Principles of Organization and Management of Hospitals. Personnel department; legal liability; fiscal management, hospital insurance, research in administration. (6 cr; prereq 162, 163) Stephan

166. Hospital Clerkship. Assignment to local hospital for survey or solution of special problem. (5 cr)

167. Management Problems in Hospital Administration. Assignment and solution of specific managerial problems. (6 cr; prereq 162, 163, ¶164)

168. Orientation to Medical Sciences. Medical terminology, applied anatomy and physiology. (3 cr; prereq ‡) Thomson

169. Administrative Residency. Field work of 1 calendar year's duration in approved hospital; weighted rotation through departments, solution of special problems and preparation of an acceptable formal report. (Cr ar) Stephan

170. Administration of Public Health Nursing. Interpretation of background and trends in public health nursing; analysis of staff and supervisory practice. (2 cr, §170A; prereq health officers, others ‡) Murphy

170A. Administration of Public Health Nursing. Scope; relationship to other aspects of public health. (1 cr, §170; prereq ‡) Murphy

171°-172.° Studies in Public Health Nursing. Orientation to research methodology; design and completion of a project. (3 cr per qtr; prereq 140) Murphy, Kroska, Sparrow

173. Culture and Public Health I. Intensive introduction to characteristics of culture and their implications for the health worker; adaptations to public health nursing. (3 cr; prereq ‡) Kroska

174. Foundations of Public Health Nursing I. Theory and analysis of the communication process in the one-to-one relationship. Seminar for application of communication and socio-cultural concepts to public health nursing. Selected experience with patients. (3 cr; prereq ¶173) Murphy and associates

175. Foundations of Public Health Nursing II. Psycho-social development and the dynamics of behavior. Seminars for analysis of nurse-patient interaction in student interviews. (4 cr; prereq 174) Williams and associates

176A-B-C. Clinical Seminar: Public Health Nursing. Opportunity for increasing competence in public health nursing practice through experience with patients and families in a community agency under faculty guidance; analysis of behavioral and mental health concepts in concurrent seminar. (3 cr per qtr; prereq 175) Public health nursing faculty

177. Nursing in Family Health and Illness: Contemporary Concepts. Examination of philosophy relative to nursing care and health guidance of patients and families from the antepartal through the geriatric periods. Opportunities provided to study current and developing community programs, including related research. (3 cr; prereq 175) E Anderson, Fredlund

178A. The Public Health Nursing Practitioner. Selected experiences in the staff nurse role in a public health agency under faculty guidance; organization of patient care services; interpretative role of public health nurse. (Cr ar; prereq 176, ‡) Sparrow

178B. Introduction to Supervision in Public Health Nursing. Philosophy and basic concepts; application to role of supervisee; adaptation to leadership of nursing team in community agencies. (Cr ar; prereq 176, ‡) Sparrow

179A. Long-Term Patient Care and Rehabilitation. Nursing problems associated with rehabilitation; selected experiences correlated with seminars. (Cr ar; prereq 171, 174) E Anderson and associates

179B. Long-Term Patient Care and Rehabilitation. Independent study. Exploration of a comprehensive multidiscipline approach in the continuity of care for long-term patients. (Cr ar; prereq 179A) E Anderson

180. Introduction to Biometry. Variation; frequency distribution; probability; estimation; significance tests; binomial, normal, Poisson distributions; serial dilutions; most probable number. (6 cr; prereq environmental health students only, others ‡) Boen

181A, B, C. Principles and Methods in Public Health Education. Role of public health educator; group procedures; community organization; communication theory; methods and materials; program planning and evaluation; community surveys; concurrent field practice in health education. (4 cr per qtr; prereq ‡) Grout, Craig

185. Air Analysis. Laboratory and field exercises on problems involving industrial hygiene and air pollution. Exercises include air flow measurement, calibration of instruments, analysis of different gases, stack sampling, dust counting and sizing, and industrial plant visits. (3 cr; prereq 152 or 155, ‡) Paulus

186. Problems of Air Pollution Control. Special supervised studies involving laboratory and field investigation procedures; pertinent literature review. (Cr ar; prereq 155, ‡) Paulus

189. Field Work in Public Health Nutrition. Placement in an approved agency with opportunity for experience in various facets of public health nutrition programs. (Cr ar; prereq ‡) Stief and associates

190. Field Work in Public Health Education. Supervised field experience. (Cr ar; prereq 183, 227) Grout, Craig

191.* Applied Human Nutrition. Food composition and standards of nutrient requirements. Methods in dietary and nutritional status surveys. Applications of nutrition to public health programs related to specific diseases and population groups. (3 cr; prereq ‡) J Anderson, Grande, Stief

195. Public Health Aspects of Cardiovascular Disease. Etiology, incidence, problems of control, and relationship to mode of life. (3 cr; prereq ‡) Keys, Grande, and staff

196.* Seminar: Public Health Nutrition. (Cr ar; prereq ‡) Stief

200. Research. Opportunities will be offered by the School of Public Health and by various co-operating organizations for qualified students to pursue research work. (Cr ar)

210. Seminar: Public Health. (Cr ar)

212.* Seminar: Public Health Engineering and Sanitation. (Cr ar; prereq ‡) Bond

213. Seminar: Epidemiology. (Cr ar; prereq ‡) Schuman

214. Health of School Age Child. Review of major health problems among children of school age; methods oi providing and evaluating school health services. (2 cr; prereq 107 or ‡) Bridge

215. Maternal and Child Health Problems. Problems in administration of health programs for infants, preschool and school age children, handicapped children, and women of child-bearing age. (3 cr; prereq 107 and ‡) Bridge

221. Seminar: Long-Term Patient Care and Rehabilitation. Exploration of multidisciplinary aspects; role relationships affecting patient care, review of current research findings. (Cr ar; prereq 179 or ‡) E Anderson and associates

222. Seminar: School Nursing and Related Field Practice. Exploration of nursing in the school setting; role relationships; review of current research. (Cr ar; prereq ‡) Murphy, Fredlund

223. Orientation to Teaching Public Health Nursing. Evolution of public health nursing within collegiate nursing education; rationale for the relationship; impact of various related developments. (3 cr; prereq ‡) Murphy, McIntyre

224. Seminar: Public Health Nursing Within the Curriculum. Course objectives: organization; opportunity to explore problems in development of plans for teaching public health nursing. (Cr ar; prereq ‡) Murphy, McIntyre

225. Practicum in Teaching Public Health Nursing. Planning for and evolution of instruction; selected field experiences and seminars. (Cr ar; prereq ‡) Murphy, McIntyre

226A. Clinical Seminar: Public Health Nursing—Mental Health. Opportunity for increasing competence in public health nursing practice including use of behavioral and mental health concepts and use of the nurse-patient relationship. Seminar analysis concurrent with experience with public health nursing patients. (Cr ar; prereq 175) von Bergen

226B. Concepts of Behavior in Psychiatric Illness. Etiology of mental illness, psychopathology involved, and current treatment. Opportunity for experience with patients in the state hospital and within the community after discharge. (Cr ar; prereq ¶226A) von Bergen and associates

226C. Concepts of Behavior in Children's Problems. Concepts and current information on child development and psychological problems in children, etiology, treatment, and prevention. Selected experiences for involvement with children and their families. (Cr ar; ¶226A) von Bergen and associates

227.* Problems in Public Health Education Programs. Independent study and experimentation in health education. (Cr ar; prereq ‡) Grout

230. Field Practice in Environmental Health. (Cr ar; prereq ‡) Bond

231. Ground Water Development. Development of ground water sources for public water supplies. Includes exploration through well design and construction. Public health problems involved. (Cr ar; prereq graduate engineer and ‡) Bond, Singer, staff, visiting lecturers

232. Field Work in Ground Water Development. Development of ground water sources; construction of wells, field tests, and public health problems. (Cr ar; prereq graduate engineer, 231) Bond, Singer, staff, visiting lecturers

233. Water Quality Investigation and Research Techniques. Field techniques and special research methods applicable to public health problems of water quality control. Procedures for establishing pollution base lines; appraisal and recognition of advancing eutrophication in surface and underground waters. (6 cr; prereq ‡) Olson, Odlaug

234. Water Quality Research. Design, logistical planning, and implementation of an independent, short-term research activity basic to water quality evaluation. Literature review, statistical design and data processing. Field testing of sampling and laboratory operations. (6 cr; prereq ‡) Olson, Odlaug

241.* Epidemiology of Noncommunicable Diseases. Application of basic epidemiologic principles to noncommunicable diseases and to trauma; selected disease examples. (3 cr; prereq 104) Schuman

280. Orientation to Supervision and Administration in Public Health Nursing. Application of principles; relationship of structure and philosophy of agency to supervisory role. (3 cr; prereq ‡, 175) Murphy, Blanchard

281. Problems in Supervision and Administration in Public Health Nursing. Analysis of selected aspects of administrative and supervisory process. (3 cr; prereq 280) Murphy, Blanchard

282. Practicum in Supervision or Administration in Public Health Nursing. Experience in selected aspects of supervision or administration in local agencies under faculty guidance. (Cr ar; prereq 280, 281) Blanchard

283. Seminar: Consultation. Opportunity for selected public health students to deepen understanding of the process involved in consultation. (2 cr; prereq ‡) Murphy and associates

285. Culture and Public Health II. Culture patterns and culture change. The dynamics of change and their implications for the health worker in developing and advanced societies. (3 cr; prereq ‡) Kroska

RADIOLOGY

For staff and courses of study offered, see the *Bulletin of the Graduate Programs in Medicine, Dentistry, and Pharmacy.*

RHETORIC

Courses Which Carry Graduate Credit When Program Related

141. Humanities Seminar: The Individual and Society. Examination of contemporary ethical and cultural values as manifested in such conflicts as: liberty and authority; freedom and organization; art and technology; science and religion. (3 cr; prereq 9 cr in humanities or ‡) Drake

147. Adult Reading Programs. Problems, methods, and research in this field. Survey and evaluation of program designs, including those suitable for TV. (2 cr; prereq EdCI 143 or 144 or ‡) J Brown

151. Report and Thesis Writing. Organization of reports and theses; library investigation; presentation of data; methods of documentation. Revision of manuscripts and improvement in writing style. (3 cr; prereq 51 or ‡) Thurston

169. Communication Problems and Processes. An analysis of contemporary communication theories and research. Problems of language, perception, and status in the application of communication theory to professional activity and growth. (3 cr; grad status or ‡) R Brown

251. Seminar: Listening Comprehension. (2 cr; prereq undergrad spch major, ‡) Nichols

ROMANCE LANGUAGES

Professor
Rodolfo O. Floripe
Walter T. Pattison, *chairman, director of graduate study (Spanish)*
Armand A. Renaud, *director of graduate study (French)*
Arturo Serrano-Plaja

Associate Professor
Claude Francis
Peter W. Lock
Richard A. Narváez
Arshi Pipa
Dorothy Rundorff
Joseph L. Waldauer

Assistant Professor
Russell G. Hamilton, Jr.
Lawrence C. Mantini

Prerequisites—For major work, 27 Upper Division credits or equivalent; for minor work, 18 Upper Division credits or equivalent.

Language Requirement—A candidate for the Master's degree must have a reading knowledge of at least one modern language other than the language of his major field (for majors in French: Spanish, Italian, or Portuguese; for majors in Spanish: French, Italian, or Portuguese). Candidates for the Doctor's degree must have a knowledge of Latin equivalent to at least 2 years of high school Latin; a reading knowledge of a second Romance language; and, by the end of the first year of graduate work, a reading knowledge of an additional foreign language, French, Spanish, Italian, Portuguese, German.

Master's Degree—Offered under both Plan A and Plan B.

Doctor's Degree—Offered in both French and Spanish.

Comparative Literature—For information on this program see page 127.

Romanic

114s. Introduction to Romance Philology. Origins of the Romance languages. Outline of factors that have influenced their growth and structure studied in significant early Catalan, French, Italian, Portuguese, Provençal, Roumanian, and Spanish texts. (3 cr; prereq Fren 30, or Ital 25, or Port 25, or Span 30 or ‡) Staff

207-208-209. Old Provençal. Literature; poetry of the troubadours. (2 cr per qtr)

230-231-232. Research Methods and Materials. (1 cr per qtr)

French

105s. French Stylistics. (3 cr; prereq 57 or ‡)

107f-108w-109s. Structure of Modern French. Application of linguistics to study of present-day French. (3 cr per qtr; prereq 57 or ¶57 or ‡) Mantini

110f. Rise of French Romanticism. (3 cr; offered 1967-68 and every 3rd yr)

111f. Nineteenth-Century Literature: The Drama. (3 cr; offered 1968-69 and every 3rd yr)

114s. Introduction to Romance Philology. See Romanic. (3 cr; prereq Fren 30, or Ital 25, or Port 25, or Span 30, or ‡)

121f. Pre-Renaissance and Pléiade Poetry. (3 cr; offered 1968-69 and every 3rd yr) Renaud

124w. Montaigne and Pascal. (3 cr; offered 1968-69 and every 3rd yr) Renaud

125f. Renaissance and Baroque Drama: Corneille and the Origins of the Classical Drama. (3 cr; offered 1967-68 and every 3rd yr) Renaud

126s. The Classical Tragedy: Racine. (3 cr; offered 1968-69 and every 3rd yr) Renaud

127f. Classical Comedy: Molière. (3 cr; offered 1966-67 and every 3rd yr) Renaud

128w. French Poetry from d'Aubigné to La Fontaine. (3 cr; offered 1966-67 and every 3rd yr) Renaud

129s. The Novel of the Seventeenth Century. (3 cr; offered 1967-68 and every 3rd yr) Renaud

130w. The Poetry of Victor Hugo. (2 cr; offered 1967-68 and every 3rd yr)

131f. Baudelaire and Parnassian Poetry. (3 cr; offered 1966-67 and every 3rd yr) Francis

132f. Symbolist Poets: Verlaine, Rimbaud, Mallarmé. (2 cr; offered 1967-68 and every 3rd yr) Francis

140w. The Novel of the Eighteenth Century. (3 cr; offered 1966-67 and every 3rd yr) Waldauer

141s. Eighteenth-Century Dramatic Literature. (3 cr; offered 1967-68 and every 3rd yr) Waldauer

142f. Voltaire. (3 cr; offered 1967-68 and every 3rd yr) Waldauer

143w. Diderot. (3 cr; offered 1967-68 and every 3rd yr) Waldauer

144f. Rousseau. (3 cr; offered 1966-67 and every 3rd yr) Waldauer

148s. The Drama of the Twentieth Century: Claudel, Giraudoux, Anouilh, Montherlant, Camus, Sartre. (3 cr; offered 1966-67 and every 3rd yr) Francis

149. French Dramatists of the Twentieth Century. The course reflects the variety of experimentation in the French theatre since Cocteau. (3 cr; prereq 30 and one literature course) Francis

150. Introduction to Formal Analysis. Outstanding literary texts from Middle Ages to 20th century. The course reveals how language, themes, and structure analyzed as a whole, in depth, lead to maximal appreciation of the beauty and significance of a great literary text. (3 cr; prereq 30 and one literature course)

153w. Balzac. (3 cr; offered 1968-69 and every 3rd yr) Lock

154s. Stendhal. (3 cr; offered 1967-68 and every 3rd yr) Lock

155w. Flaubert, Maupassant, and Narrative Techniques. (3 cr; offered 1967-68 and every 3rd yr) Lock

156w. Zola, Goncourt, and the Naturalistic Novel. (3 cr; offered 1968-69 and every 3rd yr) Lock

158w. Proust and the Novel of the Twentieth Century. (3 cr; offered 1966-67 and every 3rd yr) Lock

159. The Existential Novel. Novelists from the thirties to the present whose work reveals concern for "the human condition"—Malraux, Céline, Sartre, Camus, Blanchot, and Beckett. (3 cr)

161. Forms of the Novel in the Twentieth Century. Innovations in novelistic form, from Gide's *Les Faux-Monnayeurs* (1926) to novels of Nathalie Sarraute and Alain Robbe-Grillet. (3 cr)

162. Le Nouveau Roman. Representative French Novelists of the 50's. Includes the last existentialist novels and innovations of Nathalie Sarraute, Alain Robbe-Grillet, Michel Butor, and others. (3 cr; prereq 30 and one literature course)

165s. Poetry in the Twentieth Century: Appolinaire, Valéry, Eluard. (2 cr; offered 1968-69 and every 3rd yr) Francis

170. Rabelais. Gargantua and Pantagruel in the original text. (3 cr; prereq 30 and two literature courses, or ‡)

172. The Novel of L'Entre-Deux Guerres. (3 cr) Francis

175f-176w-177s. French Literary Doctrines from the Pléiade to the Present. (2 cr per qtr; offered 1968-69 and every 3rd yr)

201. Old French. (3 cr; prereq 1 yr Latin and 114 or ‡; offered 1966-67 and alt yrs)

202-203. French Literature in the Middle Ages. (3 cr per qtr; prereq 201; offered 1966-67 and alt yrs)

207-208-209. Old Provençal. See Romanic. (2 cr per qtr) Williams

210-211. French Seminar: History of "Sensiblité" in the Eighteenth Century through the Revolution. (3 cr per qtr) Waldauer

222. French Seminar: The Baroque in Sixteenth- and Seventeenth-Century Literature. (3 cr) Renaud

223. French Seminar: Religious Thought in the Seventeenth Century. (3 cr) Renaud

230-231-232. Research Methods and Materials. See Romanic. (1 cr per qtr)

250-251-252. French Seminar. Provides opportunity for guided research in materials for which regular graduate courses do not offer adequate scope. (Cr ar; offered when feasible) Francis, Lock, Renaud, Waldauer

259, 260, 261. Directed Readings in Romance Languages. (Cr depends upon amount of work accomplished)

Italian

114. Introduction to Romance Philology. See Romanic. (3 cr; prereq Fren 30, or Ital 25, or Port 25, or Span 30, or ‡)

150w. Modern Poetry (Leopardi, Carducci, etc.) (Formerly 71) (3 cr; prereq ††; offered 1966-67 and alt yrs) Pipa

155f. Modern Short Story (Verga, Pirandello, etc.) (Formerly 76) (3 cr; prereq ††; offered 1966-67 and alt yrs) Pipa

159f-160w. Dante. (3 cr per qtr; prereq one course above 50; students may enter either qtr with ‡; offered 1967-68 and alt yrs) Pipa

161f-162w. The Sixteenth Century. (3 cr per qtr; prereq one course above 50; offered 1966-67 and alt yrs) Pipa

164s. Dante in English. (3 cr; prereq ‡; offered when feasible) Pipa

172f. Modern Drama (Giacosa, Pirandello, etc.) (3 cr; prereq one course above 50; offered 1966-67 and alt yrs) Pipa

173s. Boccaccio. (3 cr; prereq one course above 50; offered 1967-68 and alt yrs) Pipa

174s. Petrarch. (3 cr; prereq one course above 50; offered 1966-67 and alt yrs) Pipa

175w-176s. The Italian Novel. 175: Manzoni's *Promessi Sposi*, Verga's *Mastro Don Gesualdo*, Fogazzaro's *Piccolo Mondo Antico*, Deleddo's *Elias Portolu*. 176: Four novels selected from the works of Svevo, Pirandello, Bacchelli, Palazzeschi, Silone, Moravia, Pratolini, Vittorini, Calvino. (3 cr per qtr; prereq one course above 50, ‡; offered 1966-67 and alt yrs) Pipa

180f. Early Italian Poetry: The Frederician Poets and the Dolce Stil Nuovo. Development of certain fundamental poetic forms (sonnet, *sestina, ballata, madrigale, canzone*). (3 cr; prereq 67 or ‡; offered when feasible) Pipa

185. Survey of Italian Literature. For students who wish to obtain a survey knowledge of Italian literature. The works may be read in translation if necessary. (3 cr, §66; prereq at least one upper division literature course in any dept, or ‡) Pipa

186. Survey of Italian Literature. For students who wish to obtain a survey knowledge of Italian literature. The works may be read in translation if necessary. (3 cr, §67; prereq at least one upper division literature course in any dept, or ‡) Pipa

259, 260, 261. Directed Readings in Romance Languages. (Cr depends upon amount of work accomplished) Pipa

Portuguese

114. Introduction to Romance Philology. See Romanic. (3 cr; prereq Fren 30, or Ital 25, or Port 25, or Span 30, or ‡)

259, 260, 261. Directed Readings in Romance Languages. (Cr depends upon amount of work accomplished) Hamilton

Spanish

105s. Spanish Stylistics. (3 cr; prereq 57 or equiv) Narváez

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†† The prerequisite is course 25 or consent of instructor; but for students beginning Italian in the Upper Division it may be course 3 or 50 with consent of instructor.

107f-108w-109s. The Structure of Modern Spanish. A scientific approach to the structure of present-day Spanish, with special attention to syntax, phonology, word formation, and dialectal differences. (3 cr per qtr; prereq 57 or ♯ or ¶57) Narváez

110f-111w-112s. Spanish Literature: Nineteenth Century. (3 cr per qtr; prereq 65, 66, 67; offered 1966-67 and alt yrs) Pattison

114s. Introduction to Romance Philology. See Romanic. (3 cr; prereq Fren 30, or Ital 25, or Port 25, or Span 30 or ♯)

115f. Spanish Literature of the Seventeenth Century: The Drama. (3 cr; prereq 65, 66, 67; offered 1967-68 and alt yrs) Serrano-Plaja

116w. Spanish Literature of the Seventeenth Century: The Novel. (3 cr; prereq 65, 66, 67; offered 1967-68 and alt yrs) Serrano-Plaja

117s. Spanish Literature of the Seventeenth Century: Poetry. (3 cr; prereq 65, 66, 67; offered 1967-68 and alt yrs) Serrano-Plaja

118. The Development of the Golden Age Drama from Torres Naharro to Calderón de la Barca. (3 cr) Serrano-Plaja

120. The Ballad. (3 cr; prereq 65, 66, 67; offered when feasible)

130f. Cervantes: Don Quijote. (3 cr; prereq 65, 66, 67; offered 1966-67 and alt yrs) Pattison

131w. The Picaresque Novel. (3 cr; prereq 65, 66, 67; offered 1966-67 and alt yrs) Rundorff

135. Don Juan Theme. (3 cr; prereq one upper division literature course or ♯) Rundorff

140f. Latin-American Literature: Poetry. Silva, Darío, Nervo, Chocano, Herrera y Reissig, Lugones, Agustini, Mistral, Ibarbourou, Storni, López Verlarde, and Neruda. (3 cr; prereq 65, 66, 67 or 76; offered 1968-69 and every 3rd yr) Floripe

141w. Latin-American Literature: Essay, Short Story, Drama. Rodó, González Prada, Ricardo Rojas, Blanco Fombona, Ugarte, Vasconcelos, Alfonso Reyes, Quiroga Gallegos, Florencio Sánchez. (3 cr; prereq 65, 66, 67 or 76; offered 1968-69 and every 3rd yr) Floripe

142s. Latin-American Literature: Novel. Gallegos, Azuela, Rivera, Güiraldes, Barrios, Gálvez, Lynch, Ciro Alegría. (3 cr; prereq 65, 66, 67 or 76; offered 1968-69 and every 3rd yr) Floripe

143f, 144w, 145s. Colonial and Nineteenth-Century Latin-American Literature. (3 cr per qtr; prereq 65, 66, 67 or 76; offered 1966-67 and every 3rd yr) Floripe

146f, 147w, 148s. Spanish-American Novel and Short Story. (3 cr per qtr; prereq 65, 66, 67 or 76; offered 1967-68 and every 3rd yr) Floripe

149. Contemporary Latin-American Novel. (2 cr; prereq one upper division literature course or ♯) Floripe

155f. Spanish Literature of the Sixteenth Century: The Novel. (3 cr; prereq 65, 66, 67; offered 1966-67 and alt yrs) Serrano-Plaja

156w. Spanish Literature of the Sixteenth Century: The Drama. (3 cr; prereq 65, 66, 67; offered 1966-67 and alt yrs) Serrano-Plaja

157s. Spanish Literature of the Sixteenth Century: Poetry. (3 cr; prereq 65, 66, 67; offered 1966-67 and alt yrs) Serrano-Plaja

Arab 161f-162w-163s. Hispano-Arabic Literature and Culture. (3 cr per qtr; prereq ♯)

169. Valera. (3 cr; prereq one upper division literature course or ♯) Rundorff

171. The Spanish Novel from Valera to Palacio Valdez. (3 cr; prereq one of the survey courses in Spanish literature) Pattison

172. Modern Spanish Novel (1900-1936). (3 cr; prereq one upper division literature course or ♯)

174f. Twentieth-Century Spanish Literature: Drama. Benavente, Martinez Sierra, Linares-Rivas, Alvarez Quintero, Valle Inclán, Marquina, Garcia Lorca, and Casona. (3 cr; prereq 65, 66, 67; offered 1967-68 and alt yrs) Pattison

175w. Twentieth-Century Spanish Literature: Prose. Unamuno, Azorín, Baroja, Valle Inclán, Ortega y Gasset, Pérez de Ayala, Gómez de la Serna. (3 cr; prereq 65, 66, 67; offered 1967-68 and alt yrs) Pattison

176s. Twentieth-Century Spanish Literature: Poetry. Juan Ramón Jiménez, Unamuno, Antonio and Manuel Machado, Valle Inclán, García Lorca, Alberti, Moreno Villa, Aleixandre, León Felipe, Guillén, and Salinas. (3 cr; prereq 65, 66, 67; offered 1967-68 and alt yrs) Pattison

180. The Eighteenth Century: Studies in the Principal Writers. Feijóo, Jovellanos, Cadalso, Moratín, and others. (3 cr; prereq 65, 66, 67)

182. Contemporary Spanish Novel (1935-1944). (3 cr; prereq one upper division literature course or ‡)

183. Contemporary Spanish Novel Since 1945. (3 cr; prereq one upper division literature course or ‡) Sullivan

185. Unamuno and the Existential Writers. (2 cr; prereq one upper division literature course or ‡)

186. Azorin. (2 cr; prereq one upper division literature course or ‡)

187. Un-Realism in the Spanish Theatre: Casona. (2 cr; prereq one upper division literature course or ‡)

188. Contemporary Spanish Theatre: 1939-1965. (3 cr; prereq one upper division literature course or ‡)

201. Old Spanish. (3 cr; prereq 1 yr Latin and 114 or ‡; offered 1967-68 and alt yrs)

202-203. Spanish Literature in the Middle Ages. (3 cr per qtr; prereq 201; offered 1967-68 and alt yrs)

230-231-232. Research Methods and Materials. See Romanic. (1 cr per qtr; offered 1967-68 and alt yrs)

250-251-252.° Spanish Seminar. (2 cr per qtr) Pattison, Rundorff, Serrano-Plaja

253-254-255.° Seminar: Latin-American Literature. (2 cr per qtr; offered when feasible) Floripe, Serrano-Plaja

259, 260, 261. Directed Readings in Romance Languages. (Cr depends upon amount of work accomplished) Staff

SCANDINAVIAN

Professor
Alrik Gustafson
Cecil Wood

Associate Professor
Nils Hasselmo
Marion Nelson

Assistant Professor
James A. Simpson

Prerequisites—For major work in Scandinavian languages and literatures, 27 credits in language and literature, 18 of which must be in Scandinavian, and reading knowledge of any one of the Scandinavian languages; for minor work, 18 credits in language and literature, 12 of which must be in Scandinavian.

In Scandinavian Area Studies, see special bulletin, *Programs in International Relations and Area Studies.*

Language Requirement—Candidates for the Master's degree in Scandinavian languages and literatures must have reading knowledge of one modern language other than the language of his major field. French or German would be acceptable.

Master's Degree—In Scandinavian, offered under both Plan A and Plan B; in Scandinavian Area Studies, only under Plan B.

Comparative Literature—For information on this program, see page 127.

Courses identified by the §§ symbol require no knowledge of the Scandinavian languages except for majors in Scandinavian.

118J, 119J, 120J. History of Scandinavian Countries. (3 cr per qtr, §Hist 118J, 119J, 120J) Oakley

121-122-123. Old Norse: Language and Literature. 121: Acquisition of reading knowledge of Old Norse (Old Icelandic). 122: Linguistic and literary study of texts from the Sagas and Eddas. 123: Extensive reading in the Saga literature. Comparative study of Old Swedish and Old Danish texts, including Runic inscriptions. (3 cr per qtr; prereq knowledge of 1 Germanic language other than modern English) Hasselmo

124. Structure of the Scandinavian Languages. A contrastive analysis of the phonology, morphology, and syntax of the modern standard languages. (3 cr; prereq knowledge of one Germanic language other than modern English) Hasselmo

125. History of the Scandinavian Languages. External and internal history of Scandinavian languages from Proto-Scandinavian to present. (3 cr; prereq knowledge of one Germanic language other than modern English) Hasselmo

126.* Seminar: Scandinavian Linguistics. Problems in synchronic and diachronic linguistics. (3 cr; prereq 124 and 125) Hasselmo

150.§§ Scandinavian Mythology. The study of Scandinavian myths based on the Poetic Edda and the Prose Edda. All readings in translation. (3 cr; offered 1967-68 and alt yrs) Hasselmo

151.§§ The Icelandic Saga. Literary study of the Saga literature, its origins and development. (3 cr; prereq 8 cr in literature; offered 1967-68 and alt yrs) Simpson

152.§§ Scandinavian Folklore. A literary and folkloristic investigation of the Scandinavian Ballad and Folk Tale. (3 cr; prereq 8 cr in literature or ‡; offered 1967-68 and alt yrs)

153.* Late Medieval and Renaissance Literature. Readings in the original of secular and religious literature from the 14th to the 17th century. (3 cr; prereq major or minor in Scandinavian, good knowledge of a Scandinavian language required; offered when feasible)

154.*§§ Holberg and the Period of the Enlightenment. Representative figures of 18th-century Dano-Norwegian and Swedish literature, with emphasis on the comedies of Ludvig Holberg and the songs of Bellman. (3 cr; prereq 8 cr in literature; knowledge of a Scandinavian language required for majors only; offered 1966-67 and alt yrs) Simpson

161.*§§ The Late Nineteenth-Century Scandinavian Novel. The "great tradition" in the modern Scandinavian novel, and the circumstances, intellectual and political, social and economic, out of which it grew. (3 cr; prereq 8 cr in literature) Simpson

162.*§§ Contemporary Trends in the Scandinavian Novel. Characteristic trends in Scandinavian life and thought in the 20th century as expressed in the prose fiction of Sigrid Undset, Johannes V. Jensen, Olav Dunn, Hjalmar Bergman, Pär Lagerkvist, Halldór Laxness, F. E. Sillanpää, and others. (3 cr; prereq 8 cr in literature) Simpson

171.*§§ Ibsen and the Beginnings of the Modern Drama. Intensive examination of the plays of Ibsen and his role as "founder" of modern European drama. (3 cr; prereq 8 cr in literature) Gustafson

172.*§§ Strindberg and the Drama in Revolt and Transition. Strindberg as master of the naturalistic drama and as "the father of modernity" in European and American theater. (3 cr; prereq 8 cr in literature) Gustafson

172G, 173G, 174G. Proseminar in Scandinavian History. (3 cr per qtr, §Hist 172G, 173G, 174G) Oakley

173.°§§ The Contemporary Scandinavian Theater. Emphasis on its "experimental" trends both in dramatic composition and staging. (3 cr; prereq 8 cr in literature) Gustafson

191-192-193. Readings in the Scandinavian Literatures. Intensive readings in representative texts—Danish, Norwegian, Swedish, or Finnish. (3 cr per qtr; prereq good reading knowledge of one Scandinavian language) Gustafson

205. Bibliography and Methods. Required of all graduate majors. (3 cr)

209-210-211.° Research in Scandinavian Linguistics. Guided research in synchronic and diachronic linguistics. (2 or 3 cr per qtr) Hasselmo

212-213-214.° Research in Scandinavian Literature. Guided research in a specific aspect of Scandinavian literature: a period, an author, a genre. (2 or 3 cr per qtr)

215-216-217.° Studies in Scandinavian Romanticism. (3 cr per qtr; offered 1966-67 and alt yrs) Gustafson

218-219-220.° Studies in Late Nineteenth-Century Scandinavian Literature. (3 cr per qtr; offered 1967-68 and alt yrs) Gustafson

221-222-223.° Dramatic Interpretative Problems in Strindberg. (3 cr per qtr) Gustafson

224-225-226.° Interpretative Problems in Ibsen. (3 cr per qtr) Simpson

240, 241, 242. Seminar: Studies in Scandinavian Art. (3 cr; prereq ♯) Nelson

Art 140. Scandinavian Architecture. (3 cr; prereq 9 cr in history of art or 9 cr in literature or history with △) Nelson

Art 141. Scandinavian Painting. (3 cr; prereq 9 cr in history of art or 9 cr in literature or history with △) Nelson

Art 142. Scandinavian Sculpture and the Minor Arts. (3 cr; prereq 9 cr in history of art or 9 cr in literature or history with △) Nelson

Ger 113. Gothic. (3 cr; prereq Ger 80 and 11 cr above Ger 69 or equiv; offered 1966-67) C Wood

Ger 114-115.† Methods of Comparative Germanic Linguistics. (3 cr per qtr; prereq Ger 113; offered 1966-67) C Wood

Phil 137.§§ Kierkegaard. Detailed examination of his major philosophical works. (3 cr; prereq one course from Phil 50-51-52 or ♯)

Pol 145.°§§ Government and Politics of the Scandinavian Countries. (3 cr; prereq 6 cr or 12 cr in social science)

Pol 146.§§ Social Legislation and Social Institutions in the Scandinavian Countries. (3 cr; prereq Pol 2 or 5 or Soc 1)

Soc 117.°§§ Scandinavian Folk Movements: Their Social and Political Significance. (3 cr; prereq Soc 1 or ♯)

SLAVIC AND EAST EUROPEAN LANGUAGES

Assistant Professor
Wassilij Alexeev
Marilyn J. Sjoberg

Instructor
Adele K. Donchenko

The following are offered as courses in a minor program or as related fields (in linguistics and comparative philology, area studies, comparative literature), but, for the present, no graduate degrees are offered.

Russian

Russ 103-104-105. Russian Syntax and Composition. For students with undergraduate majors in Russian. (2 cr per qtr; prereq 63 and facility in reading) Alexeev

Russ 107-108-109. Structure of Modern Russian. (3 cr per qtr; prereq 6 cr or ♯) Donchenko

Russ 110-111-112. Russian Literature in Translation. 110: Pushkin, Lermontov, Gogol. 111: Turgenev and Dostoevsky. 112: Tolstoy and the period from 1880. (3 cr per qtr; prereq 9 cr in literature...knowledge of Russian required only of majors who will read assigned portions in the original)

Russ 113-114-115. Soviet Russian Literature. Conducted entirely in Russian. (3 cr per qtr; prereq 58 or ‡) Alexeev

Slav 113-114-115. Old Church Slavic. Introduction to Slavic linguistics. Descriptive grammar of earliest Slavic texts and comparison of Old Church Slavic with other Indo-European languages. (3 cr per qtr; prereq Clas 56 or equiv; offered 1967-68 and alt yrs)

Russ 125-126-127. Structure and History of the Russian Language. Linguistic analysis of development of Russian language from time of earliest records to present. (3 cr per qtr; prereq 6 or equiv; offered 1968-69 and alt yrs)

Russ 131-132-133. Russian Poetry: Nineteenth Century. (3 cr per qtr; prereq 73 or ‡)

Russ 141-142-143. Dostoevsky. Analytic approach to study of the novel of Dostoevsky. (3 cr per qtr; prereq 9 cr in literature)

Russ 151-152-153. Directed Readings. (1-3 cr per qtr; prereq 73 or ‡)

SOCIAL WORK

Professor
Edward W. Francel
John C. Kidneigh, *director, director of graduate study*
Gisela Konopka
Anne W. Oren
Henriette E. Saloshin
Lyndell N. Scott
Dorothy A. Whitmore

Associate Professor
Miriam R. Cohn
Beulah E. Compton
Dolph Hess
Laurence F. Merl
Mayo K. Newhouse
Helen C. Yesner

Assistant Professor
Dagny Johnson
Franz X. Kamps
Eugene P. Milstone
Ida Rapoport
Thomas H. Walz

Lecturer
Susan Goldman
James A. Goodman

Instructor
Eleanor S. Felker
Joann G. Gannon
Charlotte V. Hinn
Joyce E. Peltzer
Annalee Stewart

Prerequisites—An applicant of satisfactory scholastic record, character, and professional qualifications whose Bachelor's degree was granted by a recognized college or university may be admitted by the dean of the Graduate School upon recommendation of the Admissions Committee of the School of Social Work.

A candidate for admission to the School of Social Work must present 39 quarter credits in social sciences, i.e., in sociology, political science, economics, psychology, history, or anthropology, including one or more courses in at least three of these social sciences, and a course in statistics.

Application blanks and instructions regarding admission may be secured from the School of Social Work, 909 Social Science Building, University of Minnesota, Minneapolis, Minnesota 55455.

Applications and transcripts in duplicate must be filed at least 3 months prior to the opening of the quarter in which the student expects to register. Beginning graduate students are admitted only fall quarter. Persons with previous training and experience may be admitted at the quarter which makes progression from their previous training feasible.

An application for admission is considered first by the graduate faculty of the School of Social Work, then recommended to the dean of the Graduate

School for approval and admission. Acceptance of candidates is based upon: evidence of ability to meet standards of graduate work as indicated by high grades, including psychological tests, and evidence of stability of personality and aptitude in interpersonal relationships.

Advanced standing may be granted for work done in other approved schools of social work, limited by the rules stated herein.

Language Requirement—For the Master's degree, a foreign language is not required, but is strongly recommended. (French, German, Scandinavian languages, and Spanish may be approved.) For the Ph.D. degree, two foreign languages with the option of substituting for one of these a special research technique or a collateral field of knowledge. Any combination of French, German, Japanese, a Scandinavian language, and Spanish would be approved.

Master's Degree—The degree of master of social work requires 2 years of graduate study and will be awarded to students who fulfill the following requirements:

1. Ninety credits including a 9 quarter-credit degree project (as indicated in the following) must be presented with an average grade of B or better.

2. A sequence must be completed in each of the groups of courses lettered B, C, D, and E including at least one course each in administration, casework, community organization, group work, and research.

3. A project of 9 quarter credits consisting of several seminar research papers or a single report which shows capacity for critical evaluation and analysis must be presented. Preferably all 9 credits should be earned under the supervision of one faculty member.

4. Not less than 45 credit hours must be earned in residence at the University of Minnesota with an average grade of B or better.

5. Not more than 45 credit hours will be accepted by transfer and then only if earned in an accredited school of social work. Credits accepted for transfer shall show an average of B or better.

6. Not more than 9 credit hours earned in extension courses will be accepted to apply on degree requirements and then only if the grade received is B or better and the course (a) was taught by a member of the graduate faculty, (b) is numbered 100 or above, (c) carries the same title and content as a corresponding course in the regular curriculum.

7. The candidate must pass a written examination or an oral examination conducted by a committee of three or more members of the graduate faculty.

8. All credits offered for the degree must have been earned within 7 years preceding the quarter in which the degree is conferred.

9. Following completion of 40 graduate credits, not less than 15 of which must have been earned at the University of Minnesota, and not later than the opening of the quarter preceding the quarter in which the degree is to be conferred, the student shall submit, through his major adviser, a

program of all credits presented for the degree upon the appropriate degree program form.

Doctor's Degree—Students who have the Master's degree in social work from this school, or the comparable Master's degree from a school of social work accredited by the Council on Social Work Education, may, if their records are distinctly superior, become candidates for the Ph.D. degree in social work (requiring at least 2 years of post-Master's graduate work).

A. Special Topics and Reading Courses

201, 202, 203. Special Topics in Social Work. (Cr ar) Oren

206, 207, 208. Readings in Social Work. Independent study under tutorial guidance. (Cr ar)

B. Field Work

210-211-212. Field Instruction in Social Work I. Field practice in social work process under direct supervision. (Cr ar; prereq ¶265 or ¶275 or equiv) Compton, Felker, Johnson, Gannon, Goldman, Hinn, Peltzer, Stewart

215-216-217. Field Instruction in Social Work II. Field practice in social work process under direct supervision. (Cr ar; prereq 212) Compton, Konopka, and clinical field staff

218, 219, 220. Field Instruction in Social Work III. Field experience in social work process under direct supervision. (Cr ar; prereq MSW degree)

221. Seminar for Clinical Field Instructors. (Cr ar; limited to persons engaged in supervising students in field work) Compton

C. The Social Services

225-226-227. Social Policy and Programs I-II-III. Social policy and social work programs, public and private, in economic security, housing, health, rehabilitation, interpersonal and intergroup relations, education, recreation, corrections and protective functions and occupational and vocational functions indicating the role of the social work profession. (4-2-2 cr) Newhouse, Rapoport

228. Social Policy and Programs IV-V. Continuation of 227. (3 cr; prereq 227) Newhouse, Rapoport

240. Seminar: Social Work as a Profession. (Cr ar; prereq ‡) Kidneigh

241. Seminar: The History of Social Work. Historical backgrounds of modern social work movement; evolution of theory underlying it. (Cr ar; primarily for doctoral students) Konopka

242. Seminar: Social Work Education. (Cr ar; prereq MSW degree) Francel

243. International Social Welfare. (3 cr; prereq ‡) Francel

245x. General Seminar: Social Services. (Cr ar; prereq grad social work students) Newhouse or Merl

D. Human Growth and Behavior

248A-B. Concepts of Human Growth and Behavior in Social Work Practice I. Sociopsychobiological factors associated with individual and group development as applied to social work practice. (3-2 cr; prereq ¶210 or ‡) Saloshin, Yesner, Goodman, Kamps

249A-B. Concepts of Human Growth and Behavior in Social Work Practice II. Sociopsychobiological factors associated with individual and group development as applied to social work practice. (2 cr per qtr; prereq ¶211 or ‡) Saloshin, Goodman

250. Concepts of Human Growth and Behavior in Social Work Practice III. Psychological factors associated with individual and group development as applied to social work practice. (2 cr; prereq ‡) Wiener

251-252. Concepts of Human Growth and Behavior in Social Work Practice IV-V. Clinical cases of psychosomatic and psychiatric illness; implications for social work practice. (2 cr per qtr; prereq 250, ¶215-216) Simon

253. Concepts of Human Growth and Behavior in Social Work Practice VI. Use of psychiatric concepts in social work practice. (2 cr; prereq 250, ¶217) Saloshin, Yesner, Goodman

256x. General Seminar: Concepts of Human Behavior in Social Work Practice. (Cr ar; prereq grad social work students) Saloshin

E. Social Work Practice

260. Principles of Administration in Social Work. Technical study of the process of transforming social policy into social services. (2 cr) Kidneigh

261. Supervision in Social Casework. Principles applied to supervisory process in agencies offering casework services. (2 cr; prereq 260 and ‡) Scott, Whitmore

262. Supervision in Social Group Work. Principles applied to supervision of volunteers and others working in agencies offering group work services. (2 cr; prereq 260, 277) Cohn

263. Administration in Social Group Work. Principles applied to subexecutive positions in agencies offering group work services. (2 cr; prereq 260, 278) Cohn

264. Seminar: Social Work Administration. (Cr ar; prereq 226 and 260 or ‡) Kidneigh

265. Social Casework I. Philosophy and processes, methods and skills of social casework. (2 or 3 cr; prereq ¶210) Whitmore

266, 267. Social Casework II-III. Casework I continued: critical analysis of casework process and development of skill. (2 cr per qtr; prereq 265, ¶211-212) Whitmore

268, 269, 270. Social Casework IV-V-VI. Advanced casework method focused primarily on treatment methods. (2 cr per qtr; prereq 267, ¶215-216) Scott, Yesner, Gannon

271. Community Organization. Analysis of the process by which groups and individuals within a community work together to equate social services to community need and establish social policy for planning and co-ordination of social services. (2 cr) Francel

274. Seminar: Community Organization. (Cr ar; prereq 271) Francel

275. Social Group Work I. Method. (2 or 3 cr; fall qtr open to social work students only, spring qtr open to other grad students) Konopka, Cohn

276. Social Group Work II. Group Work I continued: role of worker in group process, group formation and social forces, focused on development of skill. Introduction to rationale of program as tool. (3 cr; prereq 275, 211) Cohn

277. Social Group Work III. Intensified understanding of individualization process in working with groups. Skill and planning in executing program activities. (3 cr; prereq 276, ¶212) Cohn

278. Social Group Work IV. Advanced group work method. (2 cr; prereq 277, ¶215) Konopka

279, 280. Social Group Work V-VI. Group work with individuals in groups for treatment purposes, group therapy. (2 cr; prereq 278 or ‡) Konopka

285-286-287. Special Studies in Social Work. (Cr ar; fulfills 9 cr requirement for degree project) Francel, Hess, Goodman

290-291. Seminar: Recent Research in Social Work. (Cr ar; primarily for doctoral students) Scott

295x. General Seminar: Social Work Methods. (Cr ar; prereq ‡) Scott, Konopka

298-299-300. General Seminar: Social Work. (Cr ar; prereq MSW degree) Kidneigh, Saloshin, Scott

SOCIOLOGY

Professor
Roy E. Carter
George A. Donohue
Bertram L. Ellenbogen
Robert L. Fulton
Edward Gross
Reuben L. Hill, Jr.
Arthur L. Johnson, *associate chairman*
Don A. Martindale, *co-ordinator of graduate study*
Elio D. Monachesi, *chairman*
Charles E. Ramsey
Arnold M. Rose
Gregory P. Stone
Murray A. Straus

Associate Professor
Harold Finestone
Richard N. Hey
Irving Tallman
David A. Ward

Assistant Professor
Joan Aldous
William S. Bennett
Walter M. Gerson
Scott G. McNall
Joel I. Nelson
William L. Zwerman

Prerequisites—For major work, 18 quarter credits; for minor work, 12 quarter credits.

Language Requirement—For the Master's degree, one foreign language. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge. Routinely acceptable languages are Dutch, French, German, Italian, Japanese, Portuguese, Russian, and Spanish.

Master's Degree—The Master's degree in sociology is usually offered under Plan A. Plan B degrees, however, are also permitted upon approval of the adviser and the co-ordinator of graduate studies.

Doctor's Degree—Work for the Ph.D. degree is offered under the general rules of the Graduate School.

Graduate work in sociology is offered in the following subfields:

Subfield A: General Sociology

Subareas

I. Social Psychology
II. Social Organization
III. Methods and Statistics
IV. Theory and Social Change

Subfield B: Specialties

Subareas

V. Family Sociology
VI. Rural Sociology
VII. Sociology of Work
VIII. Urban Sociology
IX. Criminology and Penology
X. Demography
XI. Sociology of Medicine and Mental Health

Candidates for the degree of master of arts are to present themselves during their third quarter of residence work, or earlier, for an examination based upon reading lists on the four subareas of subfield A. This will normally be during the Spring Quarter of their first year; exceptions are granted by petition.

Candidates for the degree of doctor of philosophy are expected to pass comprehensive written examinations in all subareas of subfield A and in *two* subareas of subfield B. In addition, candidates must pass a special written examination in a subarea in either subfield A or B that is designated as a subarea of special interest. These examinations may be taken at two different examining sessions; these, normally, are taken in successive examining sessions.

Note—For seminars in family life education methods which may be counted toward advanced degrees in sociology, see EdCI 253A and EdCI 254 under Education.

Note—For information on work in statistics, see page 354.

100. Contemporary Penology. Prisons as social organizations; description and evaluation of current treatment programs for adult offenders. (3 cr; prereq 1, 53, or ‡) Ward

101. Criminological Theories: Historical and Contemporary. Evaluation of the major historical and contemporary theories of criminal behavior. (3 cr; prereq 1, 53, or ‡)

102. Adult Parole and Probation. Critical examination of problems and practices in supervision of adult criminals. (3 cr; prereq 1, 53 or ‡) Finestone

103. Law and the Legal System for Correctional and Social Workers. Nature and effect of legal rules, constitutional, legislative, and judicial; the adversary process; the right to a hearing; the right to and function of counsel; fact determination under rules of evidence; concepts underlying criminal law and procedures; juvenile court; probation and parole. (3 cr; prereq ¶Sequence C or B or ‡)

104. Police Problems and Practices in the United States. Personnel, organizations, and public relations of police forces; successful techniques of integrating police work with other community agencies. (3 cr; prereq 1, 53, or ‡; offered 1967-68 and alt yrs)

105. Institutional Treatment of Juvenile Delinquents: Problems and Practices. Current problems of institutional treatment of juvenile offenders and contributions of different professions to treatment. (3 cr; prereq ¶Sequence C or B or ‡) Konopka

106. Planning. (Same as Arch 132 and Pol 123) Social, economic, political, geographic, and technical phases of modern city planning. (3 cr) Borchert, Stone, Vivrett, Warp

107-108-109.† Proseminar in Delinquency Control and Treatment. (1 cr per qtr)

111. Population Theory. Cultural and social phases of population change; birth rates, death rates, and migration; implications of population change. (3 cr; prereq 1, or ‡)

112. World Population Problems. Population policy, historical and present-day, in Europe, Asia, and other selected areas; emphasis on United States. The field of population and power politics. (3 cr; prereq 1, or ‡) Gerson

115. Social Aspects of Housing and Standards of Living. Housing of the masses in relation to problems arising in urban overcrowding, population distribution, and standard of living as affected by distribution of national income, and factors related to personal and social disorganization. (3 cr; prereq 1, or ‡)

117. Scandinavian Folk Movements: Their Social and Political Significance. (3 cr; prereq 1, or ‡)

118. Delinquent Behavior. Nature of delinquent behavior and its causes; with consideration of the help that understanding of causes can give to its modification and its prevention. (3 cr; prereq 53) Monachesi

119. Modern Agencies for Control of Juvenile Delinquency. Functions of the school, of welfare, casework, and group work agencies, of juvenile bureau in police departments, juvenile court, detention home, probation services, clinics, and integrated state agencies like Minnesota Youth Conservation Commission in prevention and modification of delinquent behavior. (3 cr; prereq 53 and 118)

120. Social Psychology. Research and theory regarding relation of individual to social groups. Socialization processes; effects of social interaction and isolation; individual behavior under conditions of social organization and disorganization; cultural influence and its limits. (3 cr; prereq 1, or ‡) Rose, Stone

121. Advanced Social Psychology. Methods of acquiring knowledge in social psychology; analysis of outstanding pieces of research. Social psychology of small groups, mass behavior, and making of political and economic choices. Familiarizes student with current thinking and research in this field in light of concepts and theories presented in introductory course in social psychology. (3 cr; prereq 120 or ‡) Rose

122. Sociology of Conflict. Manifest forms of antagonism among groups of persons; causes of conflict; methods of resolving through accommodation; the role of conflict and social change. (3 cr; prereq 1, or ‡)

123. Minority Group Relations. Interaction of social and cultural groups in America; particular reference to the Negro. Processes leading to group contact; characteristics and contributions of ethnic groups in United States; mechanisms and problems of group adjustment. Democratic theory and practice; sources of prejudice; contemporary status of principal minority groups; international implications; trends and proposed solutions. (3 cr; prereq 1, or ‡) Rose, Finestone, Gerson

124. Social Movement in a Changing Society. Factors underlying social change in the modern mass society. Recent researches on social movements, reform and revolution, culture contact, impact of rapid technological change. The individual and the social structure under conditions of rapid social change. (3 cr; prereq 1 or ‡) Rose

125. Opinion and Communication: Social Factors. Processes of opinion formation and change in relation to personality and social structure; analysis of flow of public communications through society and impact of selected types of mass communication on particular audiences. Recommended that this course be taken as a 3-quarter sequence with Psy 167 and Jour 115. (3 cr; prereq 1 or 120 or Psy 140 or ‡) Carter, Gerson

126. Family Development. The natural history of families, how they form, function, and achieve distinctive identities. Developmental growth of children and parents in interaction in seven stages of the family life cycle, from engagement planning to family dissolution. (4 cr; prereq 1, CPsy 80 and ‡) Hill, Aldous, Tallman

140. Social Organization. Organization and structure of social groups; basic culture patterns of economic, political, and social institutions. Integration and disintegration of social groups and institutions. Essentials of social dynamics. (3 cr; prereq 1, or ‡) Gross, Gerson, Zwerman

141. The Family. Evolution: development of family unity or disunity, roles of the several members, methods of investigation of the family. (3 cr; prereq 1, or ‡) Johnson

142. Religion as a Social Institution. Structure and function of religious organizations in various types of societies, the nature of religious leadership, type of religious participation, and relationship of religion to other social institutions. (3 cr; prereq 1 or ‡) Johnson, McNall

143. The Newspaper as a Social Institution. Analysis of social structure and organizational patterns of newspapers. Types of newspapers and their changing functions and uses in modern society. Mechanisms of social control. (3 cr; prereq 1 or ‡) Gerson

144. Social Stratification and Mobility. Relationship of social mobility to social stratification and social organization. Hierarchical structure of society in relation to class and status. (3 cr; prereq 1 or ‡) Fulton, Gerson, McNall, Zwerman

145. Urban Sociology. Urban ecology; urban institutions and the urban way of life. (3 cr; prereq 1 or ‡) Stone

146. Industrial and Occupational Sociology. The occupational group; the factory and the business enterprise as social institutions; the contrasting functions of formal and informal organization; significance of co-operation, authority, communication, status, and group norms in the working situation. (3 cr; prereq 1 and 15 cr in sociology, psychology, political science, or economics) Gross

148. Comparative Rural Societies: Latin America. Demographic characteristics, systems of agriculture, settlement patterns, class and caste, family life, and level of living; other social institutions and social change. (3 cr; prereq 20 cr in sociology, economics, or political science, or ‡) Ellenbogen

150. Sociology of Popular Culture. Social preconditions and social effects of popular culture. Popular vs. nonpopular culture. Analysis of selected popular arts, institutionalized amusement systems, and popular holidays. Emphasis on empirical research and socio-historical analysis. (3 cr; prereq 15 cr) Gerson

151. Comparative Social Organization. Demographic and ecological characteristics, stratification system; institutional organization, and forms of association in several modern nations other than the United States. (3 cr; prereq 20 cr in sociology, economics, or political science, or ‡)

152. Sociology of Medicine and Medical Institutions. Social factors associated with the incidence of physical and mental illness and its treatment. Social organization of medical institutions. Public needs and medical services. Sociology of aging, and social problems of the aged. (3 cr; prereq 1, or ‡) Fulton

153. Sociology of Leadership and Group Action. Survey of nature, function, and sources of leadership in modern society. Techniques of leadership and their role in group actions. Examination and application of instruments for evaluating leadership and participation within groups; organization and function of voluntary groups. (3 cr; prereq 15 cr in sociology, psychology, anthropology, political science, history, or ‡; offered when feasible)

154. The Family in World Perspective. (Same as HE 183) Comparison of family organization and modes of functioning in selected major world civilizations. Interrelations of the family with the economic system and urbanization, and family influences on personality formation. (3 cr; prereq 1, Psy 1) Straus

155. Social Structure and Political Behavior. Analysis of structural and ideological conditions influencing the legitimation of political institutions and relationships of this process to political participation, political apathy, and the rise of mass movements. (3 cr; prereq 1) Tallman

160. Rural Community Organization. History, structure, and place of the rural community in American society; community demography, ecology, stratification, urbanization, and processes of co-operation and conflict. (3 cr; prereq 1 or ‡)

161. Rural Community Analysis. Offered on the St. Paul Campus for all persons interested in rural community organization, rural teaching, extension work, and related fields. Tools, techniques, and methods of making community field studies. (3 cr; prereq 1 or ‡) Donohue

162x. Rural Social Institutions. Factors in the rural environment which condition the functioning of rural social institutions, including family, school, church, local government, health, and welfare. (3 cr; prereq 1, or ‡) Donohue

170. Analytical Social Theory. Major problems of sociological theory; main types of sociological theory (positivistic, rationalistic, idealistic); major theoretical concepts. (3 cr; prereq 1, or ‡) Martindale

171. Social Life and Cultural Change. Theories of social change; their methodological problems. Comparative social thought and structure of antiquity utilized as basic data for analysis. (3 cr; prereq 1 or ‡) Martindale

172. Backgrounds of Modern Social Thought. Major trends of social thought from the Renaissance to the 19th century; factors contributing to the origin of sociology. (3 cr; prereq 1, or ‡) Martindale

180x. Methods of Social Research. Major methods; their advantages and limitations when applied to specific types of problems. (3 cr; prereq 45 or equiv) Nelson, Ramsey

182. Statistical Methods. Concept of "distribution" developed and major distributions of interest to sociological research assessed. The idea of variance and its analysis including multiple regression described with sociologically relevant data. (3 cr; prereq 45 or equiv) Tallman

183. Problems in Social Measurement. Theoretical analysis of problems in measuring social variables; problems of reliability, validity, and standardization in construction of new measuring instruments. (3 cr; prereq 45 or 182 or equiv)

184-185†, 186. Field Work and Laboratory Training in Social Research. Practicum providing direct experience with a variety of research techniques. (3 cr per qtr; prereq 45 or equiv and 180 or equiv) Straus

187. Quantitative Research Design. Formulation of quantitative problems in the social sciences for hypothesis testing and data processing; applications and use of tabulating equipment and computers for projects selected by students. (3 cr; prereq Geog 87, Soc 45, ‡, or §Geog 187) Adams

188. Area Sampling and Analysis. Design and selection techniques for areally sampled information in social science research; evaluation of census, field and map methods for error control; literature survey and individual student project. (3 cr, §Geog 188; prereq Geog 87, Soc 45, ‡) Adams

SEMINARS

201f-202w†, 202s.* Seminar: Research Problems in Crime and Social Conflict. (3 cr per qtr) Ward

203, 204, 205.* Seminar: Research Problems in Juvenile Delinquency. (3 cr per qtr; offered when feasible) Monachesi

210, 211, 212.* Seminar: Problems in Population Research. (3 cr per qtr; offered 1967-68 and alt yrs)

217.* Seminar: Sociology of Mental Health and Mental Disorder. Social factors on the etiology of mental disorders. Epidemiology of mental disorders. Mental health programs and their effectiveness. Family influences on the mental patient. Public images of the mental patient. (3 cr) Rose

218.* Seminar: Social Gerontology. Health, economic, social welfare, housing, recreational, and mental problems of older people. Demography of the aging. Mental health and mental outlook of the elderly. Continued social integration, disengagement, and group consciousness. The subculture of aging. Social trends affecting the elderly in American society. (3 cr) Rose

219.* Seminar: Sociology of Law. History of sociological jurisprudence and the sociology of law. Research studies in family law, crime and punishment, functioning of juries, the legal profession. The social scientist as an expert witness. Sociology and social psychology in civil rights decisions. Social factors affecting decisions of the police, prosecutors, and judges. (3 cr) Rose

220, 221, 222.* Seminar: Social Psychology. (3 cr per qtr) Rose

223, 224, 225.* Seminar: Research in Problems of Modern Mass Society. (3 cr per qtr; offered when feasible)

226.* Seminar: Family Development Theory. (3 cr; prereq ‡; offered fall 1967 and alt yrs) Hill, Aldous

227-228.* Seminar: Contemporary Research on Marriage and the Family. (3 cr per qtr; offered winter and spring 1967 and alt yrs) Hill

230, 231, 232.* Seminar: Research in Group Structure and Function. (3 cr per qtr) Stone

233, 234, 235.* Seminar: Methods for the Evaluation of Social Action Programs. (3 cr per qtr) Finestone

238-239.*† Seminar: Principles of Sociology. (3 cr per qtr) Stone

241, 242, 243.* Seminar: Research Problems in the Family. (3 cr per qtr; offered when feasible) Johnson

245, 246.* Seminar: Research in Urban Sociology. (3 cr per qtr; offered 1967-68 and alt yrs) Stone

247-248-249.* Seminar: Research in Large Scale Organization. (3 cr per qtr) Gross

251-252-253. Selected Problems in Comparative Sociology. (3 cr per qtr)

260, 261, 262.* Seminar: Rural Sociology. (3 cr per qtr; offered when feasible)

263.* Seminar: Research Methods in Rural Sociology. (3 cr; offered when feasible)

267. Health and Human Behavior. (Same as PubH 267) Social ecology of health; social and personal components of illness; health and the community; social and cultural aspects of health care services. (3 cr; prereq 152 or ‡)

270, 271, 272.* Seminar: Social Theory. (3 cr per qtr) Martindale

273.* Seminar: Sociology of Science. (3 cr)

280, 281, 282.* Seminar: Recent Developments in Sociological Research Techniques. (3 cr per qtr; offered when feasible) Straus

284, 285, 286.* Seminar: Statistical Theory in Relation to Social Theory and Practice. (3 cr per qtr) Monachesi

287-288-289. Social Psychology of Marriage. (Same as Psy 281-282-283) (3 cr per qtr; prereq ‡) Neubeck, Hey

290, 291, 292.* Seminar: Sociology of Religion. Intensive study of a major social institution; methodological techniques, problems, theoretical models, and specialized areas in sociological study of religion. (3 cr; prereq 142 or ‡) Johnson, McNall

297, 298, 299. General Seminar. (Cr ar) Graduate staff

SOIL SCIENCE

Professor
Harold F. Arneman
George R. Blake
Paul M. Burson
Alfred C. Caldwell
Robert F. Holt
John M. MacGregor
William P. Martin, *chairman, director of graduate study*
Richard H. Rust
Edwin L. Schmidt
Cornelius A. Van Doren

Associate Professor
Donald G. Baker
Rouse S. Farnham
Janis Grava

Assistant Professor
Russell S. Adams
Raymond R. Allmaras
Charles E. Clapp

Prerequisites—For major work, a good background in chemistry, including quantitative analysis, and college physics is desired. All students should have mathematics through analytic geometry or its equivalent, and instruction in calculus is advisable.

For a minor in soil science, the student must satisfy the graduate faculty that his preparation is adequate.

Major and Minor—A graduate student in soil science may concentrate in such areas as genesis and classification, chemistry and fertility, microbiology, microclimatology, or physics. The course of study will vary with the requirements of the area and the interests of the student under supervision of the major adviser. A minor or supporting field will be selected usually in some allied field such as agronomy, botany, chemistry, microbiology, biochemistry, physics, geology, economics, forestry, agricultural engineering, and others.

A student minoring in soil science will take the courses acceptable to the minor adviser, assigned by the chairman.

Language Requirement—For the Master's degree, none. For the Ph.D. degree, either (a) two foreign languages, or (b) one foreign language and the option of a special research technique or a collateral field of knowledge may be submitted. Acceptable languages are German and Russian or either of these paired with French or Spanish. Other combinations may be presented by petition.

Master's Degree—Offered under Plan A and Plan B. Students contemplating graduate work beyond the Master's degree will take Plan A.

Doctor's Degree—Work for the Ph.D. degree is offered under the general requirements of the Graduate School.

101. Soil Management and Land Use. (See 51) (2 cr; prereq 18 or 19 or 119) Burson

103. Soil and Water Management and Conservation. (See 52) (2 cr; prereq 18 or 19 or 119) MacGregor

105. Soil Geography. (See 54) (3 cr; prereq 18 or 19 or 119) Farnham

119. Intermediate Soil Science. (See 19) (3 cr; prereq GeCh 5) Arneman, Martin

123.* Fertilizers. History, manufacture, characteristics, and use of important fertilizer nutrients. (3 cr; prereq 3 or 19 or 119 or ‡) Caldwell

125.* Soil Development and Classification. Soil profile characteristics, influence of parent material, climate, topography, vegetation, and time on soil development, system of soil classification, and world distribution of major soil groups. (3 cr; prereq 55 or 105 or ‡) Rust

126.* Soil Physics. Soil structure, compaction, tilth, tillage; water infiltration, retention, availability, movement and evaporation; heat capacity, flow; air porosity, diffusion, deficiency effects on plants, drainage requirement. Lectures and laboratory. (4 cr; prereq 3 or 19, Math 10 and MeAg 23 or equiv) Blake

127.* Soil Microbiology. (Same as MicB 103) Bacteria, fungi, and actinomycetes of the soil, biochemical activities of the soil microflora. Lectures and laboratory. (4 cr; prereq MicB 53, 8 cr in organic chemistry and ‡) Schmidt

128.* Soil Chemistry. Chemical composition of soils; organic matter; mineral matter; ionic exchange; plant nutrients and factors affecting their availability. (3 cr; prereq 18 or 19 or 119) MacGregor

130x.* Special Problems in Soils. Research, readings, instruction. (1-5 cr per qtr, 10 cr max; prereq 18 or 19 or 119) Staff

131.* Physical Chemistry of Soils. Selected topics in physical chemistry as related to soils. Electrokinetic phenomena, colloidal behavior, interactions of organic and inorganic soil materials. Lectures and laboratory. (3 cr; prereq physical chemistry or ‡; offered 1967-68 and alt yrs) Rust

132.* Soil Fertility. Plant root-soil relationships; chemistry of essential elements in the soil and plant; diagnosing soil deficiencies. (3 cr; prereq 18 or 19 or 119) Caldwell

133.* Microclimatology (Soils). Meteorology and climatology in relation to soil-atmosphere interface; soil microclimate, physical processes taking place within the microclimate, modification of microclimate by agricultural practices, weather instruments, and use of climatic data. (3 cr; prereq Math 10, MeAg 23 or equiv) Baker

134.* Organic Soils. Formation, classification, and properties of organic soils; their use and management. Lectures and laboratory. (3 cr; prereq 18 or 19 or 119) Farnham

135. Soil Analytical Chemistry Techniques. Instrumental methods of inorganic and organic chemical analyses in soils. Lectures and laboratory. (3 cr; prereq 19, 5 cr physics, one course in analytical chemistry; limited to 10 students) Adams

136. Organic and Pesticidal Residues. Examination of the fate of natural and synthetic organic materials in soil; chemical, physical, and biological factors of the soil which influence decomposition or persistence. (3 cr; prereq 19 and 11 cr of biochemistry and/or organic chemistry) Adams

137. Soils and the Ecosystem. Formation and distribution of soils in relationship to vegetation, climate, and other soil-forming factors. Interrelationships of soils in the ecosystem. (3 cr; prereq plant ecology or ‡) Farnham

202x. Research Problems in Soils. Individual laboratory or field work on special problems in a phase of soils other than student's major thesis. Arrangements must be made in advance. (2-5 cr) Martin, Burson, Caldwell, Blake, MacGregor, Schmidt, Arneman, Rust, Farnham, Baker, Adams

203x. Seminar: Soils. Assigned reading, reports, and discussions on soils topics. (1 cr) Staff

204x.* Advanced Soil Science. Recent advances in soil classification, chemistry, physics, microbiology. (3 cr; prereq ‡) Martin, Caldwell, Blake, MacGregor, Schmidt, Arneman, Rust, Farnham, Baker, Adams

220. Fluid Flow in Soils. Flow and behavior of water and other fluids in soil. Characteristics of the soil matrix, properties of adsorbed water, diffusion of gases and water vapor. (3 cr; prereq 126, Math 55, Phys 9 or equiv; offered 1966-67 and alt yrs) Blake

280. Radioisotope Techniques Applied to Biology. (Same as PlPa 280) Lecture and laboratory. Uses of radioisotopes in biological research, criteria for their use, problems in their use and measurement. Extensive experience through laboratory and greenhouse experiments. (3 cr, §PlPa 280; enrollment limited to 10; prereq a course in nuclear physics) Linck, Rust, Caldwell

SPEECH, COMMUNICATION, AND THEATRE ARTS

Professor
Arthur H. Ballet
Ernest G. Bormann
Paul H. Cashman
Norman J. DeWitt
Alan L. Downs
Francis E. Drake
Kenneth L. Graham, *chairman*
Alrik Gustafson
Tyrone Guthrie
Ernest H. Henrikson
William S. Howell, *associate chairman*
John D. Hurrell
Frank M. Lassman
Robert E. Moore
Robert D. Moulton
Ralph G. Nichols
Hildred Schuell
Robert L. Scott, *director of graduate study (public address)*
Gerald M. Siegel
Donald K. Smith
Robert P. Sonkowsky
Clark D. Starr, *director of graduate study (speech science, pathology, and audiology)*
Mildred C. Templin
David W. Thompson
Frank M Whiting, *director of graduate study (theatre)*
Donald Z. Woods
E. William Ziebarth

Associate Professor
Joseph B. Chaiklin
Frederic Darley
J. Vernon Jensen
Wendell J. Josal
Richard R. Martin
George L. Shapiro
Wallace D. Ward
Ronald M. Wendahl

Assistant Professor
Lee H. Adey
Arnold E. Aronson
Leonard D. Bart
Frank T. Benson
Bernard L. Brock
Virginia M. Fredricks
Sheldon Goldstein
Frederick R. Greenberg
Maxine M. Klein
Richard P. McDermott

Prerequisites—For major work, a minimum of 18 undergraduate credits in speech or theatre. A comprehensive entrance examination is a prerequisite for graduate work in theatre.

Language Requirement—For the Master's degree, one foreign language, except for programs with a major in speech science, pathology, and audiology, where there is no language requirement. For the master of fine arts degree, none. For the Doctor's degree, either (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge.

Master's Degree—Offered under both Plan A and Plan B. Under Plan B, the candidate must earn from 21 to 27 credits in graduate courses in the major field and the remaining credits in related graduate courses selected with the approval of his adviser.

In his Master's program, the student may specialize in any one of the following: audiology, oral interpretation, public address, radio and television, rhetoric, speech pathology, theatre, voice science.

Additional reading requirements in dramatic literature for a candidate emphasizing theatre are to be selected with the approval of his adviser.

Master of Fine Arts Degree—The student must complete a program of approximately 2 full years of graduate credit, 45 of which must be earned in graduate courses at the University of Minnesota. He must execute and leave a record of a creative project (production, recital, or exhibition) which will be accompanied by a supporting paper that deals with the planning and/or execution of the creative work. A minimum of 9 credits will be required in history or literature of art, theatre, or music; and the department will require a minimum of 9 credits in areas of study outside of the major department. The individual program must be approved by the departmental M.F.A. committee. The candidate will be subject to final written and oral examinations.

Doctor's Degree—In consultation with his major adviser the candidate will elect at least two of the following areas of study: audiology, oral interpretation, public address and rhetoric, radio and television, speech pathology, theatre, voice science. The choice of a minor is subject to the approval of the major and minor advisers, or a supporting program may be substituted with the approval of the major adviser and at least one other full member of the graduate faculty.

The student may earn the Ph.D. degree either in the field of speech pathology and audiology or in speech and theatre arts.

Additional reading requirements in dramatic literature for a candidate emphasizing theatre are to be selected with the approval of his adviser.

Speech

PUBLIC ADDRESS AND COMMUNICATION THEORY

101, 102, 103.* Argumentation and Persuasion. Theories of modern motivational rhetoric. Analysis of persuasive speaking; practice in preparation and delivery of oral argument. (3 cr per qtr; prereq 5, Psy 2, 10 cr in social science) Brock, Howell, Scott

106.* Discussion. Co-operative thinking; recognition and definition of problems, critical analysis, examination of possible solutions. Planning, preparing for, participating in, and leading classroom, public, and radio and television discussions. (3 cr; prereq 5) Bormann, Cashman, Howell, David Smith

106A. Public Speaking and Conference Leadership. (3 cr; hospital administration majors only) Shapiro

108. The Classical Voices of Poetry: Epic, Lyric, Dramatic. (Same as Clas 108) Oral performance of selected Greek and Roman texts both in the original language and in translation. Previous upper division work either in study of a literature or in performance, but not necessarily in both, is expected. (3 cr, §Clas 108; prereq Spch 82 or Spch 83, or Th 61, or 3 cr in Latin or Greek courses numbered 60 or above, or 3 cr in upper division courses in English literature or foreign literature, or ‡) Sonkowsky

109.* Classical Rhetoric. Greek and Roman theories of speech making; historical and philosophic context and influence on education. (3 cr; prereq 5, and △) Scott

110.* History and Criticism of British Public Address. British orators, their works, the historical setting, British rhetorical theory. (3 cr; prereq 5, and △) Jensen

124.* Experiments in General Speech. Correlates of speech skills, audience reactions, and speech improvement. (3 cr; prereq 5, Psy 2) Bormann, David Smith

126A.* History and Criticism of American Public Address. Survey of history and criticism of religious and reform speaking in the United States from 1620 to 1920. (3 cr; prereq 5, Psy 2) Bormann

126B.* History and Criticism of American Public Address. Survey of history and criticism of political speaking in the United States from the time of the Revolution to the present. (3 cr; prereq 5, Psy 2) Bormann

169.* Speech and Language in Human Behavior. Basic orientation on the place of speech and language in human behavior. Individual projects and collateral reading. (3 cr) Shapiro

169A. Speech and Language in Human Behavior. (3 cr; psychiatric nursing students only) Shapiro

201x.* General Seminar. Survey of current literature and general problems. (1 cr per qtr; prereq ‡) Shapiro

203-204. Seminar: Argumentation. Theory of argumentation and debate. Use of argumentation in formal debate and in contemporary public address. (3 cr per qtr; prereq 5, Psy 2, 10 cr in social science) Brock, Howell, Scott

207, 208, 209.° Seminar: Persuasion. Contemporary public address. Literature of persuasion, methods in study of persuasion. (3 cr per qtr; prereq 5, 101, 102, 103, Psy 2, 140, 10 cr in social science) Howell

234.° Seminar: History and Criticism of Public Address. Methods of rhetorical criticism. Application of method in individually selected research projects. (3 cr; prereq 126A, 126B, or △) Bormann, Scott

235.° Seminar: Small Group Communication. Research problems and methods. (3 cr; prereq 5, 106) Bormann

251. Seminar: Listening Comprehension. Research problems and methods. Evaluation of published research. (2 cr; prereq undergrad speech major, ‡) Nichols

275, 276, 277.° Seminar: Rhetoric. History and critical study of rhetorical theory. Examination of research in rhetoric. (3 cr per qtr; prereq 109 or ‡) Scott, Donald Smith, Sonkowsky

ORAL INTERPRETATION

105.° Theory of Reading and Acting. Literature as an art; its forms; psychology of creative imagination; speech elements in literature; origins and nature of speech symbols and techniques of their use. (3 cr; prereq 83 and Psy 2) Fredricks, Thompson

107.° Platform Reading. Oral interpretation of selected poems and plays. Speech melody, rhythm, platform technique. Aesthetic analysis. Lecture recitals. (3 cr; prereq 81, 82, 83) Fredricks, Thompson

221, 222, 223.° Seminar: Oral Interpretation of Literature. Problems of silent and oral reading. Speech in relation to language and types of literature. (3 cr per qtr; prereq 81, 82, 83, 105) Thompson

RADIO AND TELEVISION

170.° Radio and Television Programming. Theory and practice. Principles of program effectiveness; program policies of the industry. Building and production of experimental programs; emphasis on talk and discussion. (3 cr; prereq 65 or 66, or ‡) Bart, Browne, Goldstein

171. Advanced Television Production I. Provides advanced students an opportunity to carry out creative problems. Program design, lighting, audio, camera, and electronic techniques. (3 cr; prereq 69) Bart, Goldstein

172.° Advanced Television Production II. Provides advanced students an opportunity to solve production problems and apply creative techniques for regularly broadcast television programs. (3 cr; prereq 171 and ‡) Bart, Goldstein

173. Educational Television Production. Uses of television for instructional purposes, review of research literature as it applies to production of televised educational materials and experimentation in preparation of such materials. (3 cr; prereq 172 or ‡) Goldstein

174.° Educational Television Programming and Administration. Various applications of television to serve educational needs; current programming and administrative practices, significant research findings as to relative effectiveness of differing types of television utilization and the impact of various modes of television transmission on programming and administrative concepts. (3 cr; prereq 173 or ‡) Goldstein

241, 242, 243.° Seminar: Radio and Television Research. Evaluation of research methods in mass communication by radio and television. Research literature. (2 cr per qtr; prereq ‡) Ziebarth

GENERAL

122.° Introduction to Research. Graduate research in speech: selection of topics and methods of investigation. Required of all graduate majors in speech. (3 cr; prereq 5, Psy 2) Bormann

Theatre Arts

Total accumulation of credits allowable in courses 101, 102, 103, 114, 118, 119, 120, 121, 122, 123, 141, 142, 143, 151, 174, 175, 176: M.F.A. candidates—9 credits; Ph.D. candidates—18 credits.

100.° Introduction to Research. Graduate research in theatre arts: selection of topics and methods of investigation. Required of all graduate majors in theatre arts. (3 cr; prereq Spch 5, Psy 2) Bormann

101, 102, 103. Theatre Practicum. Individual creative projects meeting approval of a faculty committee in one or more of these areas: playwriting, directing, acting, and design. (2-6 cr; prereq △ and ♯) Josal, staff

111-112-113. Stage Direction. 111: Theory of direction. Exercises in blocking and production of short scenes. 112: Rehearsal problems and direction of two one-act plays. 113: Problems of theatre management and staging; direction of full-length play. (3 cr per qtr; prereq 21, 6 cr from 90, 91, or 92 and ♯) Whiting

114. Theatre Management and Promotion. Theory and practice in ticket office procedures, house management, publicity and promotion; special problems in college, community; children's and professional theatre. (3 cr; prereq 12 or ♯) Loppnow

115-116. Playwriting. Creative practice in play construction. 115: One-act play. 116: Full-length play. (3 cr per qtr; prereq 21 or ♯) Thompson

117. Writing Radio and Television Drama. Group invention and presentation of scenarios. Individual writing of an original 30-minute radio or television play. (3 cr; prereq 21, Spch 5 or ♯) Browne

118, 119, 120. Stage Fencing and Combat: History and Execution. History of weapons through the ages; fighting and fencing with these weapons—their use in stage-combat. (1 cr per qtr; prereq 12 or ¶, ♯)

121, 122, 123.° Problems in Acting. Acting problems stemming from differences in genres and styles of dramatic production from the Greeks to present. Intensive scene and character analysis; skill in communicating character and concept to an audience in individual and group performance. (3 cr; prereq 61, 62 or ♯) Herstand, Klein

127, 128, 129. Production for the Lyric Stage. Problems in acting, staging, and administration for the lyric stage. (3 cr; prereq music major or ♯, ¶Mus 147, 148, 149)

131.° Creative Dramatics. Principles and methods of developing original dramatizations with children. Observation of children's classes in creative dramatics. Readings, projects, term papers. (3 cr; prereq 12 or ¶12 or elementary education major, or ♯...21 recommended) Graham

132. Children's Theatre. Selection, direction, and production of plays for children's audiences, co-ordinated with current productions of the Young People's University Theatre. (3 cr; prereq 12 or ¶12 or ♯) Graham

135. Indian Drama. Text, dramatic form, audience, and theatre architecture. (3 cr, §136) Gargi

136. Indian Theatre. Text, dramatic form, audience, and theatre architecture. Emphasis on style of performance. (3 cr, §135; prereq grad theatre major only) Gargi

141-142-143. Production of Television Drama. Televised drama produced and analyzed with reference to adaptation of techniques and theory from stage production. (3 cr per qtr; prereq 63 or Spch 65, Th 61, 111, 112, Spch 69 and ♯; offered 1967-68 and alt yrs) Goldstein

151su. Theatre Symposium. Intensive study of the art of the theatre—productions and production methods of the Tyrone Guthrie Theatre. Conducted by professional critics, actors, directors, and designers as well as University faculty members. (6 cr) Ballet, staff

171s, 172w, 173f.° History of the Theatre. Plays, arts, and crafts of the theatre from their beginnings to present. Reports and projects. (3 cr per qtr; prereq Spch 5, Th 12 and 100, or ♯) Herstand, Klein, Nolte

174-175-176.* History and Technique of Stage Movement. The application of historical research in the area of manners, games, and dances to techniques of body movement for the stage. (3 cr per qtr; prereq 171, 172, 173 and ‡) Moulton

177, 178, 179.* Theatre Backgrounds. Selective examination of plays as part of the living theatre. Chronological, comparative study of development of theatrical elements in the drama from its origins through the present. (3 cr per qtr; prereq 11 or equiv plus 9 upper division cr in English, speech-theatre, classics, or modern languages) Ballet

180.* American Theatre. Theatre as an aspect of American culture from 1752 to the present. (3 cr; prereq 12; offered when feasible)

181, 182, 183.* Readings in Theatre Arts. Directed reading and preparation of reports on selected subjects. (Cr ar; prereq 9 cr in theatre and ‡)

190. Advanced Problems in Costuming. Theory of stage costume. Special projects and reports. (3 cr; prereq 111, 112 or ‡) Schulze

191. Advanced Problems in Scenic Design. Theory of scenic design. Special projects and reports. (3 cr; prereq 111, 112 or ‡) Josal

192. Advanced Problems in Stage Lighting. Theory of stage lighting. Projects and reports. (3 cr; prereq 111, 112 or ‡) Josal

211, 212, 213.* Seminar: Stage Direction. Great plays and their potentials for meaningful and effective production in the modern theatre. (3 cr per qtr; prereq 111, 112, 113) Whiting, Moulton, Sonkowsky, Nolte

215-216-217. Seminar: Playwriting. Advanced work in creative writing for the stage limited to students of exceptional promise. (3 cr per qtr; prereq 115-116, or ‡) Nolte

251, 252, 253. Seminar: Theatre Arts. Discussion and analysis of current research, trends, and problems related to our modern theatre. (1 cr per qtr; prereq grad student in theatre arts) Ballet, Moulton, Nolte, and staff

271, 272, 273.* Seminar: Dramatic Theory. Critical theory of theatrical arts. Major trends in drama as related to dramatic production. (3 cr per qtr; prereq 171, 172, 173 and 9 cr in dramatic literature) Sonkowsky (271), Ballet (272), Ballet, Thompson (273)

281, 282, 283.* Research. Open to graduate students engaged in research. (Cr ar; prereq ‡) Staff

290.* Seminar: Stage Costuming. Research; projects and reports. (3 cr; prereq 90, 190 or ‡) Schulze

291.* Seminar: Scene Design. Projects and reports for students specializing in scene design. (3 cr; prereq 91, 191 or equiv and ‡; offered when feasible) Josal

292.* Seminar: Stage Lighting. Projects and reports. (3 cr; prereq 92, 192 or equiv and ‡; offered when feasible) Josal

294.* Seminar: Visual Arts of the Drama. Examination of selected aesthetic theories of plastic and poetic arts; relationship to visual aspects of the dramatic production. Theory of art as a symbol. (3 cr; prereq major in theatre arts or ‡) Josal

295. Seminar: Theatre Planning. Principles of planning and design of stages, auditoriums, and associated facilities; their application to the educational theatre. Both building and equipment analyzed. (3 cr; prereq 191, 190 or 192 or equiv) Josal

Speech Science, Pathology, and Audiology

101, 102, 103.* Readings. Directed readings and preparation of reports. (Cr ar; prereq ‡) Staff

119. Fundamentals of Sound. Elements of acoustics necessary to an understanding of quantitative aspects of speech pathology or audiology. Vibrators, transmission systems and their mathematical counterpart. (3 cr) Wendahl, Ward

120. Anatomy and Physiology of the Speech and Hearing Mechanisms. Gross anatomy and function of the structures related to respiration, phonation, articulation, and audition. (3 cr; prereq 119 or ‡) Lassman, McDermott

121. Acoustic Phonetics. Physiological and acoustical variables differentiating speech signals. Various phonemic classification systems including I.P.A. and Distinctive Feature Analysis are considered; phonemic transcription practiced. (3 cr; prereq 119, 120 or ¶) Wendahl

122. Voice Science. Close inspection of research data relevant to basic processes in speech production and perception. Topics include the respiratory system as a generator, vocal folds and articulators as sound sources, and the vocal tract as an acoustic modifier of the sound source. Laboratory experience and exercises. (3 cr; prereq 119, 120, 121) Wendahl

123. Laboratory Instrumentation. Basic electronics from Ohm's Law to vacuum tube and transistor amplifier design. Course designed to give student in speech basic knowledge of instrumentation in his field. (3 cr) Wendahl

140. Diagnosis and Evaluation of Speech Disorders. Principles of diagnosis and evaluation of speech disorders. Research and clinical materials relative to construction, administration, and interpretation of various diagnostic instruments. Observation and participation in various diagnostic speech facilities. (4 cr; prereq 99 and 121 or ¶ and ‡) Martin, Stolts

141. Stuttering. Analysis of materials relating to development, characteristics, and treatment of stuttering. Class demonstrations and individual projects. (3 cr; prereq 99 or ‡) Henrikson

142. Voice Disorders. Pitch, loudness, quality—their symtomatology, etiology, diagnosis, and treatment. Topics include: organic pathologies of the voice, psychological factors and voice, methods of diagnosis and treatment of voice disorders. (3 cr; prereq 99, 120 or ‡) Starr

143. Articulation Disorders. Research and theory of the nature, etiology, and treatment of articulatory problems. (3 cr; prereq 99, 121 or ‡) McDermott

144. Neuromuscular Disorders. Survey of neuromuscular disorder—cerebral palsy, multiple sclerosis, muscular dystrophy, etc.—their symtomatology and etiology and approaches to diagnosis and treatment of communication problems which occur in conjunction with them. Topics include: sensory and motor problems; language problems; diagnosis and treatment. (2 cr; prereq 120, 143 or ‡) Greenberg

145. Aphasia. In adults and children. Etiology, language, and associated nonlanguage problems; therapeutic considerations and procedures. (2 cr; prereq 99, 120 or ‡) Greenberg

146. Cleft Palate. Survey of medical, dental, and communication problems involved. Topics include: anatomy and physiology involved in velopharyngeal closure, etiology of cleft palate; surgical, orthodontic, and prosthodontic treatment of cleft palate; articulation, voice, language, and hearing loss problems. (2 cr; prereq 120, 143) Starr

147. Rehabilitation of the Laryngectomized. Historical and contemporary types of surgical intervention. Relation between types of surgery and development of speech. Methods of initiating and developing communication. Use of artificial larynx. Co-operation with other rehabilitation agencies and personnel. (2 cr; prereq 99, 120 and ‡) Henrikson

150. Speech Retardation. Theory and experimental research dealing with speech development as related to delayed or retarded speech. (3 cr; prereq 99) Siegel

164-165. Clinical Methods and Practice in Speech Pathology. (3 cr per qtr; prereq 141, 142) Staff

166A. Clinical Methods and Practice in Speech Pathology: Cleft Palate. (1-3 cr; prereq SSPA 141, 142 or ‡) Starr

166B. Clinical Methods and Practice in Speech Pathology: Voice. (1-3 cr; prereq SSPA 141, 142 or ‡) Starr

166C. Clinical Methods and Practice in Speech Pathology: Articulation. (1-3 cr; prereq SSPA 141, 142 or ‡) McDermott

166D. Clinical Methods and Practice in Speech Pathology: Stuttering. (1-3 cr; prereq SSPA 141, 142 or ‡) Martin

166E. Clinical Methods and Practice in Speech Pathology: Neuromuscular Disorders. (1-3 cr; prereq SSPA 141, 142 or ‡) Staff

166F. Clinical Methods and Practice in Speech Pathology: Aphasia. (1-3 cr; prereq SSPA 141, 142 or ‡) Greenberg

166G. Clinical Methods and Practice in Speech Pathology: Laryngectomy. (1-3 cr; prereq SSPA 141, 142 or ‡) Henrikson

166H. Clinical Methods and Practice in Speech Pathology: Hearing Impaired. (1-3 cr; prereq SSPA 141, 142 or ‡)

170. Hearing Disorders. Basic orientation to audiology. Symptomatology and pathology of hearing disorders, their medical and surgical treatment. Clinical and educational management. Psychological effects of hearing impairment. (3 cr; prereq 99, 119 or ‡) Lassman

171. Audiometry I. Pure tone and audiometry; air and bone conduction; screening audiometry; hearing conservation programs. (4 cr; prereq 99 and 119) Chaiklin

172. Communication Problems of the Hearing Impaired. Effects of impaired hearing on speech and language development. Development of speech and language for hearing impaired individuals through speech, speed reading, auditory training and other special methods and philosophies. (3 cr; prereq 170 or ‡)

173. Audiometry II. Loudness measurements and their relation to assessment of auditory disorders. Theoretical bases of loudness measurements, relevant research on loudness variables; laboratory and clinical instrumentation, procedures such as loudness matching Bekesy audiometry, and difference limen tests; implications for auditory problems. (3 cr; prereq 171) Lassman and staff

174. Speech Audiometry. Use of speech signals in evaluating the auditory system's function; types of stimulus materials, methods of administration and interpretation of results; research on theoretical and applied aspects. (3 cr; prereq 122, 171 or ‡) Chaiklin

175. Galvanic Skin Response Audiometry. Galvanic skin response audiometry in the differential diagnosis of auditory disorder; nature of the GSR mechanism; historical aspects; conditioning literature relevant to audiometry; special applications such as instrumental avoidance and delayed feedback techniques. (3 cr; prereq 173) Chaiklin

176. Hearing Science. Fundamental concepts in normal audition. Psychoacoustic methods; sensitivity and acuity; loudness, pitch, timbre, distortion, aural harmonics; masking, adaptation; the auditory reflex; binaural phenomena, localization. (3 cr; prereq 170 or Psy 55) Ward

177. Industrial Audiology and Occupational Hearing Loss. Temporary and permanent effects of steady, intermittent, and impulse noises on hearing. Noise measurement, reduction, and control; ear defenders and their limitations. Hearing conservation programs; pre-employment testing and monitoring audiometry. (3 cr; prereq 170 or ‡) Ward

180. Auditory Training. Problems of auditory discrimination and of hearing aid usage in persons with impaired hearing. Methods of developing skills in listening with and without acoustic amplification. Supervised practice with auditorially handicapped children and adults. (3 cr; prereq 119, 171 or ‡)

181. Speech for the Hearing Impaired. Language problems resulting from impaired hearing. Survey of approaches of developing and teaching speech to the hearing impaired individual. (3 cr; prereq 170 or ‡)

182. Lipreading and Lipreading Methods. Theory, principles, and methods of teaching lipreading. Considerations of visual perception and learning. Supervised practice in teaching lipreading to hard-of-hearing persons. (3 cr; prereq 170 or ‡) Staff

183. Language for the Hearing Impaired. Language problems resulting from impaired hearing. Survey of approaches of developing and teaching language to the hearing impaired individual. (3 cr; prereq 170 or ‡)

190, 191, 192. Clinical Methods and Practice in Audiology. Methods and supervised practice in analysis diagnosis and habilitation of communication disorders of persons with auditory impairments. (3 cr; prereq 173 or 174 or ‡) Chaiklin and staff

201.° **Seminar: Advanced Problems.** (Old 231) (3 cr, can be repeated; prereq ‡) Staff

204, 205, 206.° **Research.** (Old 241, 242, 243) Open to graduate students engaged in research. (Cr ar; prereq ‡) Staff

224, 225, 226. **Seminar: Experimental Phonetics.** (Old 267, 268, 269) Critical analysis of significant research in physiological and acoustic phonetics. Examination of theory, method, instrumentation, and date. (3 cr per qtr; prereq 122) Wendahl

241. **Seminar: Stuttering.** (Old 262) Intensive exploration of theoretical explanation of stuttering; research data and methodologies subserving the respective theories. Students independently design and, when feasible, execute research studies which derive from, and are consistent with a particular theory of stuttering. (3 cr; prereq 141 or ‡) Henrikson, Martin

242. **Seminar: Voice.** (Old 232) Advanced study and independent research. (3 cr; prereq 142 or ‡) Starr, Wendahl

243. **Seminar: Articulation.** (Old 233) Advanced study and independent research. (3 cr; prereq 143 or ‡) Templin, McDermott

244. **Seminar: Neuromuscular Disorders.** (Old 282) Critical review of research on communication problems of persons with neuromuscular disorders. (3 cr; prereq 144 or ‡) Staff

245. **Seminar: Aphasia.** (Old 281) Review of principal theoretical treatments, instruments for evaluation, and methods of clinical management of acquired aphasia and related disorders. Independent investigation of parameters determinative of aphasic behavior. (3 cr; prereq 145 or ‡) Darley

246. **Seminar: Cleft Palate.** (Old 283) Critical review of research on communication problems of persons with cleft palates. (3 cr; prereq 146 or ‡) Starr

247. **Seminar: The Laryngectomized.** Analysis of various research techniques and research findings relating to the laryngectomized person, the production of postlaryngectomy speech and characteristics of this speech. Individual investigation projects in one of these areas. (3 cr; prereq 147 or ‡) Henrikson

248. **Seminar: Analysis of Literature in Speech Pathology.** (Old 261) Basic problems relating to evaluation of various types of literature in speech pathology. Individual projects designed to determine and evaluate the student's analytical procedures. (3 cr; prereq grad major in speech pathology or ‡) Henrikson

249. **Seminar: Current Issues in Speech Pathology.** (Old 263) Significant problem areas in speech pathology; relation to other rehabilitation programs and personnel. Class projects involving in-depth exploration of a specific problem. (3 cr; prereq grad major in speech pathology or ‡) Henrikson

250. **Seminar: Language Retardation.** (Old 257) Analysis of causation, diagnosis, and current research techniques. (3 cr; prereq ‡) Siegel

270. **Diagnosis of Disorders in the Auditory System.** Use of audiological data in identification of site and nature of lesions in the auditory system. Differential diagnosis of temporal lobe, eighth nerve, cochlear, middle ear, and functional hearing disorders. (3 cr; prereq 173, 174 and ‡) Lassman

271. **Selection and Use of Hearing Aids.** Nature and types of amplifying systems used with the hearing impaired. Electroacoustic characteristics including gain, power, acoustic response, distortion, etc. Principles and methods of selection and usage relative to types of hearing disorders. (3 cr; prereq 123, 270 or ‡) Lassman

272. **Pediatric Audiology.** Assessment and clinical management of infants and children with hearing disorders. Problems of differential diagnosis; screening, conditioning procedures; electrophysiologic methods. Selection and use of hearing aids for children. Guidance of parents. (3 cr; prereq 173, 174 and ‡) Lassman

280, 281, 282. **Seminar: Hearing.** (Old 271, 272, 273) Major experimental research in psychophysiological and psychoacoustical nature of hearing. Critical analysis of theory, experimental method, and treatment of data. (3 cr per qtr; prereq ‡) Staff

283. Seminar: Current Issues in Audiology. Significant problem areas in audiology and its relation to other rehabilitation programs and personnel. Class projects involving in-depth exploration of a specific problem. (3 cr; prereq ‡) Staff

290, 291, 292. Advanced Clinical Methods and Practice in Audiology. Supervised internship experiences for advanced graduate students working with communication disorders of persons with auditory impairments. (3 cr; prereq 190, 191, 192 and ‡)

STATISTICS

Professor
Jacob E. Bearman (Biometry)
Robert J. Buehler
John S. Chipman (Economics)
Raymond Collier (Educational Psychology)
Leonid Hurwicz (Economics)
Gopinath Kallianpur
Milton Sobel

Associate Professor
Bernard Lindgren, *chairman*
Charlotte Striebel

Assistant Professor
Vidyadhar Mandrekar

General Viewpoint—Any candidate for an advanced degree with a major in statistics will be expected to become familiar with modern statistical theory, its supporting mathematics, and its applications.

Prerequisites—Mathematics through integral calculus.

Adviser—The chairman of the statistics graduate faculty, Professor Kallianpur, may be consulted for assistance in selecting an adviser from the above list.

Language Requirement—For the Master's degree reading knowledge of one foreign language is required; for the Doctor's degree reading knowledge of two foreign languages, or a reading knowledge of one foreign language and a special research technique or a collateral field are required. The languages are ordinarily chosen from Russian, French, German.

Master's Degree—Offered under both Plan A and Plan B. Both written and oral examinations are required.

Doctor's Degree—Most of the course work in a major program is to be chosen from the first list of courses below; some courses from the second list may be offered with the adviser's consent. A written preliminary examination is ordinarily given twice during each year; consult the chairman of the statistics faculty to arrange for this examination. A major program should include at least Stat 201-202-203, and mathematics at least through advanced calculus and linear algebra; most candidates will also include in their programs Stat 221-222-223 and Math 222A,B,C. The minor may be in mathematics or in a field in which the candidate expects to apply statistics; if the minor is mathematics, the major program should include contact with the use of statistics in some field of application.

Minor in Statistics, Ph.D.—It should not be assumed that an arbitrary selection of courses will satisfy the minor requirements. A minimum requirement includes one of the sequences Stat 121-122-123 and Stat 131-132-133, and evidence of familiarity with least squares, regression, and analysis of variance at the same level as these courses. The minor program should be planned in

advance; consult the chairman of the statistics graduate faculty. A written examination in the minor is not required.

Probability—Students are expected to acquire at least a basic knowledge of probability theory. Candidates for the Ph.D. degree will ordinarily include an advanced sequence in probability in their programs either as part of the major or as part of a mathematics minor.

101. Introduction to Decision Theory. Elements of probability; basic concepts in statistical decision theory; relationship to game theory and other types of decision problems; prediction and inference. (3 cr; prereq Econ 101A, or Math 40, or 42 or 13, or ♯)

110. Methods of Statistics. Not offered in the Statistics Department. Register for one of the following sequences: PubH 120, 121, 130, 131; Biom 100, 101, 201; Biom 100, AgEc 101, Agro 248; QA 191A, B, 193; EPsy 216, 217, 218, 216A, 217A, 218A. Credit is allowed for only one of these sequences; they differ somewhat in the number of credits, in the amount of laboratory work, and in the order of topics, but are at about the same mathematical level and overlap greatly in content.

121-122-123. Theory of Statistics. Univariate and multivariate distributions, law of large numbers, sampling, likelihood methods, estimation, hypothesis testing, regression and analysis of variance and covariance, confidence intervals, distribution-free methods. (3 cr per qtr; for nonmajors; prereq Math 10 for 121, Math 43 or equiv for 122, Math 44 or equiv for 123)

131-132-133. Theory of Statistics. 131: Probability models, univariate and bivariate distributions, independence, basic limit theorems. 132-133: Statistical decision theory, sampling, estimation, testing hypotheses, parametric and nonparametric procedures for one-sample and two-sample problems, regression, analysis of variance. (3 cr per qtr; prereq ¶intermediate calculus for 131, ¶advanced calculus for 132, ¶107 and 123 or equiv or ♯ for 132 when it is offered alone out of sequence)

Math 133B-134B. Probability with Technological Applications

144-145. Theory of Sample Surveys. Mathematical treatment of survey sampling, including stratified and multistage sampling, models for nonsampling errors. (3 cr per qtr; prereq 123 or 133)

151. Quality Control and Sampling Inspection. Not offered in the Statistics Department. Register for IE 171, 177, or QA 181.

161. Design of Industrial Experiments. For students with a background of calculus and some statistical theory. Not offered in the Statistics Department. Register for IE 198-199.

QA 171. Sample Surveys

Math 178A,B,C. Introduction to Probability Theory

181A,B,C. Topics in Statistics. Topics vary according to needs and available staff; may be repeated for credit. (3 cr per qtr; prereq 123 or 133 or ♯)

191-192-193. Analysis and Design of Experiments. Theory and applications of the general linear model, regression, analysis of variance, and design of experiments. (3 cr per qtr; prereq 123 or 133, and matrix theory)

194. Introduction to Correlation and Multivariate Analysis. The multivariate normal distribution and its properties. Inference on sample mean vectors and covariance matrices. Distribution and uses of sample correlation coefficients. Distribution and uses of Hotelling's T^2 statistic. Classification problems and the discriminant function. (3 cr; prereq 133 and Math 131A or ♯)

201-202-203. Theory of Statistical Inference. Topics in distribution theory, large sample theory, multivariate theory, sequential analysis, decision theory, nonparametric inference—more extensive and deeper coverage than in 131-132-133. (3 cr pr qtr; prereq 133, or ¶132 and 123, and advanced calculus, or ♯)

201A-202A-203A. Theory of Statistical Inference, Laboratory. Exercise in the application of the material in 201-202-203 to specific problems and practical situations. (1 cr per qtr; prereq ¶201-202-203)

221-222-223. Advanced Statistical Theory. Advanced topics in general inference and decision theory. (3 cr per qtr; prereq 203 plus a sequence in probability and Math 222, or ‡)

241A, B, C. Nonparametric Inference. Optimality properties of sufficiency, completeness, and invariance introduced and used to derive broad classes of procedures, e.g., those based on randomization, rank orders, runs, etc. Special limit theorems and measures of efficiency, tolerance intervals, Chebyshev inequalities, Kolmogorov-Smirnov statistics, and other tests of goodness of fit. (3 cr per qtr; prereq ‡)

Math 260A-B-C. Theory of Probability

Math 261A-B-C. Stochastic Processes

Math 262A-B-C. Topics in the Theory of Probability

281A, B, C. Advanced Topics in Statistics. Topics vary according to needs and available staff; may be repeated for credit. (3 cr per qtr; prereq ‡)

294. Advanced Multivariate Analysis. Tests of independence, homogeneity tests for means and dispersions, generalized regression and dispersion analysis, component analysis, canonical analysis, distribution of eigenvalues of random matrices and of sample canonical correlations. (3 cr; prereq 192 and 194 or ‡)

301. Seminar. Problems, current literature review, research. (1-3 cr per qtr; prereq ‡)

RELATED COURSES

(See statement above concerning statistics credit for these courses)

AnHu 204. Quantitative Inheritance II

CPsy 227. Multiple Factor Analysis

Econ 195B. Decision Making and Operations Analysis

Econ 201A, B, C. Econometrics

Econ 301. Seminar: Econometrics and Statistical Inference

Econ 391A, B, C. Seminar: Workshop in Econometrics

EPsy 208. Methods in Educational Research

EPsy 219, 219A. Design and Analysis of Statistical Investigations

EPsy 220, 221. Advanced Theory of Measurements

EPsy 243. Problems in Statistics

Math 133A, 134A. Mathematical Methods of Operation Analysis

Math 241. Information Theory

PubH 150. Vital Statistics

PubH 201. Topics in Biometry

PubH 203-208. Research Design in Biometry

PubH 211. Seminar: Biometry

PubH 216-219. Biomedical Measurement Problems

PubH 250-251-252. Foundations of Biometry

QA 291A, B. Reading and Research in Statistics

STUDIO ARTS

Professor
Malcolm H. Myers, *chairman*
Allen Downs
Jerome Liebling
Walter W. Quirt

Associate Professor
Peter Busa
Warren MacKenzie
Katherine Nash
Herman T. Rowan

Assistant Professor
Zigmunds Priede

Prerequisites—For the *master of fine arts degree*, admission to candidacy is limited to a selected group of students with a Bachelor's degree from an approved university or college or the equivalent and to those who provide evidence of exceptional promise as creative artists in one or more of the following subfields: painting, sculpture, printmaking, film and photography, and ceramics.

Master of Fine Arts Degree (Studio)—The applicant for admission to the master of fine arts program must submit to the chairman of the Art Department a portfolio of examples of his work in the performing medium which he wishes to emphasize in the M.F.A. program. If actual examples of the student's work are difficult to submit, color slides will be accepted. No recommendation concerning admission will be made on an application for admission until the portfolio has been received and evaluated in the Art Department and the completed application for admission to the Graduate School has been received in the Graduate School office.

The candidate for the master of fine arts degree must complete a program of approximately 2 full years of graduate credits, 45 of which must be earned in graduate courses at the University of Minnesota. He must execute and leave a record of a creative project (production, recital, or exhibition) which will be accompanied by a supporting paper that deals with the planning and/or execution of the creative work. A minimum of 9 credits will be required in history of art or literature and a further minimum of 9 credits in areas of study outside the department. The individual program must be approved by the M.F.A. committee. The candidate will be subject to final written and oral examinations.

For the master of fine arts degree, admission to candidacy is limited to a selected group of students with the Bachelor's degree from an approved university or college or the equivalent and to those who provide evidence of exceptional promise as creative artists in one or more of the following—painting, sculpture, printmaking, film and photography, and ceramics.

Minor in Art—The faculty in fine arts offers work in the subfields of art history and the studio practice of the arts which may be presented as the minor by candidates for the master of arts and Ph.D. degrees in other major fields.

120x-121x-122x. Advanced Drawing. (Primarily for painting majors) Drawing in all media from life and from imagination. Studies of history of drawing. (3 cr per qtr; prereq 55 or equiv) Staff

123f-124w-125s. Film Workshop. Motion picture as an art form. Script preparation, camera technique, and editing; visual aspects of film making. Analysis of selected professional films and visits to local studios. Winter and spring quarters, concentration on production, editing, and technical problems through making of a short film. Production limited to descriptive and experimental work. (3 cr per qtr; prereq art or humanities or music or theater major and ‡) Downs, Liebling

133f-134w-135s. Lithography. Introduction to lithography, planographic methods. (3 cr per qtr; prereq 32 or ‡) Priede

150f,w,s-151f,w,s-152f,w,s. Problems in Painting. (3 cr per qtr; prereq 72 and ‡) Quirt, Busa, Rowan

180ABCf,w,s, 181ABCf,w,s, 182ABCf,w,s. Sculpture IV. Advanced work in wood, stone, plaster, metal, and other materials of sculpture. Students work individually on projects. (3 cr; prereq total of 9 cr numbered 81 or above)

183. Proseminar: Twentieth-Century Art Theories. Lectures and discussion. Painting studio staff and students request class for verbal presentation and analysis of contemporary trends as related to the actual process of creativity. (3 cr per qtr; prereq 152, ‡) Busa, Myers, Quirt

184. Proseminar: Photography. Lectures and discussion of advanced problems involved in appropriate media. Staff and students request means to present verbal and theoretical information in addition to practice. (3 cr per qtr; prereq 125 and ‡) Downs, Liebling

190f-191w-192s. Advanced Printmaking—Intaglio Processes. (3 cr per qtr; prereq 90 or ‡) Myers

193f-194w-195s. Advanced Problems in Studio. Individual projects and guidance. (3 cr per qtr; prereq ‡) Staff

200-201-202. Advanced Problems in Painting. (3 cr per qtr; prereq ‡) Busa, Quirt, Rowan

203f,w,s-204f,w,s-205f,w,s. Advanced Problems in Painting. (3 cr per qtr; prereq ‡) Busa, Quirt, Rowan

210A-B-C. Advanced Problems in Sculpture. Graduate survey into advanced problems in permanent materials. (3 cr per qtr; prereq ‡) Nash

211A-B-C. Advanced Problems in Sculpture. Individual research of the student's choice. (3 cr per qtr; prereq 210A-B-C) Nash

212A-B-C. Advanced Problems in Sculpture. Individual research of the student's choice. (3 cr per qtr; prereq 211A-B-C) Nash

213-214-215. Printmaking—Planographic Processes. (3 cr per qtr; prereq 135, ‡) Myers

220f,w,s-221f,w,s-222f,w,s. Advanced Problems in Printmaking. (3 cr per qtr; prereq 192) Myers

223-224-225. Printmaking. For second-year M.F.A. students in any medium. (3 cr per qtr; prereq ‡) Myers

231f-232w-233s. Advanced Problems in Drawing. (3 cr per qtr; prereq ‡) Busa, Quirt, Rowan

240f,w,s-241f,w,s-242f,w,s. Advanced Problems in Ceramics. (3 cr per qtr; prereq ‡) MacKenzie

243-244-245. Advanced Problems in Ceramics. (3 cr per qtr; prereq ‡) MacKenzie

250S-251S-252S.† Seminar: Independent Creative and Critical Research and Methodology. (No cr; may be required of MFA students; prereq consent of grad adviser) Graduate staff

260F-261F-262F. Film. (3 cr; prereq 125, ‡) Downs, Liebling

260Ph-261Ph-262Ph. Photography. (3 cr; prereq 125, ‡) Downs, Liebling

263F-264F-265F. Film. (3 cr; prereq 262F or ‡) Downs, Liebling

263Ph-264Ph-265Ph. Photography. (3 cr; prereq 262Ph or ‡) Downs, Liebling

SURGERY

(Including Divisions of General Surgery, Neurosurgery, Orthopedic Surgery, Urology, Proctology, and Dental Surgery)

For staff and courses of study offered, see the *Bulletin of the Graduate Programs in Medicine, Dentistry, and Pharmacy.*

VETERINARY MEDICINE

Professor
Robert K. Anderson
John P. Arnold
Giulio D'Angio
Archie L. Good
Henry J. Griffiths
Paul B. Hammond
John Higbee
Joseph M. Janes
C. Walton Lillehei
Robert K. Lindorfer
Donald G. Low
George W. Mather
Benjamin S. Pomeroy
Jay H. Sautter
Dale K. Sorensen
Francis A. Spurrell
Clarence M. Stowe
William T. S. Thorp, *dean*
Edward A. Usenik
Owen H. Wangensteen
Alvin F. Weber
Raimunds Zemjanis

Associate Professor
Donald M. Barnes
Harold E. Dziuk
Ira M. Gourley
Donald W. Johnson
Merle K. Loken
Robert A. Merrill
Glen H. Nelson
Victor Perman

Assistant Professor
William J. Bemrick
Martin E. Bergeland
Melvyn L. Fahning
Thomas F. Fletcher
Griselda F. Hanlon
Kenneth H. Johnson
John H. Kurtz
Keith I. Loken
Charles H. McGinnis
Richard K. Schultz

Clinical Assistant Professor
Robert H. Monahan

Instructor
Edward F. Jankus

Major or minor work leading to the master of science and doctor of philosophy degrees may be taken in the following fields: veterinary anatomy, veterinary bacteriology, veterinary medicine, veterinary obstetrics and gynecology, veterinary parasitology, veterinary pathology, veterinary physiology and pharmacology, and veterinary surgery and radiology.

Prerequisites—Graduate students desiring to take their major work in the above fields should present a D.V.M. degree or its equivalent from a recognized veterinary medical college. Students who minor in the clinical fields of veterinary medicine must have the D.V.M. degree.

Major Work—Students who major in any field of veterinary medicine must choose a minor in a field outside of veterinary medicine.

Language Requirement—For the Master's degree, one foreign language (German, Danish, French, Japanese, Norwegian, Russian, Spanish, or Swedish) is required. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge. When two languages are offered, acceptable combinations are: German, Swedish, Norwegian, or Danish combined with Russian, Japanese, French, or Spanish *or* Russian or Japanese combined with French or Spanish.

Master's Degree—Offered under Plan A. In special circumstances Plan B may be followed with the adviser's consent.

Doctor's Degree—Work for the Ph.D. degree is offered in the fields listed above.

Veterinary Anatomy

100. Orientation for Veterinary Students. History of veterinary medicine, various phases of veterinary medical endeavor, and matters pertaining to professionalism. (1 cr; prereq ‡) Weber

101. Veterinary Anatomy. Anatomy of the thoracic limb, thorax, and abdomen. (7 cr; prereq ‡) Fletcher

102. Veterinary Anatomy. Anatomy of the pelvis, pelvic limb, and head and neck. (8 cr; prereq ‡) Fletcher

106. Veterinary Surgical Anatomy. Topographical anatomy of domestic animals as applied to surgery and practice of veterinary medicine. (1 cr; prereq 103, VMC 101, ‡) Fletcher, Arnold

120. Essentials of Vertebrate Development and Structure. (Same as Zool 120) Principles and patterns of vertebrate anatomy, based on the developmental approach. (5 cr; prereq Biol 2 or 50 or ‡) Staff

130. Veterinary Neuroanatomy. Functional study of gross and microscopic anatomy of the central nervous system and special sense organs of domestic animals. (3 cr; prereq 101, 151, or ‡) Fletcher

150. Comparative Prenatal Development of Domestic Animals. Microscopic and gross anatomical studies of origin and development of body organ systems and morphological considerations of fetal-maternal relationships. (4 cr; prereq ‡) Priedkalns, Weber

151-152-153. Microscopic Anatomy of Domestic Animals. Microscopic studies of tissues and organs of domestic animals. (3 cr for 151, 4 cr for 152, 5 cr for 153; prereq ‡) Weber, staff

190.° Seminar: Veterinary Anatomy. (1 cr; prereq 101, 151, ‡) Weber, Fletcher

191x.° Topics in Organology. Lecture and laboratory presentations regarding selected organ systems of domestic and laboratory animals. (2-5 cr per qtr; prereq 151 or equiv, ‡; regis for more than 1 qtr permitted) Weber, Fletcher

201, 202. Comparative Veterinary Neurology. Correlated studies of the central nervous system of domestic animals. Emphasis on relating neuroanatomy to neurophysiology. (4 cr per qtr; prereq 101, ‡) Fletcher

203. Experimental Comparative Veterinary Neurology. Principles, methods, and laboratory exercises in investigating the central nervous system of domestic animals. (3 cr; prereq 202, ‡) Fletcher

250. Morphology of Animal Cells and Intercellular Substances. Components of basic tissues of the animal body. (3 cr; prereq 153, ‡) Weber

251. Histological and Ultrahistological Techniques. Principles and methods in preparing animal tissues for histological and ultrahistological observation. (3 cr; prereq 153, ‡) Weber

Veterinary Bacteriology and Public Health

101. General Veterinary Bacteriology and Immunology. Lectures and laboratory on classification, morphology, and physiology of bacteria; bacteriology of water, sewage, milk, and food. Basic principles of infection and immunity. (6 cr; prereq 10 cr in zoology, 13 cr in chemistry, ‡) Lindorfer, Loken

102. Pathogenic Bacteria and Fungi. Lectures and laboratory on animal pathogens; basic mechanisms of infection. (6 cr; prereq 101 or equiv, ‡) Loken, Lindorfer

103. Veterinary Virology. Basic techniques of virology; viral and rickettsial agents which cause animal diseases. (4 cr; prereq 102 or equiv, ‡) Lindorfer, Loken

125-126-127. Veterinary Public Health. Principles of epidemiology; selected diseases of man and of animals transmissible to man; principles and methodology of food hygiene; meat, poultry, milk, and other foods as related to animal and human health; veterinarians' relationship to public health and animal disease control agencies. (4 cr for 125, 3 cr for 126, 2 cr for 127; prereq 103, VPaP 153, ‡) Anderson

128x.° Problems in Veterinary Bacteriology and Public Health. (Cr ar; prereq 103 or equiv, ‡) Pomeroy, Anderson, Lindorfer, Loken

130. Poultry Hygiene. General anatomy of the fowl, physiology of digestion and reproduction, and the prevention and control of the more important diseases affecting poultry. (3 cr; prereq Biol 2, Poul 1, MicB 53; offered 1967-68 and alt yrs) Pomeroy

131. Poultry Diseases and Production. Advanced lectures dealing with diseases, management, and feeding practices in current poultry production. (5 cr; prereq 103, VPaP 153, ‡) Pomeroy, Waibel

201x.° Advanced Poultry Diseases. Investigations of specific infectious disease problems of poultry. (Cr ar; prereq 131, ‡) Pomeroy, Higbee, Nelson, Bergeland

205x.* **Advanced Veterinary Bacteriology.** Special topics, techniques, collateral reading, and conferences. (Cr ar; prereq ‡) Pomeroy, Lindorfer, Anderson, Loken

211. Seminar: Veterinary Bacteriology. (1 cr; prereq ‡) Pomeroy, Anderson, Lindorfer, Loken

221. Advanced Veterinary Public Health. Veterinary public health programs and selected diseases common to animals and man. (Cr ar; prereq 127, ‡) Anderson

Veterinary Medicine

101. Veterinary Physical Diagnosis. Fundamentals of clinical veterinary medicine, procedures in physical diagnosis and restraint of animals. (4 cr; prereq ‡) Low

102. Large Animal Medicine. Diseases of the skin, musculoskeletal system, respiratory system, and cardiovascular system. (4 cr; prereq 101) Sorensen, Johnson

103. Large Animal Medicine. Diseases of the skin, hemic and lymphatic system, and digestive system. (4 cr; prereq 102) Sorensen, Johnson

104. Large Animal Medicine. Diseases of the urinary system, endocrine system, nervous system, and organs of special sense. Metabolic diseases, nutritional deficiencies, and toxic diseases affecting several systems or the body as a whole. (5 cr; prereq 103) Sorensen, Johnson

106. Small Animal Medicine. Diseases of the skin, musculoskeletal system, respiratory system, cardiovascular system, hemic and lymphatic system, and digestive system. (5 cr; prereq ‡) Mather

107. Small Animal Medicine. Diseases of the urogenital system, endocrine system, nervous system, and organs of special sense. Infectious diseases, nutritional deficiencies and toxic diseases affecting several systems of the body as a whole. (4 cr; prereq 106) Mather

130. Veterinary Jurisprudence and Business Methods. Business and legal procedures applicable to veterinary practice. Responsibilities of the veterinarian to the client, the public, and the profession. (3 cr) Sorensen

131. Infectious Diseases of Large Animals. Bacterial, mycotic, viral, and rickettsial diseases of large animals, affecting the body as a whole; pathogenesis, symtomatology, differential diagnosis, treatment, prevention, and control procedures. (5 cr; prereq 104) Sorensen, Johnson

132. Preventive Veterinary Medicine. Principles and application of preventive medical procedures for specialized practice. (5 cr) Sorensen, Johnson

137. Animal Diseases and Poisonous Plants. Important plants poisonous to animals: identification, toxicology, diagnosis, and treatment. (3 cr; prereq 104) Johnson, Kommedahl

201x.* **Advanced Veterinary Medicine.** Detailed discussions of the diseases of organs or systems in animals. One of the following etiologic group—prenatal, metabolic, toxic, infectious, or physical influences—will be selected for discussion for any quarter. (Cr ar; prereq 104, 131, ‡) Mather, Sorensen, Low

202x.* **Advanced Diagnosis and Therapeutics of Animal Diseases.** Detailed examination, discussions, and treatment of cases of animal diseases. (Cr ar; prereq 104, 131, ‡) Mather, Sorensen, Low

203x.* **Seminar.** (Cr ar; prereq ‡) Sorensen

204x.* **Medical Conference.** Medical, surgical, or obstetrical cases supported by anatomic, bacteriologic, pathologic, physiologic, pharmacologic, and radiologic evaluations whenever applicable. (Cr ar; prereq 104, 131, ‡) Mather, Sorensen, Low

Veterinary Obstetrics and Gynecology

101. Veterinary Obstetrics. Lectures on physiology and pathology of pregnancy, obstetrics, and diseases of new born. Laboratory practices in manipulative obstetrics. (4 cr; prereq VMC 101, ‡) Zemjanis

102. Animal Reproduction. Lectures on physiology and pathology of reproduction, artificial insemination, and breeding management. (4 cr; prereq VMC 101, 113, ‡) Zemjanis

201x. Advanced Diagnostic Methods. Detailed discussion and laboratory practices of methods for determination of fertility status of female and male animals. (3 cr; prereq 102 or equiv) Zemjanis, Fahning, Schultz

204x. Special Problems in Animal Reproduction. Detailed discussion and laboratory study of specific reproductive disorders. (Cr ar; prereq 102, 201) Zemjanis

206x. Comparative Physiology of Reproduction. Physiological variations of reproduction within and between species. (Cr ar; prereq VPP 109, VObs 102) Zemjanis and staff

210, 211, 212. Advanced Endocrinology of Reproduction. Physiological aspects of endocrinology involved in sex function. 210: Pituitary and pregnancy gonadotrophins. 211: Gonadal hormones. 212: Interaction between endocrine and nervous systems. (1 cr per qtr; prereq VPP 109, MdBc 100, 101) Zemjanis and staff

Veterinary Pathology and Parasitology

101. Veterinary Parasitology. Biological study of protozoan and arthropod parasites of animals; their relationships to disease and principles of parasite control. (5 cr; prereq VPaP 151, ‡) Griffiths, Bemrick, Schlotthauer

102. Veterinary Parasitology. Helminth parasites and parasitic diseases of animals; principles of control. (5 cr; prereq ‡) Griffiths, Bemrick, Schlotthauer

103. Diseases and Parasites of Wildlife. Economic and biological relationships of animal parasites and disease to regional wildlife. (3 cr; prereq ‡; offered 1967-68 and alt yrs) Griffiths, Barnes

151. General Veterinary Pathology. Descriptions, discussions, gross and microscopic demonstrations of tissue reactions, including retrogressive and inflammatory changes, neoplasms, and reparative processes. (5 cr; prereq VBac 101, ‡) Johnson and staff

152-153. Special Veterinary Pathology. Diseases of respiratory, cardiovascular, digestive, urinary, genital, endocrine, nervous, integumentary and locomotor systems. (5 cr per qtr; prereq 151, ‡) Johnson and staff

154. Veterinary Clinical Pathology. Application and interpretation of laboratory tests used in clinical diagnosis. (2 cr; prereq 153, ‡) Perman

155x. Veterinary Clinical Pathology. Application of laboratory methods to clinical material. (1-3 cr; prereq 154 or equiv, △) Perman

156. Diseases of Fur-Bearing Animals. Etiology, symtomatology, and treatment of diseases of fur-bearing animals. (2 cr; prereq 153, VMC 122, ‡) Higbee and staff

157x. Veterinary Necropsy. Necropsies, techniques, examination of tissue sections and preparation of records. (1-5 cr per qtr; prereq 153 or equiv, △) Kurtz and staff

158x. Surgical Pathology. Preparation and interpretation of surgical and necropsy specimens. (3 cr; prereq 157, △) Bergeland and staff

159. Oncology. Study of spontaneous and induced avian and mammalian neoplasms with emphasis on diagnosis. (4 cr; prereq 151 or equiv, ‡) Perman, Barnes, Johnson

160x. Diagnostic Pathology. Interpretation of anamnesis, necropsy findings, laboratory findings and histopathology in diagnosis of animal diseases. (5 cr; prereq 157, ‡, △) Bergeland and staff

202.* Seminar. (1-2 cr; prereq 153 or equiv, ‡) Barnes

240x.* Advanced Veterinary Parasitology. More important parasites of domestic animals, their identification, life histories, economic importance, and relation to disease. (Cr ar; prereq 102 or equiv and ‡) Griffiths, Bemrick

241x.* Problems in Veterinary Parasitology. (Cr ar; prereq 102 or equiv, ‡) Griffiths, Bemrick

Veterinary Physiology and Pharmacology

105-106-107-108. Animal Physiology. Physiology of circulation, respiration, digestion, kidney function, nervous system, and special senses in domestic animals. (5 cr for 105 [lect], 2 cr for 106 [lab], 3 cr for 107 [lect], 2 cr for 108 [lab]; prereq MdBc 101 or equiv or ‡; students may register for lect without lab) Good, Dziuk, McGinnis

109. Physiology of the Endocrine and Reproductive Systems. Function and regulation of endocrine organs and reproductive system in domestic animals. (3 cr; prereq 108, ‡) Good

120.° Seminar: Animal Physiology. (2 cr; prereq 109, ‡) Good, Dziuk

130x.° Problems in Animal Physiology. (Cr ar; prereq 109 or Phsl 106, 107, ‡) Good, Dziuk

151. Veterinary Pharmacology. Local and general anesthetics, analgesic, antipyretic, analeptic, and autonomic drugs. (5 cr; prereq 108 or equiv, ‡) Stowe, Hammond

152. Veterinary Pharmacology. Cardiovascular, chemotherapeutic, anthelmintic, and gastrointestinal drugs. (3 cr; prereq 151, ‡) Stowe, Hammond

153. Veterinary Pharmacology and Toxicology. Diuretics, fluid therapy, and toxicology. (3 cr; prereq 152 or equiv, ‡) Hammond, Stowe

161.° Seminar: Veterinary Pharmacology. (Cr ar; prereq 152 or equiv, ‡) Hammond, Stowe

171x.° Problems: Veterinary Pharmacology. (Cr ar; prereq 152 or equiv, ‡) Stowe, Hammond

201. Digestive Physiology of Domestic Animals. Lectures in physiology and pathophysiology of the alimentary canal of animals. (3 cr; prereq ‡) Dziuk

205. Physiological and Pharmacological Research Techniques in Large Animals. Student participation in laboratory procedures involving the cardiovascular system, drug distribution, and renal function. (2 cr; prereq 108 or ‡) Dziuk, Good, Hammond, Stowe

211,° 212.° Comparative Pharmacology of Domestic Animals. Effects, metabolism, and indications of drugs in domestic and wild animals. (1 cr per qtr; prereq ‡) Stowe

Veterinary Surgery and Radiology

101. Principles of Veterinary Surgery. General fundamentals of surgery as applied to systems of the body; discussion of inflammation with relation to tissue repair; principles of anesthesia, preoperative evaluation, and postoperative care. (5 cr; prereq VMC 101, ‡) Arnold, Gourley, Usenik

102. Special Veterinary Surgery. Lectures in surgical procedures for small animals; laboratory exercises covering small animal operations. (5 cr; prereq 101, ‡) Gourley, Usenik, Arnold

103. Special Veterinary Surgery. Lectures in surgical procedures for large animals; laboratory exercises covering selected large animal operations. (5 cr; prereq 101, ‡) Arnold, Gourley, Usenik

104. Lameness of Domestic Animals. Etiology, diagnosis, and treatment. (1 cr; prereq 103, ‡) Spurrell

121. Veterinary Radiology. Preparation and interpretation of radiographs and fluoroscopic examinations in veterinary medicine; radiant energy as a therapeutic agent; protective measures against radiation hazards. (3 cr; prereq VMC 113, ‡) Spurrell, Hanlon

131. Heredity in Animal Disease. Application of genetic principles to animal disease problems; specific inheritable and familial conditions in domesticated species. (3 cr; prereq VMC 104, ‡) Spurrell

210x.° Advanced Veterinary Radiology. Lecture and laboratory. Radiological diagnostic procedures and interpretation as applied to veterinary medicine. (2 cr; prereq 121 or equiv, ‡) Spurrell, Hanlon

219. Fundamentals of Nuclear Medicine. Lecture and laboratory exercises to orient the graduate student in medical sciences on principles and application of radioisotopes in medicine. See Rad 219. (3 cr; prereq ‡) Spurrell, Loken

220f,w,s,su.° **Anesthesia.** Selection of proper anesthetic agent; administration of local, regional, and general anesthesia in large or small animals. (Cr ar; prereq 103 or equiv, ‡) Arnold, Usenik, Gourley

225f,w,s,su.° **Advanced Small Animal Surgey.** Surgery of the various systems in small animals with preoperative and postoperative evaluation and treatment. (Cr ar; prereq 103 or equiv, ‡) Gourley, Usenik, Arnold

230f,w,s,su.° **Advanced Large Animal Surgery.** Surgery of the various systems in large animals with preoperative and postoperative evaluation and treatment. (Cr ar; prereq 103 or equiv, ‡) Arnold, Usenik, Gourley

235f. **Radiation Biology.** Lecture course on effects of irradiation on living systems, especially diseases of the animal kingdom. (3 cr; prereq 219 or equiv, ‡) Spurrell, Loken

WATER RESOURCES

There is no department of water resources, and no graduate major or minor has been established in water resources. Rather, graduate education in water resources is a multidisciplinary effort involving departments in the physical, biological, and social sciences, and the graduate degree will be earned in a graduate major field already established in one of the departments listed. The principal departments involved and their areas of specialization as related to water resources are:

DEPARTMENT	AREA OF SPECIALIZATION
Physical Sciences	
Agricultural Engineering	Irrigation and Drainage, Hydrology
Civil Engineering and Hydraulics	Hydrology, Hydraulic Engineering, Sanitary Engineering
Geology and Geophysics	Hydrogeology, Geophysics
Soil Science	Soil Physics, Climatology
Biological Sciences	
Botany	Phycology, Freshwater Ecology
Entomology, Fisheries, and Wildlife	Waterfowl, Fisheries Biology and Management
Environmental Health	Aquatic Biology, Ground Water Supply
Forestry	Watershed Management, Recreation
Plant Pathology and Physiology	Plant-Water Relationships
Zoology	Aquatic Ecology, Ichthyology
Social Sciences	
Agricultural Economics	Land and Water Economics
Geography	Climatology, Outdoor Recreation
Economics	
Political Science	
Sociology	

A student interested in water resources should consult with the graduate faculty of the above departments. The student's choice of major will depend on his baccalaureate background; that is, a student with a Bachelor's degree in the physical sciences would normally choose to do his work in one of the departments listed above within the physical sciences group. However, a baccalaureate in one of the above specific disciplines is not required in order to pursue graduate education in water resources. For example, a physics, chemistry, biology, or mathematics major will be considered for graduate study in the major fields in a number of the above departments. Neither is specific prior training in water resources required. (However, certain course work re-

quired of undergraduates in the major chosen may have to be taken without graduate credit by a student newly entering that discipline.) The graduate major fields offered by the Graduate School in the various departments are listed in the General Information section of this bulletin.

Minor interests are most often chosen within the same broad science group as the major to take advantage of the student's undergraduate preparation. The student may, however, find it desirable to broaden his background by taking his minor or supporting program in a different science area.

Courses pertinent to water resources are listed under the various departments named above. In addition, the University has a number of research facilities concerned with water resources research, some of them world renowned, and the resources of these facilities are available in connection with thesis work.

ZOOLOGY

Professor
Walter J. Breckenridge[1]
Huai-Chang Chiang[2]
Alexander Hodson[2]
William Marshall[2]
Magnus Olson, *chairman*
A. Glenn Richards[2]
Murray D. Rosenberg
Otto H. Schmitt
Nelson T. Spratt, Jr.
Franklin G. Wallace

Associate Professor
Robert M. Benolken
Marion A. Brooks[2]
Edwin F. Cook[2]
Albert W. Erickson[1]
Charles W. Huver
Norman S. Kerr
James C. Underhill, *director of graduate study*
Dwain W. Warner

Assistant Professor
Alan B. Hooper
Peter V. O. Luykx
Roger D. Price[2]
Robert P. Rhea
William D. Schmid
Frederick M. Williams

Prerequisites—For major work, 10 credits in a general zoology or biology course and at least 22 credits of advanced work approved by the graduate faculty in zoology; for minor work, 10 credits in a general zoology or biology course. It is strongly recommended that students have a background in chemistry, mathematics, and physics.

Language Requirement—For the Master's degree, one foreign language. For the Doctor's degree, two foreign languages, one of which must be German.

Master's Degree—Offered under both Plan A and Plan B.

Doctor's Degree—Every candidate for the Ph.D. in zoology is expected to complete a period of residence at a marine biological station.

101f,w,s. Basic Zoology. This course number may be used to make up certain deficiencies in background course work. (Cr ar; majors must consult major advisers, others consult department chairman)

107s. Protozoology. Introduction to taxonomy, morphology, physiology, development and genetics of free-living protozoa. (4 cr; prereq #) Kerr

110s. Animal Behavior. Survey of effector mechanisms, their nervous and endocrine control, and behavior patterns of animals. (3 cr; prereq 91 or 92 or equiv and #)

Biol 110. General Physiology. A quantitative approach to study of processes occurring in living organisms; comparative physiology of living systems. (3 cr; prereq Math 44 or 23, Biol 50, 51, 52, 60 and Phys 9 or equiv)

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[1] Offices in Museum of Natural History, Minneapolis Campus

[2] Offices in Department of Entomology, Fisheries, and Wildlife, St. Paul Campus

Biol 111. Laboratory in General Physiology. (2 cr; prereq 110 or ¶110)

112f. Advanced General Physiology. Topics of current interest in physiology. (3 cr; prereq 91 or 92 or equiv and ‡) Rosenberg

114s. Sensory Physiology. Survey of general properties of receptor organs; visual, auditory, and mechano receptor units. (3 cr; prereq 92 or equiv and ‡; offered 1967-68 and alt yrs) Benolken

115su. Advanced Natural History of Invertebrates and Fishes. Advanced taxonomic and ecological survey of local fauna; detailed and independent ecological study of several taxonomic groups. (5 cr; prereq 15 cr; offered at Itasca Biology Session only)

116w. Population Ecology. Seminars and lectures on verbal and mathematical population theories; emphasis on relationship to laboratory and field data. (2 cr; prereq 94 or ‡...Math 44 recommended; offered 1967-68 and alt yrs) Williams

117. Theoretical Biology. (3 cr; prereq ‡; offered 1966-67 and alt yrs) Williams

118f. Experimental Ecology. Experimental approach to study of environmental factors affecting animal populations. For companion laboratory course see 201. (3 cr, §Ent 118; prereq 9 cr in general biology or equiv and 3 cr in animal or plant ecology, ‡) Chiang

119su. Limnology. Conditions for life in the water and distribution of aquatic animals. (5 cr; prereq 15 cr incl Biol 2 or 50; offered at Itasca Biology Session only) Underhill

Biol 120. Developmental Biology. Study of developing systems and of the control mechanisms of development, from the molecule to the organism. (3 cr; prereq Biol 70 and 110)

Biol 121. Laboratory in Developmental Biology. (2 cr; prereq 120 or ¶120)

121f. Ichthyology. Taxonomy and habits of North American fishes, especially those of upper Mississippi drainage. (3 cr; prereq 15 cr incl Biol 2 or 50) Underhill

125f. Insect Morphology. Comparative studies of external and internal anatomy and histology of insects; phylogeny and function. (5 cr, §Ent 125; prereq 74, ‡) Cook

126w. Embryology, Development of Insects. Reproductive behavior, embryology and post-embryonic development of insects. (5 cr, §Ent 126; prereq 125, OrCh 42 or 62, ‡) Brooks

127s. Insect Metabolism and Co-ordination. Homeostasis, permeability, circulation, metabolic systems and products, properties of muscles and nerves, sensation, behavior. (5 cr, §Ent 127; prereq 126, ‡...BioC 106 or MdBc 101 recommended) Richards

130s. Principles of Systematic Entomology. Lectures on history of systematic entomology, the species concept and higher categories, systematic procedures and zoological nomenclature. (2 cr, §Ent 130; prereq 15 cr in entomology or zoology, ‡; offered 1966-67 and alt yrs) Cook

135su. Field Ornithology. Field and laboratory studies of ecology and life histories of birds in Itasca Park region. (5 cr; prereq 15 cr; offered at Itasca Biology Session only)

138f,w,s. Seminar: General Physiology and Biophysics. (Cr ar) Staff

140w. Biological Microscopy. Necessary elements of optics, use and limitations of various types of microscopes, interpretation of microscopical data. Laboratory; demonstration plus project in field of student's interest. (4 cr, §Ent 140; prereq 15 cr in zoology, entomology, or botany, and ‡; offered when demand warrants) Richards

143su. Animal Parasites. Parasites of local fauna with special reference to helminths. (5 cr; prereq 15 cr incl Biol 2 or 50; offered at Itasca Biology Session only)

144f. Medical Entomology. Principal arthropods noxious to man and animals. Emphasis on those that serve as vectors of pathogenic organisms of man and animals. (3 cr; prereq 15 cr incl 74 or equiv, ‡) Price

145w.° Parasitic Protozoa. Structure, life histories, and economic relations of protozoal parasites of man and animals. Laboratory diagnosis. (3 cr; prereq 15 cr incl Biol 2 or 50 and ‡) Wallace

146s.* Helminthology. Worm parasites of man and animals, their structure, life histories, and biological relationships. (3 cr; prereq 15 cr incl Biol 2 or 50 and ‡) Wallace

153s. Molecular Biology. Quantitative analysis of cellular processes which may be treated on a molecular basis: osmotic pressure, Brownian motion, ion distribution, phase separation, intermolecular forces. (3 cr; prereq 51, Phys 9 or equiv and ‡; offered 1966-67 and alt yrs) Benolken

155f-156w-157s. Biophysics. Theoretical and experimental aspects of biology that can be studied by quantitative physical means. 155: Tissue ultrastructure (biostatics) as revealed by hypermicroscopy, birefringence, X ray, electron and radioactive means, and by colloidal and micellar phenomena. 156: Dynamics of biophysical systems; excitatory state, contraction, secretion, synthesis. 157: Integrative biophysical systems; stability of systems, transmission of information, sensory mechanisms. (3 cr per qtr; prereq 28 cr distributed between physics and biology, ‡...physical chemistry and general physiology recommended; schedule ar) Schmitt

162su.* Vertebrate Ecology. Field work on populations and their relationships to local environments; habitat analysis and ecological research methods. Individual and team research projects, field trips, and lectures. (5 cr, §Ent 162; prereq Biol 80 or equiv; offered at Itasca Biology Session only) Marshall, Tester

164w. Cytology. Principles and methods of experimentation; organization, function, and ultrastructure of cells and cell components; cell growth and cell heredity. (3 cr; prereq 51 or ‡) Luykx

165s. Advanced Cytology. Topics in current cytological research. (2 cr; prereq 164 and ‡; restricted to 10-15 students; schedule ar) Luykx

166w-167s. Cytology Laboratory. Phase contrast microscopy, cytochemical methods, autoradiography; demonstration of optical equipment; individual projects. (2 cr per qtr; prereq ‡) Luykx

195su. Special Problems in Ornithology, Ecology, and Limnology. Advanced work on special topics adapted to needs of individual students. (Cr ar; prereq Biol 2 or 50 and ‡; offered at Itasca Biology Session only) Staff

196su. Special Problems in Entomology and Vertebrate Ecology. Advanced work in entomology and ecology and ample opportunity for individual research, especially in various faunistic studies. (Cr ar, §Ent 196; prereq ‡; offered at Itasca Biology Session only) Cook, Marshall, Tester

197f, 198w, 199s.* Advanced Work. Individual work in some special discipline. (Cr ar; prereq Biol 2 or equiv or ‡) Staff

201w.* Experimental Ecology Laboratory. Laboratory companion course of 118. (2 cr, §Ent 201; prereq 118 or ¶118) Chiang

202s.* Insect Ecology. Dispersal, distribution, abundance, natural control, and related problems. (3 cr, §Ent 202; prereq 118 or ‡) Chiang

203f.* Insect Physiology. General and comparative physiology. Organ systems and their functioning. Research methods and evaluation of data. (Cr ar, §Ent 203; prereq ‡) Richards

209w. Topics in Comparative Physiology. Intensive coverage of comparative animal physiology: neuromuscular mechanisms, invertebrate endocrinology, biological rhythms, related topics. (2 cr; prereq 91 or 92 or equiv or ‡; offered 1967-68 and alt yrs)

214s. Field Ecology. Field work in major and minor communities in Minnesota; extended field trips to neighboring states. (3 cr; prereq 94 or ‡...Bot 50 or 130 or equiv recommended; offered 1966-67 and alt yrs) Underhill

283f, 284f, 285f. Physiology of Development. Organization, presentation, and evaluation of results of research in experimental embryology. 283: Chemical embryology, metabolic aspects of growth, differentiation, and morphogenesis. 284f: Embryonic differentiation including neuroembryology. 285f: Endocrines in development, including sex differentiation. (4 cr per qtr; prereq 182 or equiv and ‡; 285 offered 1967-68, 283 offered 1968-69, 284 offered 1966-67) Spratt

297f,w,s. Seminar: Special Research Fields

298f,w,s. General Seminar

299f,w,s. Research

Note—For additional courses in the related economic fields, see section on Entomology, Fisheries, and Wildlife in this bulletin.

GRADUATE OFFERINGS, DULUTH CAMPUS

Majors in Education, Curriculum and Instruction, Educational Psychology, English, Chemistry, and History

The Graduate School offers at the University of Minnesota, Duluth a full program for the master of arts degree with majors in education, curriculum and instruction, educational psychology, English, and history; and M.S. degrees in inorganic chemistry, organic chemistry, and physical chemistry. The education program is designed to serve elementary school teachers and principals, rural teachers, and secondary school teachers. The major in English is offered to high school teachers or those entering into this field, and teacher certification must be completed before the degree can be awarded. Students work under advisers at Duluth. The chemistry majors are for students preparing to teach in colleges and for those planning additional graduate study or careers in industry.

Graduate work at Duluth is under the jurisdiction of the dean of the Graduate School and is identical in admission, candidacy, and degree requirements with the parallel program on the Minneapolis Campus. Blanks for use in applying for admission may be secured by writing to the Academic Dean, University of Minnesota, Duluth, Duluth, Minnesota 55812.

Inquiries regarding counseling and testing, scholarships, fellowships and loan funds, living accommodations, employment, and placement should be addressed to Student Personnel Services, Kirby Student Center, University of Minnesota, Duluth, Duluth, Minnesota 55812.

Prerequisites—For all majors in *education, curriculum and instruction,* and *educational psychology* (school counseling), 6 quarter credits in psychology and a total of not less than 18 quarter credits of undergraduate work in education (including Ed 71, 81 or equivalent). The applicant should indicate whether his emphasis within the major field is (a) elementary teaching, (b) secondary teaching, (c) elementary principalship, or (d) rural education. Ordinarily, applicants should already hold a teaching certificate, and for the field of educational psychology, teaching experience is strongly advised.

Applicants for the major in *English* must be high school teachers, or those entering this teaching field. Teacher certification requirements must be completed before the M.A. degree will be awarded.

A limited number of openings are available for students who wish to major in *chemistry.* These applicants should have completed advanced inorganic chemistry and a full year of physical chemistry. Details concerning prerequisites for the chemistry M.S. degrees may be obtained from the academic dean, University of Minnesota, Duluth.

Admission to Candidacy—Before a student at Duluth is admitted to candidacy in education, curriculum and instruction, and educational psychology, he must arrange with Student Personnel Services to take the Graduate Education Battery of Tests. Application forms for requesting admission to candidacy are available in the office of the academic dean on the Duluth Campus.

The application for candidacy will be reviewed by the Candidacy Committee at Duluth. This committee will recommend action to the dean of the Graduate School, through the appropriate graduate group committee.

Master's Degree—Only Plan B is available at Duluth except for the major in chemistry, which is a Plan A program. History majors may select either Plan A or Plan B.

Language Requirement—For education, curriculum and instruction, and educational psychology, none. For chemistry, English, and history, reading knowledge of one foreign language.

Examinations—Final examinations, and all other work for the degree, are conducted by the graduate faculty at Duluth.

Note—Some of the courses listed below are scheduled in the late afternoon and on Saturday mornings to enable teachers in the Duluth area to carry graduate work during the academic year.

Except in cases where course descriptions are included here, course descriptions will be found in the departmental listings in this bulletin.

Education, Curriculum and Instruction, Educational Psychology

Professor
Thomas W. Chamberlin
Dean A. Crawford
John A. Dettmann
Henry J. Ehlers
Robert W. House
Harry C. Johnson
Maude L. Lindquist
William R. McEwen
R. Dale Miller
Ruth Palmer
Valworth R. Plumb
Lewis J. Rickert
Richard O. Sielaff
Arthur E. Smith
Armas W. Tamminen
Gordon O. Voss
Ward M. Wells
Chester W. Wood

Associate Professor
Kenneth N. DeYoung
Moy F. Gum
Hubert M. Loy
Cyril M. Milbrath
James R. Murphy
Anna L. Stensland
John E. Verrill

Assistant Professor
Iver Bogen
Richard G. Lidberg
Alvin W. Ollenburger
Vernon L. Simula

GENERAL COURSES

AgEd 154. Rural Education and Community Leadership. (3 cr; prereq 10 cr in education) Milbrath

ArEd 151. Curriculum Building in Art Education. (3 cr; prereq ‡) A Smith

ArEd 171. Implementing the Instructional Program in Art. (3 cr; prereq ‡) A Smith

ArEd 183. Advanced Course in the Teaching of Art. (3 cr; prereq ‡) A Smith

ArEd 190. Development of Art Education in the Twentieth Century. Effect of various 20th-century art movements on teaching of art in public schools. (3 cr; prereq ‡) A Smith

ArEd 295.* Problems in Art Education. Independent projects under staff guidance; may include advanced studio practice or technical problems requiring experimental or library research. (Cr ar; prereq consent of major adviser) A Smith

CPsy 100. Observation and Experimental Study of Children. Experience with various techniques of observing behavior, record keeping, and methods of analyzing and interpreting behavior records; lectures, discussions, and laboratory exercises. (3 cr; prereq tchg exper and Ed 71, 81, or equiv) Loy

EdAd 116. The Teacher and School Administration. (3 cr; prereq tchg exper or ‡) Wood

EdAd 117. Schools in Rural Areas. (3 cr; prereq ‡) Milbrath

EdAd 123. Organization of Community School Programs. (3 cr; prereq 117 or ‡)

EdCI 105. Audio-Visual Materials in Education. Characteristics, advantages, limitations, and practical use of audio-visual materials of nonprojected and projected types; practice in the operation of audio-visual equipment. (3 cr; prereq 9 cr in education or ‡) Remington, Wells

EdCI 107. Radio and Television in Education. Production, techniques of classroom use, selection of equipment, teaching appreciation, and administration of radio and television in the schools. (3 cr; prereq 9 cr in education; offered at Duluth summer only)

EdCI 109. Audio-Visual Materials and Equipment Laboratory. (3 cr; prereq 105 or ‡) Wells

EdCI 118. The Community School. (3-6 cr; prereq ‡)

EdCI 145. Reading Difficulties. (3 cr; prereq 64, 143B or equiv, or basic training in counseling or school psychology, tchg exper, and ‡) Simula

EdCI 184. Supervision of Student Teaching. For persons planning to supervise or administer student teaching and other professional laboratory experiences in elementary and secondary education. (3 cr; prereq 15 cr in education and ‡) Loy

EdCI 271.* Problems in Curriculum Construction. (3-6 cr per qtr; prereq admission to candidacy for Master's degree, ‡) Dettmann, House, H Johnson, Lindquist, Plumb, A Smith, Crawford, Wells, Wood, Verrill, Stensland, Milbrath, Voss

EPsy 110. Educational Measurement in the Classroom. (3 cr; prereq Psy 58 or ‡) H Johnson, Plumb

EPsy 116. Statistical Methods in Education. (3 cr; prereq ‡ and ¶116A) Tamminen

EPsy 116A. Statistical Methods in Education Laboratory. (2 cr; prereq ¶116) DeYoung

EPsy 140. Instruments and Techniques of Measurement. (3 cr; prereq 110 or 116) Falk, Tamminen

EPsy 150. Clinical Practice in Remedial Teaching. (3-6 cr; prereq EdCI 145 or equiv, CPsy 179 or equiv, tchg exper, and ‡) Simula

EPsy 159. Personality Development and Mental Hygiene. (3 cr; prereq 9 cr in education) Tamminen

EPsy 193. Psychology of Human Learning. (3 cr; prereq 12 cr in psychology and educational psychology) Tamminen

EPsy 208. Methods in Educational Research. (3 cr; prereq candidate for MA degree, 116 or equiv) DeYoung

HEd 141. Critical Issues in Contemporary Education. (3 cr; prereq 9 cr in education) Ehlers

HEd 156. History of Ideas in American Education. (3 cr; prereq 9 cr in education or ‡) Ehlers

HEd 179. Critical Thinking for Teachers. (3 cr; prereq 9 cr in education) Ehlers

Lib 101. Library Administration. Principles of library administration, organization, and management. A general course for all librarians. (3 cr, §old 55; offered at Duluth summer only)

Lib 102. Reference I. Intensive study of some 150 outstanding and useful reference books and tools most frequently used by students and librarians. Landmark reference books, indexes and periodical guides. The theory and practice of reference work. (3 cr, §old 62; offered at Duluth summer only)

Lib 103. Cataloguing and Classification. Basic principles of descriptive cataloguing, rules of entry, subject headings and classification in libraries, for all types of libraries. (3 cr, §old 83; offered at Duluth summer only)

Lib 104. Selection of Library Materials. Theory, principles, and techniques of selection; an introduction to the basic tools for selection of books, magazines, pamphlets, phonograph records, and films for all types of libraries. (3 cr, §old 70; offered at Duluth summer only)

Lib 171. Reading Guidance for Children. Reading interests of children; materials that meet these interests. Knowledge of sources, selection, evaluation, and methods of introducing books to children. (3 cr; prereq 104)

Lib 172. Reading Guidance for Adolescents. The library's relationship to the teen-ager in terms of his interests and needs. Methods of introducing books and developing and guiding reading. (3 cr; prereq 104)

MuEd 101. Basic Concepts in Music Education. (3 cr; prereq tchg exper in music or ‡) House

PE 101. Principles of Physical Education. (3 cr; prereq 54) Rickert, Wells

PE 114. Administration of the School Health Education Program. (3 cr; prereq Hlth 3 and ‡) Rickert

PE 115. Advanced Kinesiology. (3 cr; prereq undergrad course in kinesiology or ‡)

ELEMENTARY EDUCATION

CPsy 179. Clinical Procedures with Children. Methods of clinical psychology; basic concepts and research problems in clinical work with children. Primarily for students not majoring in clinical psychology. (3 cr; prereq 12 cr in psychology, educational psychology, sociology, or child psychology) Simula

EdAd 115. Elementary School Organization and Administration. (3 cr; prereq ‡)

EdCI 102. Teaching Social Studies in Elementary School. (3 cr) Crawford, Erickson, Lidberg

EdCI 103. Teaching Science in Elementary Schools. (3 cr; prereq 9 cr in education) Verrill

EdCI 119. Elementary School Curriculum. (3 cr; prereq ‡) H Johnson

EdCI 143A. Teaching and Supervision of Reading in Elementary Schools. (3 cr; prereq 145, EPsy 148, 150, and ‡) Simula

EdCI 143B. Materials and Instructional Techniques in Reading. Analysis and evaluation of materials for reading instruction; consideration of programmed, basal, linguistic, and other types of materials. Laboratory projects and demonstrations of techniques of instruction; criteria for selection of materials and techniques for students with special needs. (3 cr; prereq tchg exper or ‡)

EdCI 148. Teaching Modern Mathematics in Elementary Schools. (3 cr; prereq 9 cr in education or ‡) H Johnson

EdCI 149. Teaching and Supervision of Mathematics in Elementary Schools. Functions of mathematics instruction; curriculum studies; development of socialized units, measurement and diagnosis; experimental research on methods of mathematics instruction; literature on mathematics. (3 cr)

EdCI 150. Supervision and Improvement of Instruction. (3 cr; prereq ‡) H Johnson

EdCI 153. Teaching and Supervision of English in Elementary Schools. (3 cr; prereq 9 cr in education)

EdCI 166. Current Trends in Kindergarten Education. Current practices in kindergarten teaching, evaluated in light of recent research in child development and kindergarten teaching. (3 cr; prereq 55 or tchg exper) Sword

EdCI 170A. Curriculum and Course of Study Construction, Educational Television Production. Principles and methods for selection and organization of units, courses of study, and curriculums at the elementary school level. (3 cr; prereq 119 or ‡; offered at Duluth summer only)

EdCI 179. Education of Mentally Retarded Children in Elementary Schools. Curriculum content, materials and methods of instruction for educable mentally retarded children. Preparation of units and development of teaching aids. (3 cr; prereq ‡; offered at Duluth summer only)

EPsy 148. Clinical Diagnosis of Reading Difficulties. (3 cr; prereq EdCI 145 or equiv, CPsy 179 or equiv, tchg exper, and ‡) Simula

EPsy 182. Education of Exceptional Children. (3 cr; prereq Ed 71, 81 or equiv; offered at Duluth summer only)

EPsy 183. Education of Gifted Children. (3 cr; prereq 9 cr in education; offered at Duluth summer only)

MuEd 150. Administration and Supervision of School Music. (3 cr; prereq Mus 81, 82 or ‡) House

SECONDARY EDUCATION

CPsy 132. Adolescent Development. Growth; mental, social, emotional, and personality development. (3 cr; prereq 12 cr in psychology, educational psychology, sociology, or home economics)

EdAd 167. Junior High School. (3 cr; prereq 9 cr in education) Plumb

EdAd 201, 202. Foundations in Educational Administration. Foundation for all students preparing for public school administrative positions. Aspects of administration as they relate to co-ordination, operation, and organization of elementary and secondary schools in a local district. (3 cr per qtr; offered at Duluth summer only)

EdAd 227. Teacher and Employee Administration. Selection and placement of school employees, salary schedules, conditions of service, records and reports, and legal aspects. (3 cr; prereq 201, 202; offered at Duluth summer only)

EdAd 264. The Secondary School Principalship. Factors affecting administration, staff, and student relationships, intra-school relationships, school services. (3 cr; prereq 201, 202; offered at Duluth summer only)

EdAd 265. Administering the High School Program. Scheduling, administrative practices affecting learning, the academic program, community relationships, program evaluation. (3 cr) Wood

EdCI 101. Driver Education. Instruction in driver training for high school teachers and others who wish to qualify for such work. (3 cr; prereq ‡) Rickert

EdCI 112. Programmed Instruction in the Classroom. (3 cr; prereq tchg exper and ‡; offered at Duluth summers only)

EdCI 113. High School Curriculum. (3 cr; prereq ‡) Plumb

EdCI 122. Literature for Adolescents. (3 cr; prereq ‡) Stensland

EdCI 125. Occupational Information Laboratory. Using, reviewing, and evaluating occupational information. Sources and types of material, occupational filing plans, and practical techniques at secondary school level. (3 cr; prereq ‡) Tamminen

EdCI 131A. Advanced Course in Teaching Technical Business Subjects. (3 cr; prereq 81 and 83 or ‡) Sielaff, Dettmann

EdCI 131B. Advanced Course in Teaching Bookkeeping, Accounting, and Data Processing. Methods of teaching bookkeeping and related data processing courses at the secondary and collegiate levels, guidance information, recent research and trends. (3 cr; prereq 82 or ‡)

EdCI 132. Teaching the Basic Business Subjects. (3 cr; prereq ‡) Sielaff, Dettmann

EdCI 135. Group Procedures in Guidance. (3 cr; prereq EPsy 133 or ‡) Wood, Gum

EdCI 144. Teaching Reading in Junior and Senior High Schools. (3 cr; prereq 9 cr in education) Stensland

EdCI 155. Material Laboratory for Social Studies Teachers. Printed and audio-visual materials useful in social studies classes. (3 cr; prereq tchg exper, ‡, and 89 or equiv) Crawford

EdCI 168. Current Developments in the Social Studies. (3 cr; prereq 89 or ‡) Lindquist

EdCI 169. Student Organizations and Activities. (3 cr; prereq ‡) Wood

EdCI 266. Supervision of High School Instruction. (3 cr; prereq EPsy 193 or 293 or ‡) Ollenburger

EdCI 294. Advanced Course in Curriculum and Methods in Secondary School English. (3 cr; prereq Engl 90 or equiv) Stensland

EPsy 119. Automatic Data Processing in Education. History, basic philosophy; types of operations performed and machines used in these operations; actual writing of several standard data processing computer programs. (3 cr) Ollenburger

EPsy 133. Basic Procedures in Student Personnel Work. (3 cr; prereq 9 cr in education) Plumb

EPsy 134. School Counseling Procedures. Basic principles and practices related to work of counselors in public schools. Lectures, discussion, audio-visual aids, practice in case study analysis, and interviewing. (3 cr; prereq 110 or 116, 133 and ‡) Gum

EPsy 233.° Problems in Guidance and Personnel Work. (1-9 cr; prereq ‡) Tamminen, Gum

EPsy 282B. Supervised Practicum in Counseling. (3 cr; prereq ‡) Gum

HEEd 160A. Home Economics Curriculum. Examination of research and literature; development of units of study and programs at the elementary and secondary level; production and evaluation of materials. (3 cr; prereq HE 88, tchg exper or ‡)

HEEd 194A. Adult Education in Home Economics. (3 cr; prereq HE 88, EdT 82A-B or ‡) Palmer

Ind 101. Tests in Industrial Subjects. (3 cr) Northey

Ind 102. General Shop. (3 cr) E Andrews

Ind 106. Industrial Education Workshop. (3 or 6 cr [may be repeated for a maximum of 6 cr]; prereq tchg exper or ‡) E Andrews, Northey, Voss

Ind 107. Co-ordination. (3 cr; prereq 62, or ‡) Voss

Ind 109. Conference Leading for Industry. (3 cr; prereq ‡) Voss

Ind 111. Instructional Materials Laboratory for Nonmajors. (3 cr; prereq tchg exper or ‡) Northey

Ind 150. Vocational Education Surveys. (3 cr; prereq ‡) Voss

MuEd 105. Advanced Topics in Instrumental Music Education. (3 cr; prereq ‡) Murphy, House

MuEd 151. Practical Operation of School Music. (3 cr; prereq Mus 81, 82, or ‡) House

English

Professor
Joseph E. Duncan
Wendell P. Glick
William A. Rosenthal, *head, director of graduate study*
Albert Tezla

Associate Professor
William M. Crockett
Robert C. Hart
Lewis D. Levang
Robert R. Owens

Engl 104. Emerson and Thoreau. (3 cr; prereq 6 cr in literature in this dept) W Glick

Engl 105. Hawthorne and Melville. (3 cr; prereq 6 cr in literature in this dept) W Glick

Engl 106. Whitman and Mark Twain. (3 cr; prereq 6 cr in literature in this dept) W Glick

Engl 109, 110. Romantic Prose and Poetry. English literature, 1790-1832. 109: Wordsworth, Coleridge, Scott, etc. 110: Byron, Shelley, Keats, etc. (3 cr per qtr; prereq 6 cr in literature in this dept or ‡; offered 1966-67 and alt yrs) Tezla

Engl 112. Hemingway and Faulkner. Literary development and analysis of selected works. (3 cr; prereq 6 cr in literature in this dept) Hart

Engl 120-121. The Interpretation of Poetry. Certain technical aspects of poetry in relation to poetic meaning. 120: Analysis of a number of short poems. 121: Analysis of a number of long poems. (3 cr per qtr; prereq ‡) Tezla

Engl 128. Modern British Drama. Historical study of British drama from 1900 to the present: Shaw, Synge, O'Casey, Fry, Osborne, Beckett, Pinter, and others. (3 cr; prereq 6 cr of literature in this dept) Duncan

Engl 130, 131, 132. Victorian Prose and Poetry. English literature from 1832 to 1901. 130: Carlyle, Thackeray, Browning, and others. 131: Darwin, Arnold, Eliot, and others. 132: Hardy, Wilde, Hopkins, and others. (3 cr per qtr; prereq 6 cr of literature in this dept) Crockett

Engl 135. Literary Criticism. Reading and analysis of selected critical writings from Aristotle to Arnold. (3 cr; prereq ‡) Tezla

Engl 151, 152, 153. English Novel. Development of British novel. 151: Eighteenth century. 152: Nineteenth century. 153: Twentieth century. (3 cr per qtr; prereq 6 cr of literature in this dept) Owens (151), Crockett (152), Rosenthal (153)

Engl 154, 155. American Novel. History of the American novel in relation to patterns of American thought. 154: Nineteenth century. 155: Twentieth century. (3 cr per qtr; prereq 6 cr of literature in this dept) W Glick (154), Hart (155)

Engl 156. American Drama. Critical survey, primarily of period from 1914 to present; some attention to historical and cultural background; some representative plays of 18th, 19th, and early 20th centuries. (3 cr; prereq 6 cr of literature in this dept) W Glick

Engl 162. Milton. (3 cr; prereq 21, 22) Rosenthal, Duncan

Engl 165. Introduction to Modern English. Word stock, inflections, and structural patterns of standard American-written English. (3 cr; prereq 6 cr in literature in this dept or ‡)

Engl 166. History of the English Language. History of sounds, word stock, and structures of the English language; changes in the language since the Renaissance. (3 cr; prereq 165 or ‡; offered 1967-68 and alt yrs)

Engl 187, 188, 189. Eighteenth-Century Literature. English life and letters from 1700 to 1798. (3 cr per qtr; prereq 6 cr of literature in this dept; offered 1967-68 and alt yrs) Owens

Engl 192, 193, 194. Sixteenth-Century English Literature. Sixteenth-century English literature, excluding Shakespeare's drama. 192: More, Ascham, Skelton, and others. 193: Wyatt, Surrey, Lyly, Greene, Deloney, and others. 194: Spenser, Sidney, Marlowe, Daniel, Chapman, Raleigh, Drayton, and others. (3 cr per qtr; prereq 6 cr of literature in this dept) Levang

Engl 197, 198, 199. Seventeenth-Century Literature. English literature from 1600 to 1700. 197: Donne, the Metaphysical poets, Webster, Browne, and others. 198: Burton, Bacon, Jonson, Herrick, Denham, and others. 199: Dryden, the Restoration Wits, Congreve, and others. (3 cr per qtr; prereq 6 cr of literature in this dept; offered 1966-67 and alt yrs) Duncan

History

Professor
Arthur J. Larsen
Maude L. Lindquist, *director of graduate study*
Ellis N. Livingston
James F. Maclear

Hist 103A, 104A, 105A. Renaissance and Reformation. (3 cr per qtr; prereq 1, 2, 3; offered 1966-67 and alt yrs) Maclear

Hist 131, 132, 133. Minnesota and the Northwest. 131: Exploration, settlement, and development to 1849. 132: Territorial commonwealth and early statehood to 1870. 133: Development of Minnesota to present. (3 cr per qtr; prereq 20A, 21A, 22A) Lindquist, Larsen

Hist 141D, 142D, 143D. History of American Foreign Relations. 141D: Revolution to 1860. 142D: 1860 to 1920. 143D: 1920 to present. (3 cr per qtr; prereq 20A, 21A, 22A; offered 1966-67 and alt yrs) Livingston

Hist 182-183-184. Readings in American History in the Nineteenth Century. 182: Development of American nationality, 1789-1824. 183: Jacksonian democracy and manifest destiny. 184: Civil War and Reconstruction, 1860-1880. (3 cr per qtr; prereq ‡) Larsen

Hist 185-186-187.† Readings in Twentieth-Century American History. 185: Late 19th century to 1917. 186: 1917-1938. 187: 1938 to present. (3 cr per qtr; prereq 67, 68, 69) Livingston

Hist 197-198-199.† Directed Study. A proseminar. (3 cr per qtr; prereq ‡)

Hist 200. Historical Bibliography and Criticism. (3 cr; required of candidates for advanced degrees in history who do not present evidence of similar training elsewhere)

Hist 290-291-292.† Seminar: Topics in Minnesota and the Northwest. 290: Explorations to 1849. 291: Territorial and early statehood to 1873. 292: Since 1873. (3 cr per qtr) Larsen, Lindquist

Inorganic, Organic, and Physical Chemistry

Professor
James C. Nichol, *director of graduate study, physical chemistry*

Associate Professor
Edward J. Cowles
F. James Glick
Larry C. Thompson, *director of graduate study, inorganic chemistry*

Assistant Professor
Ronald Caple, *director of graduate study, organic chemistry*
Donald K. Harriss

Chem 103. Qualitative Organic Analysis. Identification of pure organic compounds; separation of mixtures and identification of their components. (3 cr; prereq 63)

Chem 108. Seminar. Practice in preparation and oral presentation of reports on articles from the literature, on senior research, or on graduate research. (1 cr, §old 98)

Chem 111. Structural Organic Chemistry. Applications of spectroscopy in molecular structure determinations. (3 cr; prereq 63, 142) Cowles

Chem 112. Organic Reaction Mechanisms I. Methods of establishing organic mechanisms, with examples. (3 cr; prereq 63, 142) Cowles

Chem 113. Organic Synthesis I. Reagents and reactions and their applications in organic synthesis. (3 cr; prereq 63) Cowles

Chem 114. Organic Reaction Mechanisms II. (3 cr; prereq 112) Cowles, Caple

Chem 115. Organic Synthesis II. (3 cr; prereq 113) Cowles, Caple

Chem 121. Instrumental Analysis. Theory and practice of various instrumental methods of analysis. (3 cr; prereq 142 or ¶142) Moore, Thompson

Chem 124-125. Quantitative Analysis. Theory and practice in classical and instrumental methods of chemical analysis. (5 cr for 124, 4 cr for 125; prereq 50, 142) Moore

Chem 130, 131. Inorganic Chemistry. 130: Atomic structure and properties of elements based thereon. Chemistry of the co-ordination compounds. 131: Acids and bases; nonaqueous solvents; oxidation-reduction reactions; mechanism of selected inorganic reactions; survey of the chemistry of the representative elements. (3 cr for 130, 2 cr for 131; prereq 2 yrs chemistry or ‡) Cowles, Thompson

Chem 133. Inorganic Chemistry Laboratory. Preparation of typical inorganic compounds, illustrating special and more advanced techniques. (2 cr; prereq 130 and 131 or ‡) Thompson

Chem 140-141-142.† Physical Chemistry. Quantitative treatment of physical principles and theories underlying chemistry. Laboratory, physicochemical measurements. (3, 4, 5 cr; prereq 2 yrs chemistry, incl 50, or ‡, Phys 9, Math 25; 3 hrs lect for 140, 141, 142, 3 hrs lab for 141, 6 hrs lab for 142—may be taken for 3, 3, 3 cr by omitting lab work) Nichol

Chem 146. Chemical Thermodynamics. A treatment of laws of thermodynamics with a brief introduction to statistical thermodynamics. (3 cr; prereq 142) Nichol

Chem 148. Introduction to Quantum Theory. Electronic structure and spectra of atoms, principles of wave mechanics, and theoretical aspects of the chemical bond. (3 cr; prereq 142) Harriss

Chem 149. Introduction to Molecular Structure. Physical methods of determining molecular structure. (3 cr; prereq 148) Harriss, Thompson

Chem 151. Chemical Kinetics. Reaction velocity and mechanism of reactions in gases and in solution. Absolute reaction rate theory, relationship between kinetics and thermodynamics, catalysis. (3 cr; prereq 146) Harriss, Nichol

Chem 152. Solutions of Electrolytes. Experimental behavior, thermodynamic properties, modern theories of strong and weak electrolytes, determination of activity coefficients and dissociation constants, polyelectrolytes. (3 cr; prereq 151) Nichol, Thompson

Chem 154. Transport Processes in Solution. Transport phenomena in solution; viscosity, diffusion, electrophoresis, and sedimentation. (3 cr; prereq 151) Nichol

Chem 161. Advanced Inorganic Chemistry. Structure and bonding of inorganic compounds and mechanisms of inorganic reactions. (3 cr; prereq 149 and 151) Thompson

Chem 202. Research in Inorganic Chemistry. (Cr ar [normally 1 cr 1st qtr, 3-9 cr per qtr thereafter]) Thompson

Chem 203. Research in Organic Chemistry. (Cr ar [normally 1 cr 1st qtr, 3-9 cr per qtr thereafter]) Caple

Chem 204. Research in Physical Chemistry. (Cr ar [normally 1 cr 1st qtr, 3-9 cr per qtr thereafter]) Nichol

Departments in Which There Is Neither a Major Nor a Minor But in Which Graduate Credit May Be Earned

Professor
Addison M. Alspach (Music)
Lyda C. Belthuis (Geography)
Howard G. Hanson (Physics)
Blanchard O. Krogstad (Zoology)
Cecil H. Meyers (Business Administration and Economics)
Francis B. Moore (Analytical Chemistry)
Glenn C. Nelson (Art)
Theron O. Odlaug (Zoology)
Arvid N. Pearson (Sociology)
Robert F. Pierce (Speech Pathology)
Richard O. Sielaff (Economics)
Gerhard E. von Glahn (Political Science)
Frederick T. Witzig (Geography)
J. Fred Wolff (Political Science)

Associate Professor
John B. Carlson (Botany)
C. Lindsley Edson (Music)
Edward Flaccus (Botany)
John L. Gergen (Physics)
Leverett P. Hoag (Geography)
M. Harry Lease (Political Science)
Paul H. Monson (Botany)
James R. Murphy (Music)
Rudolph I. Schauer (Art)
James E. Smith (Music)

Assistant Professor
Walter L. Baeumler (Sociology)
Sylvan D. Burgstahler (Mathematics)
Thomas J. Bydalek (Analytical Chemistry)
John L. Kroening (Physics)
Shirley A. Munger (Music)
Freddy M. Munoz (Art)
Michael Sydor (Physics)

Instructor
H. Boyd Christensen (Art)
Philip K. Meany (Art)

Humanities

Art 100. Art Seminar. For senior and graduate art majors; discussions, readings, reports in the area of arts and aesthetic interest. (3 cr; prereq △) A Smith

Art 110. Advanced Problems in Design. Opportunity to apply design to creative aesthetic problems on an advanced experimental level. (3 cr per qtr [may be repeated for a maximum of 9 cr]; prereq 99 or equiv and ‡) Schauer

Art 150. Problems in Painting. (3 cr per qtr [may be repeated for maximum of 9 cr]; prereq 96 or ‡) Munoz

Art 170. Problems in Ceramics. Research in studio projects; glaze and body chemistry; ceramic sculpture. (3 cr per qtr [may be repeated for a maximum of 9 cr]; prereq 98 or ‡) G Nelson

Art 177. Workshop in Advanced Painting. Creative work in oil or watercolor with criticism by a nationally recognized American artist. (Cr ar [normally 6 cr, may be repeated for cr]; prereq ‡) Visiting artist

Art 180. Problems in Sculpture. Development of previously acquired skills in wood, stone, metal, or clay; emphasis on creative discipline. (3 cr per qtr [may be repeated for maximum of 9 cr]; prereq 97 or ‡) Christensen, G Nelson

Art 190. Problems in Print Processes. Advanced printmaking in the area of specialized interest. (3 cr per qtr [may be repeated for a maximum of 9 cr]; prereq 91 or ‡) Meany

Mus 100. Projects in Musicianship Skills. Concentration on one or more of the following: sight reading, memorization, accompanying, ensemble playing. Supplementary work in ear training and music analysis provided when necessary. (3 cr per qtr, max 6 cr; prereq 2 yrs of music theory and advanced performing ability) Munger

Mus 101. Creative Expression: Conducting, Arranging, Composition. Serious work in any one or more of the above-named fields. The entire class shall constitute a performing ensemble for conducting experience and laboratory trial of student arrangements and compositions. Group assignments and/or individual projects required according to needs and concentrations of students. (3 cr, may be repeated for a max of 9 cr; prereq 2 yrs of music theory and performing ability)

Mus 102. Preparation of Group Performance. Concentration upon one or more of the following: rehearsal management and techniques, programming, staging, instrument care and maintenance, and special problems of opera and "musical" preparation. Organization of the class into one or more groups for production of a concert or operatic scenes. (3 cr per qtr, max 6 cr; prereq teaching exper or extensive exper in performing groups)

Mus 140. Interpretation of Choral Literature. Musical and vocal techniques necessary for presentation of great choral compositions from Renaissance to 20th century. (3 cr; prereq ‡)

Mus 141, 142. Advanced Orchestration. (2 cr per qtr; prereq 5C or equiv) Miller, J Smith, Murphy

Mus 193. Proseminar: Music History. Specific problems in music history; lectures, discussions, reports, research papers, and student performance; student becomes acquainted with available documentary sources and early instruments. (3 cr; prereq 5C and 66 or ‡) Miller, J Smith

Mus 204. Graduate Applied Music. (2 cr per qtr, max 6; prereq placement test by Music Dept) Alspach, Murphy, Downs, House, J Smith, van Appledorn, Edson, Munger

Spch 105. Theory of Reading and Acting. (3 cr; prereq 81, 82 or ‡)

Spch 106. Discussion. (3 cr; prereq 2 or ‡)

Spch 109. History of Rhetoric. Development of rhetorical thought as expressed by representative writers. (3 cr; prereq 1, 2...51 recommended) Ness

Spch 119. Speech Improvement and Management of the Speech Handicapped in the Classroom. (3 cr; not open to speech correction majors) Friedman, Pierce

Spch 126. Studies in Public Address. Application of rhetorical theory for critical analysis of speeches of representative historical figures. (3 cr; prereq 1, 2...51, 109 recommended) Ness

Spch 179. Advanced Theater Workshop. For in-service directors and advanced students preparing themselves to be drama teachers or to enter the theater professionally; participation in all phases of selected plays; ways to improve the stage facilities typically available to the high school drama teacher. (6 cr; prereq ‡)

Spch 181. Independent Study in Speech and Drama. Directed individual research; problems and projects in general speech, speech science and correction, drama, and broadcasting. (1-3 cr, may be repeated for maximum of 6 cr) Ness, Pierce

Science and Mathematics

Bot 112. Aquatic Flowering Plants. Higher plants of aquatic and marsh habitats; identification; adaptive morphology; food value to wild life. (3 cr; prereq 10 cr in botany or ‡) Monson

Bot 115. Flora of Minnesota. (4 cr; prereq 52 or ‡; offered 1966-67 and alt yrs) Monson

Math 100. Topics in Geometry. Selected topics from synthetic metric geometry, projective geometry, non-Euclidean geometries; ruler and compass constructions; theory of geometric constructions. (3 cr; prereq 60; offered 1966-67 and alt yrs) McEwen

Math 101-102-103. Topics in Applied Mathematics. Ordinary and partial differential equations; Fourier series; the Laplace transform; matrix theory and vector calculus; special functions. (3 cr per qtr; prereq 153 or △) Burgstahler

Math 109. Theory of Numbers. Elementary properties of integers; prime and composite numbers; Euclid's algorithm; congruences; the theorems of Fermat and Wilson; primitive roots; indices, Diophantine equations. (3 cr; prereq 26 or 62 or 72; offered 1967-68 and alt yrs) McEwen

Math 131-132. Linear Algebra. Vector spaces over a field, linear dependence of vectors, dimension; matrices and systems of linear equations; special matrices and canonical forms; characteristic values and vectors; diagonalization of quadratic and Hermitian forms; applications. (3 cr per qtr; prereq 62 or 72; offered 1967-68 and alt yrs) Burgstahler, McEwen

Math 151-153. Advanced Calculus I and II. I: Functions of several variables; partial differentiation, implicit functions, extrema, transformations, Jacobians, integrals depending on a parameter. II: Infinite series, power series, uniform convergence, computation with series. Improper integrals. Orthogonal functions and Fourier series. (3 cr per qtr; prereq 27 and 62 or 72) Burgstahler, McEwen

Math 174. Complex Variables. Complex numbers, derivatives and integrals of analytic functions, elementary functions and their geometry, Cauchy's integral theorem and formula. Laurent expansions, evaluation of contour integrals by residues. Fundamental theorem of algebra. (3 cr; prereq 27 and 62 or 72; offered 1966-67 and alt yrs) Burgstahler, McEwen

Math 178. Introduction to Mathematical Probability. Axiomatic development of probability; random variables and their probability distributions with emphasis on the binomial and Poisson distributions; applications to games of chance and discrete stochastic processes. (3 cr, §55; prereq 62 or 72; offered 1966-67 and alt yrs) McEwen

Math 180. Finite Groups. Permutation groups, Cayley's theorem; groups related to geometrical configurations; the Jordan-Hölder theorem, Abelian groups, quotient groups, applications. (3 cr; prereq 62 or 72; offered 1967-68 and alt yrs) Burgstahler, McEwen

Phys 106-108-110. Modern Physics. (3 cr per qtr; prereq 51) Hanson

Phys 113-115-117. Theoretical Physics. Theoretical course in mechanics, electricity, and magnetism to prepare students for advanced work. (3 cr per qtr; prereq 51) Gergen

Zool 123. Advanced Insect Biology. (3 cr; prereq 60 or equiv)

Zool 146. Helminthology. (3 cr; prereq 62 and ‡) Odlaug

Social Sciences

BA 105A. Intermediate Accounting I. Review of accounting processes, measurement of income, accounting treatment of inventories and plant assets. (3 cr, §BE 105A; prereq 33 or 35 or ‡) Curtis, Dettmann, Sielaff

BA 105B. Intermediate Accounting II. Accounting treatment of cash receivables, investments, intangible assets, and applications of actuarial mathematics. (3 cr, §BE 105B; prereq 105A or ‡) Curtis, Dettman, Sielaff

BA 105C. Intermediate Accounting III. Accounting treatment of stockholder's equity; interpretation and analysis of financial statements. (3 cr, §BE 105C; prereq 105A or ‡) Curtis, Dettmann, Sielaff

BA 107. Retail Management. Retailing principles and methods; relations of retailing to other parts of the economy; problems associated with operation of stores of various types. (3 cr; prereq 157 and Econ 1, 2, 3 or ‡) Sielaff

BA 115A. Cost Accounting. Practices, principles, and procedures of handling production costs for use in inventory valuation and income determination. Job order, process, and standard cost systems. Brief introduction to standard cost as a tool of cost control. (3 cr, §BE 115A; prereq 33 or equiv) Curtis, Dettmann, Friest, Sielaff

BA 115B. Cost Accounting. Use of cost information in managerial decision making. (3 cr, §BE 115B; prereq 115A or ‡) Curtis, Dettmann, Friest, Sielaff

BA 125A. Auditing Principles and Procedures. (3 cr, §BE 125A; prereq 105B or ‡) Dettmann, Sielaff

BA 125B. Auditing Laboratory. (1 cr, §BE 125B; prereq 125A or ¶125A) Dettmann, Sielaff

BA 135A. Income Tax Accounting. Principles involved in determining taxable net income, computation of federal and state income taxes for individuals and preparation of income tax returns. (3 cr, §BE 77; prereq 105A or ‡) Curtis

BA 135B. Income Tax Accounting. Determination of taxable net income and computation of income taxes for partnerships, corporations, estates, and trusts. Gift and estate taxes. Applications of income tax fundamentals to the making of business decisions. (2 cr, §BE 77; prereq 135A or ‡) Curtis

BA 157. Marketing. Basic concepts. Functions, institutions, channels, pricing. Marketing policies and methods. (3 cr; prereq Econ 1, 2 or ‡) Kim, Sielaff

BA 167. Advertising and Sales Promotion. Economics and functions of advertising and sales promotion. Budgets, agencies, media, copy, layout, printing processes, research, sales organization and management. (3 cr, §BE 56; prereq 157 and Econ 1, 2, 3 or ‡) Sielaff

BA 172. Systems of Industrial Relations: Manpower Management. (3 cr, §72 and BE 83; 4 hrs lect; for grad students only) E Davidson

BA 185. Advanced Accounting Problems. Consolidated statements, fiduciary and fund accounting, foreign exchange, and compound interest. (3 cr, §BE 79; prereq 105C or ¶105C) Curtis

Econ 103. Economic Development. Conditions necessary for increasing income, capital formation, measurement of economic growth and problems of "underdeveloped" areas. (3 cr; prereq 1 and 2 or ‡) Meyers, Quinney, Sielaff

Econ 150A, B, C, D. Current Economic Issues. (1-3 cr per qtr; prereq 1, 2, 3 or ‡) Meyers, Sielaff

Econ 165. Economic Analysis: The Firm. Analysis of individual decision making by firms under conditions of monopoly, competition, and monopolistic competition. (3 cr; prereq 1, 2, 3 or ‡) Meyers, Sielaff

Econ 166. Economic Analysis: Income and Employment. Determinants of national income, employment, and price level, with particular attention to aggregate consumption and investment. (3 cr; prereq 1, 2, 3 or ‡) Meyers, Sielaff

Econ 168. Economics of Public Finance. (3 cr; prereq 1, 2, 3 or ‡) Meyers

Econ 180A, B, C. History of Economic Thought. Principal economic ideas and literature of the past. Relationship to current economic problems and theories. (3 cr per qtr, §BE 91, 92, 93; prereq 6 cr selected from 150A, B, C, D, 165, 166, and 168 or ‡) Sielaff, Meyers

Econ 182. Economic Security. Public and private approaches to problems of economic security. Nature and causes of economic insecurity. Details of and economic and social implications of private and public programs. Emphasis on economics of income and employment maintenance and stabilization rather than upon legal or administrative aspects of policy. (3 cr, §BE 82; prereq 1, 2, 3) E Davidson

Geog 101. Western and Central Europe. Physical and cultural geography of the countries of western and central Europe considered regionally and by more detailed discussion of topics related to British Isles, France, Low Countries, West Germany, and countries of central Europe. (3 cr; prereq 10, 11, plus 3 cr) Witzig

Geog 105. Mediterranean. (3 cr; prereq 10, 11 plus 3 cr) Witzig

Geog 107. Soviet Union. (3 cr; prereq 10, 11 plus 3 cr)

Geog 110. South America. (3 cr; prereq 10, 11 plus 3 cr) Hoag

Geog 112. Western Anglo-America. (3 cr; prereq 10, 11 plus 3 cr) Belthuis

Geog 113. Eastern Anglo-America. (3 cr; prereq 10, 11 plus 3 cr) Belthuis

Geog 126. Australia and New Zealand. (3 cr; prereq 10, 11 plus 3 cr) Belthuis

Pol 109. The Judicial Process. Structure of the American judiciary; selection of judges; process of litigation; influences on judicial decisions; impact of and compliance with decisions. (3 cr; prereq 2 or ‡) Lease

Pol 137. American Political Parties. (3 cr; prereq 6 cr or 12 cr in social sciences) Wolff

Pol 160. American Political Thought. (3 cr; prereq 6 cr or 12 cr in social sciences or ‡) Wolff

Pol 162. Recent Political Thought. (3 cr; prereq 6 cr or 12 cr in social sciences or ‡) von Glahn

Pol 163. Political Theory and Utopia. (3 cr; prereq B or 9 cr in social sciences or ‡) von Glahn

Pol 164. Development of Political Thought: Ancient. (3 cr; prereq 6 cr or 12 cr in social sciences or ‡) von Glahn

Pol 165. Development of Political Thought: The Middle Ages. (3 cr; prereq 6 cr or 12 cr in social sciences or ‡) von Glahn

Pol 166. Development of Political Thought: Early Modern. (3 cr; prereq 6 cr or 12 cr in social sciences or ‡) von Glahn

Soc 141. The Family. Evolution of the family, development of family unity or disunity, roles of the several members, methods of investigation of the family. (3 cr; prereq 1 or ‡) Pearson

Soc 145. Urban Sociology. (3 cr; prereq 1 or ‡)

Soc 151. Sociology of Education. Social structure of the school; the classroom as a social system; educational roles; impact of social classes on education; the school and community power structure. (3 cr; prereq 1 and 15 cr in social sciences, education, or psychology, or ‡) Pearson

Soc 161. Rural Community Analysis. (3 cr; prereq 1 or ‡) Pearson

INDEX

College and Department Abbreviation Code

Acct, Accounting
Aero, Aeronautical Engineering
AgEc, Agricultural Economics
AgEd, Agricultural Education
AgEn, Agricultural Engineering
AgJo, Information and Agricultural Journalism
Agro, Agronomy and Plant Genetics
AmSt, American Studies
Anat, Anatomy
AnCh, Analytical Chemistry
Anes, Anesthesiology
AnHu, Animal Husbandry
Anth, Anthropology
Arab, Arabic
Arch, Architecture
ArEd, Art Education
Art, Art
Ast, Astronomy

BFin, Business Finance
BioC, Biochemistry (Biological)
Biol, Biology
Biom, Biometrics
Bot, Botany
BPhy, Biophysics

CE, Civil Engineering
ChEn, Chemical Engineering
Chin, Chinese
Clas, Classics
Comp, Composition
CLit, Comparative Literature
CPsy, Child Psychology

DH, Dairy Husbandry

Econ, Economics
Ed, General Education
EdAd, Educational Administration
EdCI, Curriculum and Instruction
EdT, Methods and Student Teaching
EE, Electrical Engineering
Engl, English
Ent, Entomology, Fisheries, and Wildlife
EPsy, Educational Psychology

For, Forestry
Fren, French
FSci, Food Science and Industries

GeCh, General Chemistry
Gen, Genetics
Geo, Geology and Geophysics
Geog, Geography
Ger, German
Grk, Greek

HE, Home Economics
Heb, Hebrew
HEd, History and Philosophy of Education
HEEd, Home Economics Education
Hist, History
Hlth, School Health Education
Hort, Horticultural Science
Hum, Humanities
Hydr, Hydromechanics

IE, Industrial Engineering
InCh, Inorganic Chemistry
Ind, Industrial Education
Indn, Indic
Ins, Insurance
IntR, International Relations
IR, Industrial Relations
Ital, Italian

Jour, Journalism
Jpn, Japanese

Lat, Latin
Law, Law
Lib, Library Science

Math, Mathematics
MdBc, Biochemistry (Medical)
ME, Mechanical Engineering
MeAg, Mechanized Agriculture
Med, Medicine
MetE, Metallurgical Engineering
Mgmt, Management
MicB, Microbiology
MinE, Mining Engineering
Mktg, Marketing
MM, Mechanics and Materials
MuEd, Music Education
Mus, Music

Nor, Norwegian
NPsy, Psychiatry and Neurology
NSci, Natural Science

Obst, Obstetrics and Gynecology
OMgt, Office Management
Opth, Ophthalmology
OrCh, Organic Chemistry
Ortl, Oriental
Otol, Otolaryngology

PA, Public Administration
Path, Pathology
PCh, Physical Chemistry
PE, Physical Education
Ped, Pediatrics
PetE, Petroleum Engineering
Phcg, Pharmacognosy
Phcl, Pharmacology
Phil, Philosophy
Phsl, Physiology
Phys, Physics
PlPa, Plant Pathology and Physiology
PMed, Physical Medicine and Rehabilitation
Pol, Political Science
Port, Portuguese
Poul, Poultry Science
Prod, Production
Psy, Psychology
PubH, Public Health

QA, Quantitative Analysis

Rad, Radiology
Rec, Recreation
Rhet, Rhetoric
Rom, Romanic
Russ, Russian

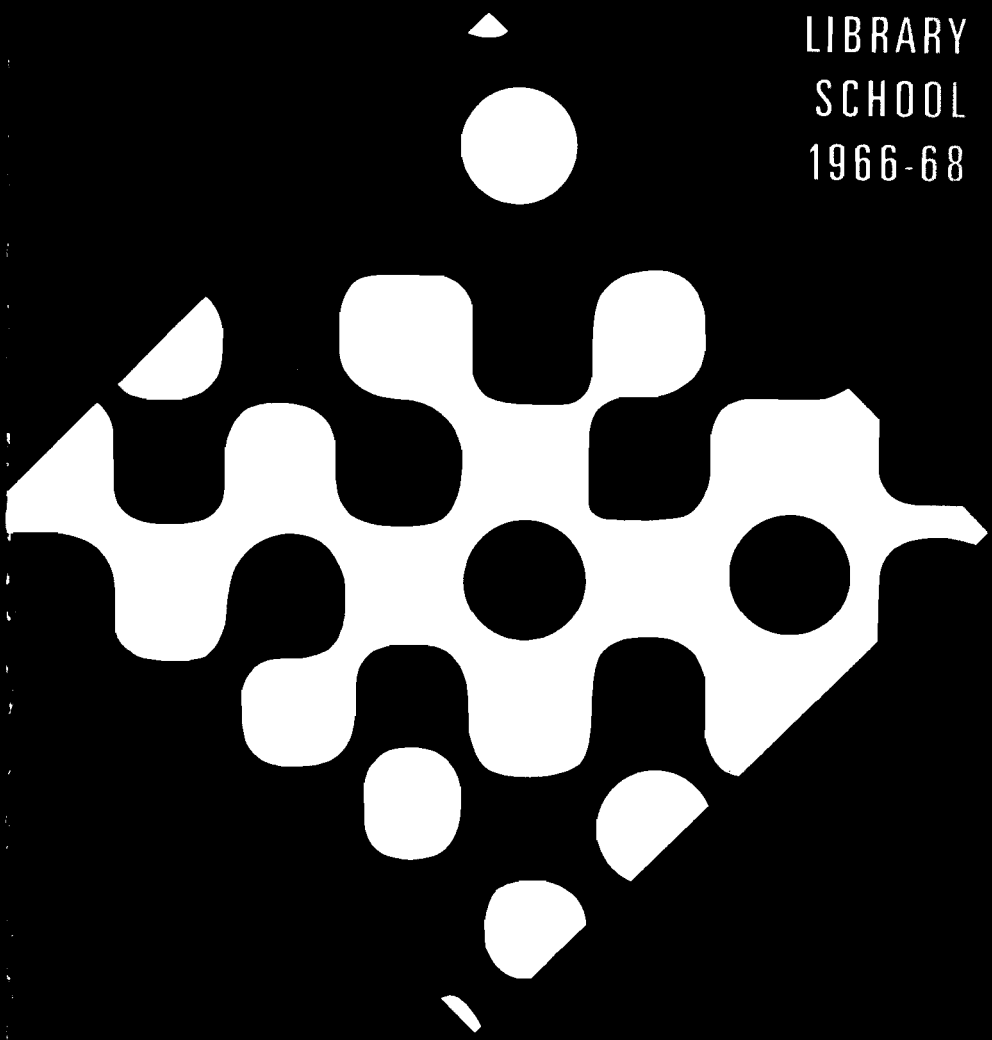
Scan, Scandinavian
Skt, Sanskrit
Slav, Slavic
Soc, Sociology
Soil, Soil Science
Span, Spanish
Spch, Speech and Theatre Arts
SSPA, Speech Science, Pathology, and Audiology
Stat, Statistics
Surg, Surgery
SW, Social Work
Swed, Swedish

Th, Theatre
Tib, Tibetan
Tran, Transportation

VAna, Veterinary Anatomy
VBac, Veterinary Bacteriology and Public Health
VMC, Veterinary Medicine and Clinics
VObs, Veterinary Obstetrics
VPaP, Veterinary Pathology and Parasitology
VPP, Veterinary Physiology and Pharmacology
VSR, Veterinary Surgery and Radiology

Zool, Zoology

UNIVERSITY OF MINNESOTA BULLETIN



LIBRARY
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Volume LXIX Number 3 February 1, 1966

UNIVERSITY OF MINNESOTA BULLETIN

Published semimonthly January 1 to December 15 inclusive. Second-class postage paid at Minneapolis, Minnesota. Send change of address notices and other communications to Office of Admissions and Records, University of Minnesota, Minneapolis, Minnesota 55455.

Library School

GENERAL INFORMATION

The Library School aims to prepare capable, professional librarians for work in public libraries, special libraries, college and university libraries, and school libraries. It is accredited by the American Library Association and is a member of the Association of American Library Schools.

The Library School is a part of the University of Minnesota College of Liberal Arts. In accordance with the standards of the American Library Association, it offers as the basic, minimum preparation for a professional career, a calendar-year program of study leading to the M.A. degree. It offers 15 credits (Lib 101-105) in librarianship to undergraduates in the College of Liberal Arts. A 24-credit minimum certification program for school librarians is also available.

Questions not answered in this bulletin may be sent to the Director of the Library School, Room 3, Walter Library, University of Minnesota, Minneapolis, Minnesota 55455.

Opportunities in Librarianship—The importance of libraries in our society is increasingly recognized each year. New types of libraries are being established, particularly by business and industry. Rural areas, previously without library service, are now establishing regional libraries requiring librarians capable of organizing and directing larger institutions of this kind. With the increasing enrollments in public schools and the recognition that modern education requires greater school library services, the demand for school librarians is great. Cities which have not previously had school library supervisors are now establishing such high-level positions. Specialists in technical and scientific library work are scarce and in great demand. College and university libraries must grow rapidly in the next decade to meet the needs of the large numbers of students expected. Young men and women who have an interest in books, people, and ideas find a challenging lifework in the rapidly expanding field of librarianship. Salaries of 1964 graduates averaged over $6,000.

Library Science Courses Are Available for:

1. Librarians in the field who have had no professional education. Such students may register for the five basic courses without being candidates for a degree.

2. College undergraduates in the College of Education or the College of Liberal Arts who wish to take a minor in librarianship or to take a few courses as electives to determine vocational interest in the profession.

3. College graduates who wish to prepare for a professional career in librarianship by completing the M.A. degree.

4. Postgraduate students, certified to teach in Minnesota, who wish to prepare for school library work by completing a 24-credit program leading to certification by the State Department of Education.

Evening Courses—Certain courses are offered in the late afternoon and evening. To be sure of graduate credit for extension study, the student should be admitted to the Graduate School. For more information concerning evening study, telephone or write the Library School Office, Room 3, Walter Library, University of Minnesota, Minneapolis, Minnesota 55455 (telephone 373-3100).

Correspondence Courses—The Library School, in accordance with the standards of the American Library Association, offers no correspondence courses.

Facilities—Classrooms, faculty and administrative offices, and the Library School library are located in Walter Library, the main building of the University of Minnesota Library. The special collection of the Library School library contains approximately 6,500 volumes. In addition, all students use the University libraries as a laboratory. There are now over 2 million volumes in these libraries. Library methods and practices may be observed, not only in the University libraries, but also in the public, school, and special libraries of the metropolitan area of the Twin Cities.

Summer Session—The Library School offers a selection of courses in two 5-week terms for which resident credit is given. Graduate courses are staggered in such a way that the Master's degree can be earned in 4 or more summers, depending upon the courses offered. The degree must be completed in 7 years.

All summer students should request advice on admission to courses at least 8 weeks before the term begins. Students who have not submitted transcripts for evaluation before May 1 will be advised to wait until the second term of Summer Session before registering for classes.

Student Employment—The University maintains a Student Employment Bureau which helps students find jobs to meet a part of their expenses. Students should apply in person after they have registered and know their class schedules.

Scholarships—Several scholarships are available. Applications should be submitted by February 15 for the following year. Scholarship applications will not be considered until the applicant has applied for admission to the Graduate School.

Graduate Library Assistantships—Through the co-operation of the University Library, students who have completed the 15 credits of basic courses are eligible to apply for a Graduate Library Assistantship. Appointees work 20 hours per week in the University Library, at a salary of $2,200 for 12 months, and study half-time, carrying no more than 9 credits in 1 quarter. A student holding such an appointment benefits from this work-study program by gaining practical experience while he is studying for the library profession. The typical graduate library assistant would be able to earn his living for 5 quarters of graduate study, and be ready for a responsible position as a professional librarian when he completes his degree.

Housing Facilities—Most out-of-town students live either in the University-maintained residence halls or in private rooming houses. Information concerning residence halls may be obtained from the director of University Housing, 100 Wesbrook Hall, or from the Student Housing Bureau, 209 Eddy Hall. Information about private rooming houses may be obtained from the Student Housing Bureau. Single students under the age of 21, whether undergraduate or graduate, must have approval of the Student Housing Bureau to live in an apartment.

Food Services and Restaurants—Several restaurants and food services are available to students in Coffman Memorial Union. Largest is the cafeteria, on the ground floor. There is also a soda fountain, a lunch counter, and a commuters' lunchroom for students who bring lunches from home. There are also several privately operated restaurants near the campus.

Tuition and Fees—An application fee of $10 will be required of all applicants for admission to fall quarter 1966 and subsequent terms. During the academic year, full-time graduate students pay $131 per quarter if they are residents of Minnesota, or $307 per quarter if nonresidents. Foreign students are required to pay a health fee of $5 per quarter.

Summer students, whether resident or nonresident, pay a tuition fee of $46.50 per 5-week term if carrying 1 to 4 credits, or $59.50 per 5-week term if carrying more than 4 credits. All students pay an additional $11 incidental fee per term.

Admission Policies and Application Procedures

Priority in registration and admission to courses will be given to persons officially admitted to the M.A. program or the minimum certification program. Students who hold a fifth-year library degree from an accredited library school are eligible for any library course at any time.

For Undergraduates in the University of Minnesota College of Liberal Arts:

No special procedure is required. However, the Library School office will be ready at any time to interview undergraduates and advise them on opportunities for a career in librarianship.

For Undergraduates in the College of Education:

A formal application for admission to the Minimum Certification Program for School Librarians is required. This application should be submitted during the first term of the junior year.

For College Graduates:

A. Persons interested in the 24-credit Minimum Certification Program for School Librarians should request a description of the program and an application form from the Library School. Applications should be submitted at least 8 weeks before the first class attendance. In order to avoid loss of credits toward a graduate degree, all applicants for admission to the certification

program should also apply for admission to the Graduate School before attending any classes.

B. All persons interested in a career as a librarian should apply for admission to the Graduate School to major in library science at least 8 weeks before the first class attendance. Any student with a Bachelor's degree from a recognized college or university may apply for admission to the Graduate School. All applicants will take the Miller Analogies Test, and no action will be taken on an application until this test score is reported to the Graduate School. Acceptance will depend on the undergraduate scholastic record, the Miller Analogies Test score, and the approval of the Library School and the Graduate School. Sometimes the Library School discourages students over age 35 from embarking on a career in librarianship. An applicant of unsatisfactory scholastic record and qualifications will be refused admission to the Graduate School, but may be advised, if a resident of Minnesota, to register for a probationary period as an adult special student in the appropriate undergraduate college.

For seniors in their last term of undergraduate study, and for all college graduates planning a career as a librarian, *the first step is to apply for admission to the Graduate School.* Application blanks can be obtained from the Library School office. Applicants should submit with these forms one official transcript of their undergraduate records. Applicants for admission to the Graduate School will be notified by letter of the action on their applications, usually after 4 weeks or more.

C. Graduates of accredited library schools who wish to increase their knowledge of librarianship by attending library science courses should request permission from the director of the Library School at least 4 weeks before the first meeting of the class.

D. Persons working in libraries who have had no professional education should request permission to register for any of the five basic courses from the director of the Library School at least 4 weeks before the first meeting of the class.

E. Students wishing to use library science as a minor in a Ph.D. program should first complete an M.A. in library science, then be admitted to candidacy for the doctorate in a subject field, and then request an evaluation of their total academic record by the Library School.

Qualifying Examinations—Students who have completed basic and general introductory courses in reference, cataloguing and classification, and selection of library materials in library instruction programs not accredited by the American Library Association may take qualifying examinations in these subjects. They will be excused from taking these courses at Minnesota if they demonstrate their mastery of these subjects by performance on a qualifying examination taken at least 1 week before the beginning of their first term in the Library School. The secretary at the Library School will schedule such examinations and administer them to students who have been admitted to the Graduate School. Graduate students may try qualifying examinations for any given course only once.

Curricular Requirements for the Master of Arts Degree

Foreign Language—Reading knowledge of a foreign language, modern or ancient, preferably French, German, or Russian, is required of all candidates for the Master's degree in library science. Students should consult the language department of their choice for information about meeting this requirement. Students who have never studied any foreign language may wish to enroll in special courses for graduate students in French, Spanish, German, Russian, Italian, or Portuguese.

Programs for the M.A. Degree—The Graduate School offers the Master's degree under two plans: Plan A, including a thesis, and Plan B, which substitutes additional course work and research papers for a thesis. The Library School recommends Plan B for most students. Plan A will be permitted in the case of students with unusual backgrounds and interests. Programs of study leading to the M.A. degree will be planned according to the special abilities, backgrounds, and aims of the individual student.

The Graduate School of the University of Minnesota permits a great flexibility in the designing of individual study programs for the Master's degree. Every program must include at least 45 graduate quarter credits in residence including at least 9 graduate credits in a related field.

The typical Plan B program of study will include 51-54 quarter credits of graduate study, consisting of 36 credits in library science course work, 9 credits in a related field, and 9 credits of research at least 6 of which must be in library science.

The typical Plan A program will include 57 quarter credits of graduate study, consisting of 30 credits in library science course work, 9 credits in a related field, and a thesis which counts for 18 credits.

Students who have completed basic courses in reference, cataloguing, and selection in an accredited library school (or who have passed qualifying examinations in these fields) may be required to take fewer library courses and more courses in related subjects than do students with no previous study in library science. In each program, the number of credits in related fields will depend upon the student's previous study.

Programs for School Librarians—For the preparation of school librarians there are three programs available. The chief emphasis of the Library School is upon the M.A. program described above. Graduates of liberal arts colleges who lack teaching certificates (and thus are ineligible for school library positions) may request from the Library School a detailed description of a special program which combines the courses required for a teaching certificate and courses required for an M.A. in library science. Persons wishing to become minimally qualified for positions as school librarians may apply for admission to the MINIMUM CERTIFICATION PROGRAM FOR SCHOOL LIBRARIANS. Requests for application forms and information about this program should be sent to the Library School office.

The Advisory System

The advisory system of the Library School is designed to help the student understand the rules and regulations of the Graduate School, the College

of Liberal Arts, the College of Education, and the Library Division of the State Department of Education, and to help him plan a study program which will achieve his aims without loss of time or credit.

The matching of the student's background of experience and study, his goals and interests, and the rules and regulations of the several agencies concerned requires the help of an expert adviser. Students admitted to the Graduate School or to the minimum certification program will be assigned an adviser. Prospective students who have not yet been admitted to one of these programs cannot be properly advised. In most cases they would be wise to wait until they have been officially admitted to a program before attending classes.

1. *The first step is to apply for admission to the Graduate School at least 8 weeks before you wish to attend classes.* You do not need to have completed any previous study of library science to make such application.

2. When you have received a letter from the Graduate School officially admitting you to the Graduate School, you should ask the director or one of his assistants in the Library School office to advise you on your first registration.

3. To help you choose among public, college, school, or special library work, the first five basic courses will serve as an introduction to librarianship as a professional field. During your first term the director or one of his assistants will assign you, according to your interests and aims, to a faculty member who will advise you in subsequent quarters. For example, you may decide to prepare for reference work, cataloguing and classification, acquisitions, administration, or various other kinds of work in libraries. Your personal adviser will help you with such decisions and with the choice of minor-related fields.

DESCRIPTION OF COURSES

Note—‡ means "consent of instructor is required"

For School Librarians Only

(No credit toward a graduate degree is granted for 53 and 74)

53. School Library Management. A practical introduction to the management of the small school library. Understanding and organization of simple routines, methods, and records necessary for the operation of such a library. (3 cr) Kromer, Olson

74. Library Materials in the Classroom. Correlating the library, as a materials center, with the school program. Sources of information and evaluation of materials for teaching and resource units. (3 cr) Olson

For Juniors, Seniors, and Graduate Students

(Credit toward the M.A. is granted for these courses if the student is officially admitted to the Graduate School)

101. Library Administration.** Principles of library administration, organization, and management. A general course for all librarians. (3 cr) Berninghausen

102. Reference I.** Intensive study of some 150 outstanding and useful reference books and tools most frequently used by students and librarians. Landmark reference books, indexes, and periodical guides. Theory and practice of reference work. (3 cr) Wezeman, Van der Boom

103. Cataloguing and Classification.** Basic principles of descriptive cataloguing, rules of entry, subject headings, and classification in libraries, for all types of libraries. (3 cr) Simonton, Samanisky

104. Selection of Library Materials.** Theory, principles, and techniques of selection; an introduction to the basic tools for selection of books, magazines, pamphlets, phonograph records, films, etc., for all types of libraries. (3 cr) Wezeman, Freeman

105. History of Libraries and Librarianship.** A survey of library development from ancient times to the present with emphasis on library service in the United States in the 19th and 20th centuries. The characteristics and functions of libraries as social agencies. (3 cr) Shove

171. Reading Guidance for Children. Reading interests of children and the various kinds of materials that meet these interests. Knowledge of the sources, selection, evaluation, and methods of introducing books to children. Required for minimum certification. (3 cr; prereq 104) Olson

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** Courses 101 to 105 are basic, introductory courses required of all M.A. candidates, unless they have demonstrated their mastery of these subjects by performance on qualifying examinations.

172. Reading Guidance for Adolescents. The library's relationship to the teen-ager in terms of his interests and needs. Methods of introducing books and developing and guiding reading. Required for minimum certification. (3 cr; prereq 104) Olson, Kromer

173. Reading Guidance for Adults. The learning and reading ability of adults. Books are read and discussed in the fields of light fiction, psychology, religion, travel, history, biography, essays, poetry, drama, and science. Books are reviewed from the standpoint of adult reading and evaluation of book collections. (3 cr; prereq 104) Wezeman

Graduate Courses

(Courses numbered above 200 are open only to students who have been officially admitted to the Graduate School or students who already hold a fifth-year degree in library science from a library school accredited by the American Library Association.)

206. Legal Literature and Research. (3 cr; prereq 102, ‡) Greene

231. Public Library Extension and Development. Larger units of service based upon county and multi-county patterns. Operation of federal and state aid programs. The legal basis for the larger unit of service. Consideration of the financial, administrative, materials selection, and personnel problems involved. (3 cr; prereq 101) Wezeman

241. Library Mechanization. Application of data processing and systems analysis principles to library operations; principles, problems, and examples of library mechanization. (3 cr; prereq 101 and 103 or ‡) Simonton

242. Introduction to Information Retrieval. Theory of various methods of subject analysis; methods of data representation, including coding; search strategies. (3 cr; prereq 103 or ‡) Simonton

243. Advanced Information Retrieval. Advanced topics in library mechanization and information retrieval. (3 cr; prereq 241, 242) Simonton

253. History of Books and Printing. Bookmaking in its various forms from earliest times to the present. Evolution of the alphabet; the manuscript book; the invention and spread of printing; the design of the modern book. Emphasizes the aesthetic and technical aspects. (3 cr; prereq ‡) Shove

Note—Each candidate for an M.A. degree is required to take one of the following four courses, indicated by ‡‡.

254.‡‡ The Public Library. History and development. Service standards. Modern trends and problems. Overview of the literature of the field. Development of the materials collection of the public library. (3 cr; prereq 101) Wezeman

255.‡‡ The College and University Library. The place of the library in the college and university organization. The influence on the library of developments and trends in higher education. (3 cr; prereq 101) McDiarmid

256.‡‡ Special Libraries. Procedures, practices, and problems of newspaper, music, insurance, medical, technical, and other special libraries. (3 cr; prereq 101) Aspnes

257.‡‡ School Libraries. Library objectives in relation to educational objectives, larger units of school service, value and effect of standards. (3 cr; prereq 101) Olson

258. Problems in College and University Librarianship. Personnel, buildings and equipment, appraisal of collections, administration and policy-making. (3 cr; prereq 101 and 255) Berninghausen, McDiarmid

259. Problems in Public Librarianship. Critical evaluation of the ingredients of public library service: personnel, materials, buildings. Case studies, readings, field research when possible. (3 cr; prereq 101 and 254) Wezeman

260. Literature of the Social Sciences. Bibliographical and other reference sources. The development of knowledge, landmark books, and current trends in the subjects covered. (3 cr; prereq 102) Shove

261. Literature of the Humanities. Bibliographical and other reference sources. The development of knowledge, landmark books, and current trends in the subjects covered. (3 cr; prereq 102) Shove, Van der Boom

262. Literature of the Natural Sciences. Bibliographical and other reference sources, with emphasis on indexing, abstracting, and reviewing mediums. The growth and development of scientific literature and its control and dissemination. A science background is not required for this course. (3 cr; prereq 102) Shove

265. Advanced Bibliography. The national and trade bibliographies of the world, with emphasis on those of the United States, Great Britain, France, Germany, and Russia. Their use in the selection and acquisition of books and in the preparation of subject bibliographies. (3 cr; prereq 102) Shove

266. Advanced Reference. A subject approach to major reference sources especially in the field of law, medicine, business, genealogy, local history, history, literature, education, agriculture, pure and applied science. City, state, and national government documents and UNESCO publications. Research information resources for urban areas. (3 cr; prereq 102) Wezeman

267. Descriptive Bibliography. Special problems in bibliographical research, with emphasis on bibliographical problems encountered in the acquisition, cataloguing, and description of antiquarian books. (3 cr; prereq 103 and 265 or ‡) Parker

268. Research Methods in Librarianship. Types of library research. Evaluation of research reported in library literature. How to prepare research papers in library science. (3 cr; prereq ‡) McDiarmid, Olson

272. Children's and Young People's Work. Value, effect, and needs of library service to this group are considered in the light of research studies that have been made. Library education, professional organizations and responsibilities, public and school library co-operative service, reading and readability, writing and publishing, evaluation, and selection. (3 cr; prereq either 254 or 257) Olson

275. Publishers and Publishing. Publishing in the United States in the 19th and 20th centuries. Economics and organization, copyright, influence of machines, important publishers and booksellers, special publishing, censorships, etc. Book production and book distribution. (3 cr) Shove

276. Communication Media and the Library. The process of communication, books, magazines, newspapers, television, radio, and the film in relation to libraries in society. (3 cr; prereq ‡) Berninghausen

277. History of Children's Literature. A survey of children's literature through the 19th century. A search for significant qualities of a literature for children in the cultural context of the times. (3 cr) Kromer

283. Advanced Cataloguing and Classification. Advanced study of rules of entry, descriptive cataloguing and subject analysis of library materials, administrative problems in cataloguing. (3 cr; prereq 103) Samanisky, Simonton

Note—Graduate students under Plan B are required to register for two or more of the following research courses with the approval of the professor who will guide the research paper.

295. Library Research. (3 cr; prereq ‡) Staff

296. Library Research. (3 cr; prereq ‡) Staff

297. Library Research. (3 cr; prereq ‡) Staff

UNIVERSITY OF MINNESOTA BULLETIN

UNIVERSITY OF MINNESOTA

Law School

Volume LXIX, Number 4 February 15, 1966

UNIVERSITY OF MINNESOTA BULLETIN

Published semimonthly January 1 to December 15 inclusive. Second-class postage paid at Minneapolis, Minnesota. Send change of address notices and other communications to Office of Admissions and Records, University of Minnesota, Minneapolis, Minnesota 55455.

The contents of this bulletin and of other University bulletins, publications, or announcements are subject to change.

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Law School

GENERAL INFORMATION

The Law School of the University of Minnesota was established in 1888. It is a charter member of the Association of American Law Schools and is on the approved list of the American Bar Association.

The University of Minnesota is located in a large metropolitan center affording easy access to federal, state, and local courts and governmental units. Students may conveniently observe judicial, legislative, and administrative hearings, consult with public officials and judicial personnel, and engage in research in public records of these government units.

The faculty consists chiefly of 26 resident, full-time professional law teachers who devote their time to teaching, research, and public service in their respective fields. The procedure courses are taught by men trained and experienced in actual litigation, who now devote full time to their Law School responsibilities. In addition, outstanding practicing lawyers are used for lectures in fields of their specialties and for parts of the Law School's tutorial program.

Law School Building

The Law School is housed in Fraser Hall, located between the East River Road (of the Mississippi River) and 15th Avenue Southeast, on the Minneapolis Campus of the University. All Law School administrative and faculty offices, student lounges and offices, and library facilities are located in Fraser Hall. All Law School classes are held in Fraser Hall.

Library Facilities

THE LAW LIBRARY

The library of the Law School, containing more than 300,000 volumes, and extensive areas for study and research, ranks fifth among law school libraries in the United States and is an outstanding legal research center. It is administered by a director who is a graduate of an American law school as well as a European law school and of an American school of library science. He is assisted by a staff of experienced law librarians.

Because of its exceptionally strong collection of American and British statutes, session laws, law reports, periodicals, treatises, publications of administrative agencies, appeal papers, digests, encyclopedias, and other legal materials, scholarly research in practically any field of Anglo-American law can be carried on in this library. The Rare Book Room contains

over 3,000 volumes of early English and American statutes, reports, and treatises. The document collection contains large numbers of British Commonwealth publications as well as American federal and state government publications and United Nations documents.

The Anglo-American collection includes an outstanding collection of legal materials of former British Commonwealth countries such as India and Pakistan. The library also has extensive sections in foreign (especially for Western European countries) and international law, and a good working collection of literature in related social science fields.

Law students may use the law library 24 hours a day, 7 days a week, a privilege rarely extended to any entire student body elsewhere. While the primary function of the library is to serve the faculty and students of the Law School, its services are available also to the faculties and students of other departments of the University, to members of the bar, and to all persons who have a real need for legal materials. When needed, special office facilities are provided for visiting lawyers, judges, and scholars from other institutions.

OTHER LIBRARY AND RESEARCH FACILITIES

Law students also make use of the general library system of the University which contains over 2,000,000 volumes. The Walter Library building, which houses the principal collection, is conveniently located immediately across the street from the Law School. In addition, students may obtain permission to use the facilities of the Minnesota State Law Library in the Capitol Building in St. Paul, where a vast collection of American legal materials is also available.

PREPARATION FOR LAW STUDY

The Law School does not prescribe any special prelaw college program. Its principal concern is that before entering Law School students have a college education of considerable breadth and, at the same time, one in which the student has dug deeply into advanced courses in areas of special interest to him. Such an education is assured by the major sequence requirement and the cultural distribution plan of most liberal arts colleges. The major sequence insures penetration of one field in considerable depth, while the cultural distribution plan insures a reasonable grounding in such diverse areas as science and mathematics, philosophy and humanities, literature and composition, and the social sciences. It is for this reason that the Law School requires for admission a B.A. degree or its equivalent.

The Law School does not recommend particular areas or departments for prelaw majors. While many law students major in economics, history, or political science, other departmental majors provide good backgrounds for law study and practice. These include such areas as philosophy, the humanities, English, sociology, psychology, mathematics,

the physical sciences, anthropology, geography, journalism, speech, classics, and modern languages. The Law School welcomes and encourages a variety of educational backgrounds among its students. It is important that each student's education be as broad as is consistent with the completion of the major requirements. Therefore, a student should ordinarily endeavor to take his electives in areas not too closely related to his major. For example, a student majoring in mathematics or physics would do well to take his advanced electives in such areas as economics, political science, or history.

The Law School attaches special importance to work that will train a student to express himself in the English language forcefully, effectively, and accurately. A lawyer's whole professional career, whatever his specialty, requires hourly communication of ideas through words, oral and written. Success in Law School, as well as in later years of practice, depends in a considerable measure on development of the capacity for effective verbal expression. Therefore, the student should seize every opportunity to take courses that require independent thought and writing. A student should also develop, through courses or activities, his capacities for expressing himself orally.

Students in high school, who intend to qualify for later admission to the Law School, should study in a penetrating manner such courses as history, English, higher mathematics, natural science, and courses dealing with current social problems.

REQUIREMENTS FOR ADMISSION

Academic Program Requirements

Admission to the Law School requires the bachelor of arts degree or its equivalent. The degrees bachelor of science and bachelor of business administration with a well-balanced program will be accepted as the equivalent of the B.A. degree.

The Law School urges that students taking these degrees plan a program with as wide a cultural distribution as possible.

Law School Admission Test

Each applicant for admission is required to take the Law School Admission Test given by the Educational Testing Service of Princeton, New Jersey.

The test is given in a single day and is divided into three parts. In the morning, the student takes an aptitude test designed to measure some of the qualities of mind which make for successful performance in the study of law. The two afternoon parts are designed to test writing ability and general background. At the time of preparation of this bulletin, the score from the morning part of the examination was the only score used in making most admissions decisions. Nevertheless, a student should do

as well as possible on all parts of the examination since this policy could change without notice.

The test is given in August, November, February, and April at selected centers throughout the United States and in some foreign countries. One of these centers is at the University of Minnesota. Normally the test should be taken in November or February of the senior year in college.

Application forms and information bulletins about the test can be obtained from the University of Minnesota Law School, Minneapolis, Minnesota 55455, from your college office, or from the Educational Testing Service, Princeton, New Jersey.

The completed application form, together with the required fee of $12, must be received in Princeton about 2 weeks before the test date. Early inquiry should be made to obtain the exact dates for the tests.

If the student has taken the Law School Admission Test, but did not arrange to have the results sent to the University of Minnesota at the time he took the test, a duplicate test score can be sent to the Law School. Write the Educational Testing Service, give them if possible the date and your examination number, ask to have a duplicate transcript of your score sent to this Law School, and enclose $1 with your request.

Qualitative Requirements for Admission

Admission is limited to applicants who show reasonable prospects for success in law study and in the profession; however, not all who are qualified by this standard can be admitted. In order to avoid detriment to the quality of professional training given by the Law School, only the number of qualified applicants within the capacity of the building facilities and academic staff will be admitted.

The Law School makes a careful study of each application for admission. All relevant factors are taken into consideration. Admissions decisions are not made merely by applying mechanical criteria; however, the experience of the admitting officers is that an excellent academic record from a good college or university is the best indicator of the probability for success in law school.

Procedure for Application

Obtain the application forms from the Law School or the University Office of Admissions and Records. The application will be complete when the Law School has received the application, transcripts from each college attended (have two copies from each college sent to the Office of Admissions and Records, University of Minnesota, Minneapolis, Minnesota 55455), and the Law School Admission Test Score. All students not previously enrolled in another school or college within the University of Minnesota are required to remit a $10 application fee.

Application should be made by March 1 or earlier if possible. Appli-

cations received after that date will be considered, but the prospects for admission are not as good for late applications as for applications filed before March 1.

Registration with Bar Association Officials

A number of states require a student to register with bar admission officials prior to commencement of law studies. A student should ascertain whether this is required in the state where he intends to practice. Such registration is not required in the state of Minnesota.

Advanced Standing

A candidate for graduation must spend the required time in residence, either at this Law School or at some other school which is a member of the Association of American Law Schools. A student coming from such other school must have the preliminary education required for admission to this school and must spend at least 1 year in attendance at this school before he can qualify for a degree. Advanced standing will be given only to students with satisfactory records, and credit may be withdrawn because of poor work in this school. Candidates should forward a transcript of their records in both prelaw and law work.

PROGRAM OF INSTRUCTION

Summary of Requirements

The Law School program leading to the bachelor of laws degree requires 3 academic years of full-time Law School study carried on at prescribed levels of academic achievement.

Summer School

The Law School regularly offers at least 42 quarter credits of advanced courses in summer school. These courses extend without interruption through the two University terms of Summer Session. Students who have completed 1 year at a law school which is a member of the Association of American Law Schools are eligible for admission to the University of Minnesota summer school. Information on the Summer Session is available each year after March 1 through the dean's office. A student may accelerate and obtain his LL.B. degree in the December preceding normal June graduation by successfully completing two complete Summer Sessions.

Purpose and Method

The curriculum of the Law School has three objectives: (1) to provide a thorough and basic training in the law and legal techniques required for successful practice of law and for scholarly work in law; (2) to create an understanding of and appreciation for the role of the lawyer and legal tribunals in the administration of justice; and (3) to prepare the Law School graduates for the lawyer's responsibility to improve the administration of justice and to provide governmental and community leadership. Emphasis is placed on an understanding of the history, principles, and purposes of legal institutions, the operation of these institutions in the modern world, and the development of the skills of legal craftsmanship.

The Law School uses a variety of teaching methods. The basic form of instruction is the case and problem method, which centers around the critical study and discussion of decisions by courts and administrative agencies. The decisions selected for study reflect both the evolution of the law and the efforts to arrive at satisfactory solutions to difficult current problems. Instructors also make use of textual and legislative materials. Decisions, texts, and legislation are supplemented with hypothetical or real problems put to students for consideration and solution.

These decisions and other legal materials give the student a realistic understanding of the history and current state of the law. But the more important purpose for using actual decisions as the basic teaching tool is to pose factual problems out of real life for which the student must seek satisfactory solutions. The primary value of this method of study is the experience gained by the student himself in seeking the best solution for the problem posed, not simply the understanding he acquires concerning the decision actually reached by the court. For the end product sought by the Law School is a lawyer qualified to resolve new and difficult legal problems, thoroughly grounded in his knowledge and understanding of past legal tradition and present law.

Tutorial instruction is used extensively at Minnesota to develop the student's ability to solve problems. In the first year every student is given specific problems to resolve. He engages in independent research and study upon each problem and prepares a legal memorandum, opinion letter, or brief. His analysis and writing are then closely scrutinized by an outstanding lawyer with *Law Review* editorial experience. After a conference, he prepares a second, or even a third draft, with the same procedure for scrutiny and discussion.

In the second year, the tutorial program consists of an appellate moot court, with tutorial assistance in the preparation of briefs. The cases are also argued orally.

Tutorial and small group work designed to develop the individual continues in the senior year. The student participates in a seminar in which a small group of students examines intensively a special area of interest under a faculty expert in that area. Each senior must prepare a substantial piece of written work aimed at exploring and solving a legal problem, under the guidance of a faculty member. Each senior is also

given experience in the basic method of resolving controversies; he prepares and tries two cases in the practice court, one to a judge and one to a jury. Members of the judiciary preside at these trials, held in the courtroom of the Law School.

Courses of Study

The normal course load is 16 hours per week in the first and second years and 15 hours per week in the third year. Additional work cannot be taken without the dean's approval. Attendance at all classes and all special lectures is required. All courses in the first year are required. The schedule for each year is available in the dean's office in the late summer.

Beginning students are admitted only in the fall of the year and are expected to register and attend an orientation period immediately preceding the regular opening of classes.

FIRST YEAR

101. Contracts. Basic course in law of contract and promissory obligation; formation of contracts; legal validity and construction; breach; conditions; remedies; third-party rights. (9 cr) Enker, Kinyon, Livermore

103. Legal Process. Introduction to methods and processes of legal decision-making by judicial, legislative, and administrative agencies; illustrated by examining how these agencies deal with a problem of wide public concern, the allocation of the burden of industrial accidents. (4½ cr) Auerbach, McCoid

106. Legal Research. Books and other tools of the legal profession; preparation of memorandums of law on the basis of facts supplied by practicing attorneys; tutorial instruction in legal analysis and legal writing. (3 cr) Greene and instructors in legal research

107. Property I. Fees, life estates, concurrent tenancies, landlord and tenant, reversions, remainders, uses, executory interests, powers of appointment, class gifts, rule against perpetuities. (9 cr) Stein, Waterbury

108. Torts. Civil liability for infliction of harm, including intentional infliction of physical harm and defenses, the negligence cause of action, and strict liability; function of tort law; infliction of harm from insult, indignity and shock, including defamation; misrepresentation and other forms of infliction of economic harm. (9 cr) Christie, McCoid, Morris

109. Introduction to Procedure. Pleading, common-law, code and rule; demurrers and related motions; functions of judge and jury; judgments. (9 cr) Cound, Hetland, Wolfram

110. Constitutional Law. Judicial review; distribution of powers under federal system: national powers, state powers, intergovernmental relations; limitations on governmental power: economic and property interests, personal liberties, equality under the law. (6 cr) Auerbach, Lewis, Lockhart

SECOND AND THIRD YEARS

BA 85. Legal Accounting. Bookkeeping techniques; financial statement analysis; recognition of revenue; matching of costs and revenues; inventory and depreciation methods; costs of borrowed capital; accounting for various forms of business association; relationship to legal problems. (3 cr; for law students with inadequate background in accounting; exemption from course is given to students with extensive background in accounting and to others by examination) Pavlock

102. Criminal Law and Procedure. The major problems of the criminal law and its administration viewed as a device for controlling socially undesirable behavior; construction and analysis of modern penal statutes; legislative problems of criminal law revision; juvenile court procedure; selected problems of criminal procedure and constitutional rights. (6 cr) Enker, Pirsig

120. Banking and Negotiable Instruments. Introduction to commercial payment devices, instruments, and commercial bank practices; selected legal problems and principles under the Uniform Negotiable Instruments Law and the Uniform Commercial Code. (4½ cr; prereq 101) Greene, Kinyon

121. Appellate Advocacy. Practice before appellate courts; preparation by each student of briefs and argument in two appellate moot court cases with tutorial instruction in legal analysis, legal writing, and oral argument. (3 cr) Adamson and instructors in legal research

122. Introduction to Business Associations. Creation, form, nature, termination of agency, partnership, unincorporated business associations; powers, duties, liabilities, compensation of agents, partners, business associates; risks in conduct of business by representatives. (3 cr) Morris

123. Private Corporations. Structure and characteristics; formation and promotion; issuance and transfer of securities; exercise and sale of control; shareholder's suits; capital creation and reduction; distributions; authority and responsibility of representatives; sale of assets and mergers; reorganization; dissolution. (6 cr) Morris

124. Modern Real Estate Transactions. The commercial transfer of land and financing of land acquisitions: real estate contracts, deeds, leases, mortgages; the recording system; adverse possession; covenants for title; easements and promises respecting the use of land; fixtures; waste. (6 cr) Graven

125. Remedies. Equity, damages, restitution; primary emphasis upon equitable relief, with legal material largely restricted to contract. (6 cr) Enker, Wolfram

126. Sales. The sale of goods at common law, under the Uniform Sales Act, and under the Uniform Commercial Code. (4½ cr) Kinyon, McClure

127. Trusts and Estates. A basic introduction to the law governing devolution of property; the requirements of a valid *inter vivos* gift, intestate succession, the formalities required for an effective will, and the various types of challenge which may be made to a will meeting formal requirements of execution and attestation; problems of probate administration; the law governing the creation, administration, and distribution of trusts; tax problems arising out of the descent and distribution of property. (6 cr) Hogg, Stein

128. Taxation I. Principles of federal income taxation of individuals; introduction to and selected problems in federal income taxation of decedents' estates, trusts, partnerships, and corporations; introduction to and selected problems in federal estate and gift taxation. (6 cr) Scallen, Waterbury

129. Evidence. Proof of fact, direct and circumstantial proof; exclusionary rules including hearsay and hearsay exceptions; privileged communications; constitutional protections; competency of witnesses; impeachment. (6 cr) Hetland

130. Law Review. Credit is given without grade for satisfactory participation by selected second year students in the Law Review program. (3 cr)

140. Administrative Law. Function of administrative agencies in our society; administrative powers and procedures; legislative, judicial, and executive control of administrative agencies; interrelations of legislative, judicial, executive, and administrative agencies in development of public policy. (4½ cr) Auerbach

141. Secured Transactions. Chattel secured credit; pledges, field warehousing, chattel mortgages, conditional sales, assignment of receivables, trust receipts, and factors' liens; Uniform Commercial Code. (3 cr; prereq 126) McClure

142. Conflicts. Jurisdiction, judgments, choice of law. (4½ cr) Cound

143. Creditors' Remedies. State remedies, including attachment, garnishment, and execution; selected bankruptcy problems. (3 cr) McClure

144. Seminar: Criminal Law. Problems of criminal law administration and of the juvenile court; includes reports prepared by members on selected topics in the field, lectures by invited specialists, attendance at a juvenile court hearing, and an inspection trip to a penal institution; a limited number of advanced students from related fields may participate. (3 cr) Clendenen, Pirsig

145. Estate Planning. A study of arrangements for the devolution of private wealth, application of principles of the law of wills, trusts, future interests and federal income, estate and gift taxation to the development of such arrangements; consideration of the role of life insurance and employee benefits in the development of such arrangements; consideration of drafting techniques. (4½ cr; prereq 128 and 127) Hogg, Stein

146. Seminar: Estate Planning and Drafting. A research and writing or drafting seminar focusing on specific problems; either legal problems for research and writing in the areas of federal tax and related property, partnership and corporate law; or research for and drafting of specific provisions for insertion in wills, trusts, or business purchase agreements, designed to achieve specific estate planning objectives of general interest. (3 cr; prereq 128, 127, 145 [145 may be taken concurrently]) Waterbury

147. Independent Research. Preparation in depth of a major paper on a difficult legal problem. (3 cr) All faculty

148. Seminar: Legal Problems in Minnesota Public Affairs. Participants study and seek solutions to selected problems of importance faced by Minnesota legislators, legislative interim commissions, municipalities, and other public agencies; both factual and legal exploration is used, aimed at producing a recommended course of action or solution to be submitted to the governmental officials involved, together with draft legislation or other appropriate governmental action. (3 cr) Graven

149. Seminar: Equity in Modern Society. Intensive analysis of the distinctive powers and doctrines of equity and how they are being molded to meet present-day social, economic, and political problems; examination of the use of injunctions, declaratory judgments, and class actions in various areas of the law to meet changing conditions of recent years. (3 cr)

150. Insurance. Primarily the law governing the making of insurance contracts and their construction; also regulation of the insurance industry. (4½ cr) Hogg

151. Seminar: Land Planning. Examination of selected problems of governmental control of development and use of land; emphasis on the legal means for effectuating planning in metropolitan areas, including zoning, subdivision regulation, urban renewal, housing and building codes. (3 cr)

152. Judicial Administration. The adversary process and its comparison with administrative methods, fact determination, and the role of judge and jury; selection of judges; the history, function, economics, and organization of the legal profession; measures adopted and suggested for improving the administration of justice. (3 cr) Pirsig

153. Seminar: Impact of Law on Social Development. Joint seminars for anthropology and law students; the interplay between law and anthropology. (3 cr) Auerbach

154. Seminar: Tax. A consideration, in depth, of problems of federal taxation beyond the offerings in Taxation I and Taxation II. (3 cr) Waterbury

155. Law of Labor Relations. Collective bargaining and the laws regulating organization for collective bargaining; selection of representatives; negotiation and administration of collective bargaining agreements; limitations on strike, boycotts, and picketing; the internal relations of the union and its members. (4½ cr) Lewis

156. Labor Law Practice. For students intending to engage in labor practice; arbitration of labor disputes; N.L.R.B. proceedings in representative cases and unfair labor practice cases; negotiation of collective agreements; mediation and

conciliation processes; legislative committee hearings. Emphasis is placed on actual practice sessions. (1½ cr; prereq 155) McCoid

157. **Standards of the Legal Profession.** Examination of the ideals of the profession and their enforcement; includes the content and role of professional ethics. (1½ cr) Pirsig

158. **Legislation.** Legislative organization and procedure; textual authenticity; statutory interpretation. (3 cr) McClure

159. **Local Government Law.** Place of local government units in the governmental structure; sources of and limitations upon the power of local governments; legislative control; home rule; relationship to other local government units and to the federal government; role of the judiciary; organization annexation, consolidation, and dissolution. The planning function; eminent domain; zoning; subdivision regulation; financial aid and tax incentives for private business. (4½ cr)

160. **Seminar: Trade Regulation.** Problems inherent in the impact of a need for regulating certain aspects of business on a free enterprise economy: Sherman Act; Clayton Act; patents, etc. (3 cr) Levy

161. **Modern Social Legislation.** Governmental programs designed to assure to every member of society the means to obtain without unreasonable effort the material items necessary for a decent minimum standard of living; particular emphasis on the Fair Labor Standards Act, Fair Employment Practices Acts, Workmen's Compensation laws, Unemployment Compensation laws, Social Security System. (4½ cr) Lewis

162. **Statutory Interpretation.** An examination of the problems involved in interpreting and drafting statutes. Particular emphasis on the use of legislative history in the interpretation of federal statutes. Several problems will be assigned. (3 cr) Christie

163. **Practice.** Rules of civil procedure including pretrial and posttrial motions, parties, pleading and discovery, appeals; practice trials including court and jury cases. (12 cr) Graven, Hetland

164. **Seminar: Regulated Industries.** The various aspects of the regulation of public utilities—the legal controls over price, supply, and service—in the context of the problems of a related group of utilities—the rail, motor, water, and air transport industries; emphasis on the interaction between the legislature, the administrative agencies, and the courts in the development of regulatory policy, and the relationship between the regulatory policy and the relationship between the regulatory and anti-trust policies. (3 cr) Auerbach

165. **Trade Regulation.** Analysis of the statutes and policies governing business in a free enterprise economy; Sherman Act; Clayton Act; Robinson Patman Act; patent law and policy. (4½ cr) Levy

166. **Seminar: Malpractice Litigation.** Planned to afford the student the opportunity to analyze the meaning of "malpractice" and what should constitute malpractice on the part of a professional, specifically in the context of the medical profession. (3 cr; prereq 108 and 129) McCoid

167. **Securities Regulation.** Legal and financial aspects of federal and state securities acts; registration; prospectus; distribution; remedies implied from statutes. (3 cr)

168. **Seminar: Business Planning.** Designed to expose the students to the planning process. The format will be to explore some common corporate transactions in the light of corporate law, tax law, and the law of securities regulation. (3 cr) Waterbury

169. **Seminar: Supreme Court.** Work of the United States Supreme Court during its current term; special emphasis on important recent decisions, jurisdiction, practice. (3 cr)

170. **Seminar: Judicial Administration.** Relates primarily to the administration of justice in the civil field; includes problems of civil procedure, evidence, court organization, the legal profession and its organization, the qualification and

selection of judges and court personnel, jury trial, use of expert testimony, calendar delays. (3 cr) Pirsig

171. **Seminar: Civil Rights.** Constitutional and statutory problems particularly affecting the Negro civil rights movement; the effect of that movement on the law. (3 cr; prereq 110) Livermore

172. **Legal Problems of a Welfare State.** Consideration of the old age and survivors and dependents insurance aspects of the social security system and the problems raised by governmental efforts to aid those in need. (3 cr) Lewis

173. **Taxation II.** Federal income taxation of corporations and shareholders; current problems in business planning. (3 cr; prereq 128 and 123) Scallen, Waterbury

175. **International Law.** Nature and sources of international law, jurisdiction of states over persons and property, recognition of states and government, the law of treaties. (4½ cr) Christie, Hogg

176. **Seminar: Patent Law.** Selected problems arising from those federal laws designed to stimulate technological and cultural progress. (3 cr)

177. **International Commercial Transactions.** Problems of foreign trade and investment. (4½ cr) Hogg

178. **Advanced Law Review.** Credit is given without grade for satisfactory participation by Law Review seniors in the Law Review program. Includes research, analysis, and writing for publication. Officers of the Law Review and some senior members work as tutorial instructors in the process of editing and publication. (3 cr)

179. **Directed Research.** (1½ cr) Ar

180. **Federal Jurisdiction.** Distribution of power between federal and state courts; structure and function of the federal judiciary; original jurisdiction of the district courts; removal jurisdiction; law applied by federal courts; actions against state officials. (4½ cr)

181. **Seminar: Regulation of the Medical Profession.** Discussion of a series of problems involved in the legal regulation of the medical profession and medical practice, including but not limited to the following: control of membership in medical societies; control of membership on hospital staffs and hospital staff privileges; regulation of narcotics and narcotic addiction; legal regulation of operations, including abortions and sterilizations; mandatory reporting of accidents and child abuse cases; "good samaritan laws" immunizing physicians and others from liability for negligence in "emergency" medical care; definition of "due care" in medical malpractice actions; "invasion of privacy" and disclosure of information concerning patients; court authorization of operations and medical procedures such as blood transfusion. (3 cr) McCoid

182. **Seminar: Secured Transactions.** Chattel-secured credit; pledges, field warehousing, chattel mortgages, conditional sales, assignment of receivables, trust receipts, and factors' leins; Uniform Commercial Code. (3 cr; prereq 126) McClure

183. **Seminar: Metropolitan Area Problems.** The seminar will examine a series of problems involved in the government of metropolitan areas, e.g., urban renewal and metropolitan planning, and various proposals for the reorganization of government in such areas. Substantial attention will be devoted to an examination of the role of the federal government—particularly through the grant-in-aid device—in the solution of such problems. (3 cr; preference to those who have had 159)

184. **Unfair Competition.** Copyrights, trademarks, and unfair competition; trade libel, disparagement, interference with contractual relations, and other business torts. (4½ cr) Livermore

185. **Jurisprudence.** Philosophies of law; theories of justice; analysis of legal language; legal reasoning as a means of social control; law and the social sciences. (4½ cr) Christie

186. **Family Law.** Analysis of the common law and statutory doctrines relating to the creation, functioning, and deterioration of family status; illegitimacy, marriage, juvenile protection, divorce, support. (4½ cr) Levy

187. **Law and Medicine.** Problems of proof of medical facts in legal proceedings; the legal aspects of medical practice; guest lectures by medical personnel in specific areas of medicine of most significance in personal injury and workmen's compensation practice. (3 cr) McCoid

188. **The Child and the State.** Intensive study of adoption, illegitimacy, neglect of children, delinquency, and custody proceedings. (3 cr) Levy

189. **Selected Problems in Constitutional Law.** A consideration in depth of several difficult problems of constitutional law ordinarily not treated at any length in the basic constitutional law courses. (3 cr; prereq Constitutional Law) Lewis

190. **Comparative Law.** The "Code System" approach to solutions of selected legal problems differing from the Anglo-American method; comparative student reports in selected areas of law. (4½ cr) Greene

191. **Law and Land Economics.** Graduate students in agricultural economics and law students explore common problems relating to land economics and their relation to law. (3 cr) McClure

192. **Seminar: Divorce Counseling.** Students will participate with psychiatrists in interviewing and representing indigent clients seeking divorce, and examination of interviewing techniques and the role of a lawyer in divorce cases. (3 cr) Levy

193. **Seminar: Criminal Procedure.** Study of what are—and ought to be—the procedural rights and liabilities of those accused of crime with emphasis on constitutional dimensions of criminal procedure. (3 cr) Enker

194. **Seminar: Bankruptcy.** Primarily for those third-year law students contemplating an active bankruptcy practice; for others the regular course in Creditors' Remedies should be sufficient to meet these needs. Probably no paper required. (3 cr) McClure

195. **Seminar: Family Law Clinical.** Students will participate in the legal, social, and behavioral aspects of neglected child and illegitimacy cases, parental termination proceedings and the adoption process, as well as the procedures and aims of a family court in divorce, separation, and custody cases. Also involves participation with psychiatrists in interviewing and representing indigent clients seeking divorce, and examination of interviewing techniques and the role of a lawyer in divorce cases. This seminar includes 195A. (4½ cr; prereq 186) Levy

195A. **Seminar: Family Law.** Participation in the legal, social, and behavioral aspects of neglected child and illegitimacy cases, parental termination proceedings and the adoption process; and the procedure and aims of a family court in divorce, separation, and custody cases. (3 cr; prereq 186) Levy

196. **Seminar: Trusts and Estates.** Builds on the materials covered in the basic Trusts and Estates course; specific content varies from year to year. (3 cr; prereq 127) Hogg

197. **Seminar: Labor Law.** Participants will deal in a variety of ways with a variety of problems, including grievance arbitration, the practice of law before the N.L.R.B., and the individual and the labor union. Participants may explore special problems of practice concerning the representation of workers in areas such as social security and workmen's compensation. (3 cr; prereq 155) Lewis

198. **Seminar: Multiparty Litigation.** A study in depth of the procedural problems involved in actions with more than two parties, particularly permissive joinder, impleader, and class actions; the law of indemnity and contribution. (3 cr) Cound

199. **Seminar: Corporate Planning and Drafting.** The student is given hypothetical corporate problems (perhaps taken from the practicing lawyer's desk) on a

client's proposed course of action; each problem is designed to require the student to grasp the business situation and goals involved, analyze for pertinent legal principles, plan the transaction to avoid legal and business (including taxation) pitfalls, plan the requisite steps to consummate the desired transaction, draft the appropriate papers and present his research. (3 cr; prereq 123)

Additional seminars are offered on a wide range of legal problems as prompted by student and faculty interests.

HOUSING

All Law Students

Numerous apartment houses (and for single students, rooming houses) are available within walking distance of the Law School. Vacancies in houses, duplexes, apartments, and rooming houses are reported to the Student Housing Bureau, 209 Eddy Hall, University of Minnesota, Minneapolis, Minnesota 55455. Normally, it is best to look for this type of housing in person in the early summer. However, at the time of preparation of this bulletin, there is no shortage of housing near the University.

Married Students

Permanent apartments for married students with one to three children are maintained on the St. Paul Campus of the University. There is convenient bus service to the Minneapolis Campus. The apartments are unfurnished; one bedroom, $70 per month; 2 bedrooms, $80 per month; all utilities except telephone are included. Stoves and refrigerators are provided. Since the waiting list is long, an interested student should get his name on the list as soon as he is admitted to the University. Contact either the Student Housing Office, 209 Eddy Hall, University of Minnesota, Minneapolis, Minnesota 55455, or Commonwealth Terrace, 1295 Gibbs Avenue, St. Paul, Minnesota 55108.

Single Students

The best facilities available for single male students are in sections of Centennial Hall used for graduate and professional students. The cost for room and board for the academic year at the time this bulletin was prepared was from $780 to $900. The higher figure is for a "deluxe" single room. Contact either the Student Housing Bureau, 209 Eddy Hall, University of Minnesota, Minneapolis, Minnesota 55455, or Centennial Hall, University of Minnesota, Minneapolis, Minnesota 55455 for information.

For those who prefer to live with law students, the Gamma Eta Gamma law fraternity provides good housing for single students. Contact Gamma Eta Gamma Law Fraternity, 1126 5th Street S.E., Minneapolis, Minnesota 55414.

EXPENSES

Tuition and fees, academic year—residents	$435
Tuition and fees, academic year—nonresidents	921

In order to be classified as a resident, the University of Minnesota ordinarily requires bona fide residence for a period of 1 year and evidence of intent to be a permanent resident of Minnesota. The University Office of Admissions and Records makes these determinations. An appeal from such a determination may be taken to a committee.

The Law School has made careful estimates of living and educational expenses for students attending the Law School. The estimated expenses for a law student who is a resident of Minnesota are $1,925 per year ($1,250 for a Twin Cities commuter living at home). The expenses for a nonresident are $486 greater. Details may be obtained from the dean's office.

Financial Planning

Students are responsible for making adequate financial arrangements to carry them through each year of law school. The importance of sound financial planning cannot be underestimated. Lack of it accounts for or contributes to as many dropouts as outright scholastic failure, especially during the first year. Some students supplement their income with outside employment, but this is generally discouraged, particularly for first-year students. Excessive outside employment is never permitted. It is well to consider, for planning purposes, that employment in jobs ordinarily open to students is likely to impair academic work and be an unreliable source of continuing income.

As indicated in the loan and scholarship sections of this bulletin, there are several sources of financial assistance for students. Of special interest to second- and third-year students is the loan program of a local bank which will normally provide for their needs up to $1,000 annually. Reliance should not be placed, however, on the availability of loans and scholarships until applications have been approved or definite arrangements made.

In the absence of a definite commitment or arrangement for future years, the fact that a scholarship or loan has been approved for 1 year does not assure that additional funds will thereafter be made available. Normally, such assistance is continued if needed, although in the case of scholarships the student is expected to maintain a B average in order to qualify for the following year. The University and the Law School provide emergency loan services, which are liberally administered but may not be available under all circumstances. It is advisable, therefore, for students whose financial resources are marginal to arrange with an individual or bank in their home town for extension of credit in the event their financial plans are disrupted.

Part-time Employment

Employment opportunities in Minneapolis and St. Paul are substantial. However, the faculty is gravely concerned over the effect outside work has on the student's performance in Law School. It is strongly recommended that the student engage in no outside work. All students engaged in outside employment are required to submit a statement concerning the number of hours of work and to counsel with one of the deans. If individual circumstances require a substantial amount of employment, arrangements must be made through the dean's office to reduce the amount of Law School work accordingly.

Fraternity or residence hall counseling provides room and board plus a small amount of cash for the academic year. Nonresidents are also given the benefit of paying resident tuition rates. The time required for counseling duties is substantial. For more information, contact Mr. Harold R. Marquardt, Co-ordinator of Residence Counseling Program, 8 Temporary North of Mines, University of Minnesota, Minneapolis, Minnesota 55455.

FINANCIAL AIDS

Scholarships

Almost all Law School scholarships require a showing of financial need. Scholarships are available to first-year students as well as to advanced students. The stipends vary with the financial need, and usually cover the cost of tuition and books for residents, and tuition for nonresidents, but may be sufficient to cover all expenses.

Application forms may be obtained from the dean's office of the Law School. Entering students should apply by March 1. Students currently in Law School should apply by late May. A scholarship applicant does not apply for a particular scholarship.

Law Firm Scholarships—Annual scholarships are supported by each of the following law firms and individual lawyers.

Altman, Geraghty & Mulally, St. Paul
Arriola, Joaquin C., Agana, Guam
S. H. Bellman, Minneapolis
Erling Berg, Duluth
Best, Flanagan, Lewis, Simonet & Bellows, Minneapolis
Blethen, Ogle, Gage & Krause, Mankato
Briggs & Morgan, St. Paul
Lyman A. Brink, Hallock
Bundlie, Kelley & Torrison, St. Paul
Arthur A. Burck, New York, New York
Butchart, Fredin & Eaton, Duluth
Cant, Haverstock, Beardsley, Gray & Plant, Minneapolis
Doherty, Rumble & Butler, St. Paul
Dorsey, Owen, Marquart, Windhorst & West, Minneapolis
Erickson, Popham, Haik & Schnobrich, Minneapolis
Faegre & Benson, Minneapolis
Faricy, Moore, Costello & Hart, St. Paul
Felhaber, Larson & Fenlon, St. Paul
Robert H. Ford, Chicago, Illinois
Cassius E. Gates, Seattle, Washington
Ernest A. Gellhorn, Cleveland, Ohio
Gislason, Reim, Alsop & Dosland, New Ulm
Grannis & Grannis, South St. Paul
H. G. Haugland, Minneapolis
Hultstrand, Abate & Wivoda, Hibbing
Hvass, Weisman & King, Minneapolis
Jevne & Jevne, Minneapolis
Robert G. Johnson, Willmar
Stephen F. Keating, Minneapolis

Kueppers, Strong & Kueppers, St. Paul
Sheldon S. Larson, Winthrop
Leonard, Street & Deinard, Minneapolis
Lindquist, Magnuson & Glennon, Minneapolis
Mackall, Crounse, Moore, Helmey & Holmes, Minneapolis
Maslon, Kaplan, Edelman, Joseph & Borman, Minneapolis
Maun, Hazel, Green, Hayes, Simon & Aretz, St. Paul
McCabe, Van Evera, Mundt & Hall, Duluth
Meagher, Geer, Markham & Anderson, Minneapolis
Merchant, Merchant & Gould, Minneapolis
Montague, Applequist, Lyons, Nolan, Donovan & Knetsch, Duluth
Moses, Friedell, Share & Solomon, Minneapolis
Murphy & Preece, Grand Rapids
Nelson & Oyen, Montevideo
Neville, Johnson & Thompson, Minneapolis
Allen I. Nilva, St. Paul
O'Brien, Ehrick & Wolf, Rochester
O'Connor, Green, Thomas & Walters, Minneapolis
O'Leary & Trenti, Virginia
Herbert E. Olson, Bemidji
Oppenheimer, Hodgson, Brown, Wolff & Leach, St. Paul
Padden & Dickel, Crookston
Richard H. Plunkett, Rochester
E. E. Ranta, Minneapolis
Harvey T. Reid, St. Paul
Rice & Efron, Minneapolis
Arthur Roberts, Duluth
Robins, Davis & Lyons, Minneapolis and St. Paul
Millard Ruud, Austin, Texas
Walter R. Severson, San Francisco, California
Paul M. Shaw, Deer River
Lee H. Slater, St. Paul
J. M. Sogard, Great Falls, Montana
Spellacy, Spellacy & Lano, Marble
Stacker & Stacker, St. Paul
C. A. Stark, Minneapolis
M. C. Steen of Cleary, Gottlieb, Steen & Hamilton, New York, New York
Stringer, Donnelly & Sharood, St. Paul
Sullivan & Cromwell, New York, New York
Sullivan, McMillan, Hanft & Hastings, Duluth
Paul C. Thomas, St. Paul
Van Valkenburg, Moss & Flaherty, Minneapolis
Vennum, Newhall, Ackman & Goetz, Minneapolis
Charles T. Wangensteen, Chisholm
James L. Wanvig, San Francisco, California
John P. Weber, Grand Rapids
West & Gowan, Rochester
Wright & West, Minneapolis
Hobart M. Yates, St. Paul

In addition to the foregoing law firm scholarships, generous gifts from individuals, corporations, and other organizations have provided the following scholarship funds. Some are endowed, while others are supported by annual gifts, and some by both endowment and current gifts.

Walter D. Boutell Memorial Scholarship—A bequest of $15,000 by the late Walter D. Boutell to assist needy students who have shown exceptional industry and ability in their work.

Cargill Foundation Scholarship—An annual gift of $1,650 from the Cargill Foundation of Minneapolis to provide one first-year, one second-year, and one third-year scholarship to students of ability and need.

Wilbur H. Cherry Memorial Scholarship Fund—A fund of some $60,000 initiated by the Minnesota Law Alumni Association and built through the generosity of alumni and friends in memory of the late Professor Wilbur H. Cherry for scholarships to needy and promising students of the Law School.

Class of 1924 Scholarship Fund—A growing endowment fund established by the Class of 1924 in memory of its departed members to be expended for scholarships in the dean's discretion.

Homer B. Dibell Law Scholarship Fund—A gift of $10,000 to endow a scholarship in memory of The Honorable Homer B. Dibell, a Minneapolis Supreme Court Justice and member of the Law School faculty.

James E. Dorsey Scholarship Fund—A fund of about $9,000 created by friends, associates, and family of James E. Dorsey to be used for scholarships as determined by the faculty.

Henry J. Fletcher Memorial Aid Fund—See section on Loan Funds. The income from this fund may be used for scholarship assistance to deserving and needy students.

General Mills Law Scholarship—An annual gift of $500 for a promising law student with financial need.

Honeywell Incorporated Law Scholarship—An annual $500 scholarship for a promising student with financial need.

Curtis Lloyd Jensen Scholarship—A fund of $10,000 bequeathed by Verna Blanche Jensen in memory of her brother, Curtis Lloyd Jensen, LL.B, '35, the income to be used for scholarships for Law School students of high character, all-around promise, and need.

Sidney J. Kaplan Legal Scholarship Endowment Fund—A growing endowment fund of over $10,000 created in memory of Sidney J. Kaplan of Minneapolis by associates, friends, and family to provide annual scholarships on the basis of aptitude for outstanding performance in legal studies, and not on the basis of need.

Law Faculty Scholarship Fund—A fund of $19,000 donated by members of the Law School faculty for scholarships in the Law School, augmented by current faculty gifts.

Law Student Wives' Association Scholarship Fund—An annual scholarship for a married law student based primarily on merit, taking into consideration both academic achievement and service to the Law School.

Garwood Lippincott Scholarship—Established in memory of Garwood Lippincott, president of the Student Editorial Board of the *Minnesota Law Review*, 1941-42, who gave his life in the service of his country. The scholarship is awarded annually to a member of the Student Editorial Board of the *Minnesota Law Review* who has completed 1 year's work on the board, such member to be selected by the student officers of the board for that year.

Minnesota Mining and Manufacturing Law Scholarship Fund—An annual gift of $1,000 to provide funds for two $500 scholarships to be awarded by the faculty on the basis of scholastic ability and need.

Minnesota Mutual Life Insurance Company Law Scholarship—An annual $500 scholarship for a promising student with financial need.

Minnesota State Bar Foundation Law Scholarships—This foundation, affiliated with the Minnesota State Bar Association, provides several substantial scholarships yearly for needy and outstanding law students who are residents of Minnesota.

Edmund M. Morgan Scholarship Fund—An endowment of $7,500, the gift of Mr. Charles M. Dale of Portsmouth, New Hampshire, to honor Edmund M. Morgan. The income is to be used for scholarships for students of promise in financial need.

Weed Munro Scholarship—A bequest of $1,000 and a residuary fund after the death of life beneficiaries, to establish a Weed Munro Scholarship in the Law School.

Ronald J. Nemer Scholarship Fund—A growing fund created by classmates and friends in memory of Ronald J. Nemer to provide scholarship aid for promising law students.

Northern States Power Company Law Scholarship—An annual $500 scholarship for a promising student with financial need.

F. H. Peavey & Company Law Scholarship—An annual scholarship for an outstanding student with financial need.

John S. Pillsbury Family Law Scholarship—An annual $500 scholarship for a promising and needy law student.

Harvey T. Reid Scholarship Fund—An award, administered by the Minnesota State Bar Association, made possible through the generosity of Mr. Harvey T. Reid of Fort Lauderdale, Florida. The award is in the amount of $750 the first year and $300 the second and third years.

Harold J. Richardson Law Scholarship Fund—An endowment of $13,000 established by Mrs. Harold J. Richardson in memory of her husband, the income to be used for scholarships for deserving students.

Sullivan and Cromwell Scholarship Fund—An endowment fund in excess of $10,000 contributed by Mr. Morris Darrell of New York City, the income to provide an annual scholarship of not less than $500.

Walter J. Trogner Scholarship Fund—An endowment fund of over $300,000, the gift of the late Walter J. Trogner, a Law School graduate of the class of 1911 and Minneapolis attorney, providing scholarships up to $2,500 for exceptionally promising students.

William Reynolds Vance Scholarship Fund—A fund of over $25,000 donated by Charles M. Dale, '17, to perpetuate the name and honor the memory of the late Dean William Reynolds Vance and to be used for scholarships for students who have completed at least 1 semester in the Law School and have demonstrated ability, character, and need.

Charles B. Wartenbe Scholarship—A $500 scholarship from funds provided by Mrs. Virginia Dixon Wartenbe in memory of her husband, a graduate of the class of 1905.

Judge Betty W. Washburn Scholarship Fund—An endowment fund of $10,000 established by Mrs. Anton Hulman, Sr. in memory of Judge Betty W. Washburn of Minneapolis to provide annual scholarships for promising law students.

Loans

Law students of good character and dependable scholarship with financial need may borrow from various loan funds. Repayment of loans is expected on a reasonable periodic payment basis after graduation.

National Defense Loans—All law students meeting the general requirements for loans are eligible for loans through the University under the National Defense Education Act. All students who know they will need to borrow should make an application for these funds by May 15 of the academic year preceding the year when the funds will be needed. The terms are 0 percent interest while the student is in school and for 1 year after graduation; 3 percent thereafter. Applications are available through the dean's office, or the University Bureau of Student Loans and Scholarships.

First National Bank of Minneapolis Loans—The Law School has an arrangement with the First National Bank of Minneapolis to provide loans at low interest and liberal repayment terms for second- and third- year law students. Guarantee funds for the plan are provided by the Law Alumni Association and contributors to loan guarantee funds. Students have up to 4 years to make repayment after the bar examination.

Federal Cartridge Foundation Guarantee Loan Fund—Gifts to make financial aid in the form of loans available to law students, to be used to furnish security for loans or as direct loans to students.

Henry J. Fletcher Memorial Aid Fund—Approximately $20,000 given by Charles L. Horn, LL.B., '12, and others, to perpetuate the memory of the late Professor Henry J. Fletcher and to assist students attending Law School.

Bernard M. Heinzen Guarantee Loan Fund—A gift in memory of Bernard M. Heinzen of the class of 1928 to make financial aid in the form of loans available to law students, to be used to furnish security for loans or as direct loans to students.

Frank B. Kellogg Loan Fund—A bequest by the late Frank B. Kellogg now valued at over $39,000.

Albert P. Krost Loan Fund—A fund of $10,000 to be loaned to worthy law students, established by the bequest of Clara B. Krost in memory of her husband, Albert P. Krost.

Law Alumni Loan Fund—Approximately $45,000 donated by alumni and friends of the Law School. Loans are without interest until graduation or termination of law studies.

Gustavus Loevinger Memorial Aid Fund—Gifts of $4,000 from friends and relatives of the late Judge Gustavus Loevinger.

Vernon W. Olson, Jr., Memorial Loan Fund—Over $1,000 in gifts by family and friends in memory of Vernon W. Olson, Jr., '52, to provide interest-free loans for deserving members of the *Minnesota Law Review*.

Robins, Davis & Lyons Guarantee Loan Fund—Gifts to make financial aid in the form of loans available to law students, to be used to furnish security for loans or as direct loans to students.

Wheeler, Fredrikson & Larson Loan Fund—A growing fund to provide loans interest free until graduation.

Wheeler, Fredrikson & Larson Guarantee Loan Fund—A gift to make financial aid in the form of loans available to law students, to be used to furnish security for loans or as direct loans to students.

University of Minnesota Loan Funds—These funds are used primarily for first-year law students who have previously attended the University of Minnesota. Eligible students are referred by the dean's office to the University Bureau of Student Loans and Scholarships.

STUDENT ACTIVITIES AND HONORS

Minnesota Law Review

The *Minnesota Law Review*, established in 1917, is a legal periodical of the Law School. It publishes leading articles by experts in their fields, as well as notes and comments on recent developments of the law prepared by an editorial board consisting of students who are elected on the basis of their high scholastic achievements. Successful service on the *Law Review* is the highest honor recognized by the Law School. It is an experience in research, legal analysis, and writing of unexcelled value in the development of professional and technical skills.

Law School Council

The Law School Council consists of representatives from each class. The council, as representative of the student body, plays an important role in the administration of the Law School. It supervises the functioning of the honor system under which examinations in the school are written. It serves as an important medium for the exchange of views and suggestions between staff and students with respect to questions arising in the course of Law School operations, and supervises the operation of the Henry Rottschaefer Student-Faculty Lounge. It arranges for special lectures and Law School convocations. It has charge of social functions involving the school as a whole, such as the activities of Law School Day and the annual Law School Dance.

The council, as representative of the student body, is a member of the American Law Students Association sponsored by the American Bar Association.

Legal Aid Clinic

The Legal Aid Clinic is conducted in co-operation with the Minnesota State Bar Association. Second- and third-year students act as student attorneys in interviewing students, employees, and staff of the University who are financially unable to obtain private counsel. The student attorneys determine whether the client has a legal problem. If it is decided that he does, the students do the necessary research and arrange for the client to have an interview with a practicing attorney who confers with the student attorneys and refers to their research work before approving any advice which is to be given to the client. If it becomes necessary to litigate the client's problem, the student attorneys do all of the necessary investigation and filing of papers under the supervision of the practicing attorney to the ultimate conclusion of the case. Included in this work is attendance at the trial as assisting counsel.

In co-operation with the Minnesota State Bar Association, the members of the clinic do research and submit articles on common interest points of the law for a column which is printed in several suburban newspapers. The clinic also supplies scripts for a radio program on common interest points of the law.

Court-appointed counsel for the District Court (federal) in Minneapolis and St. Paul are invited to use the services of the clinic to perform investigation and research work in the defense of indigent defendants. Members of the clinic work on these cases and follow them to their final disposition with the court-appointed attorneys.

Members of the clinic are also active in all phases of the Minnesota Public Defender Program whose director has offices in the Law School.

Order of the Coif

The Law School has a chapter of the Order of the Coif, a national honorary society of law students. Election to this society is made by the faculty at the close of the senior year from the 10 per cent of the graduating class highest in scholarship.

Degrees with Honors

Honor students receive their degrees *cum laude, magna cum laude,* and *summa cum laude* in accordance with standards established by the faculty.

Other Honors

Each year recognition is given to students with A averages and to those with B averages by placing them on the Dean's List. Recognition is also given to the student in each class who makes the greatest improvement in his academic work over the preceding year.

Associate Membership, Minnesota State Bar Association

A student in his senior year may become an associate member of the Minnesota State Bar Association upon payment of $1 dues. This entitles him to all the privileges of full membership except the right to vote. He may attend meetings and receives copies of *Bench and Bar*, an association publication. Lectures by leading practitioners are sponsored by a committee of the association on topics of special interest to those about to enter the legal profession. Membership is voluntary but is favored by the school.

PLACEMENT

The Law School maintains a placement office for the benefit of its students and graduates. The assistant dean in charge of placement and the placement secretary render assistance to law students seeking part-time or summer employment. The primary work of the office is concerned with placement of seniors and graduates. Law firms, corporations, and government agencies from all over the United States and Minnesota come to the Law School almost daily to interview students. The placement service strives to provide guidance to students, graduates, and employers on placement matters.

SPECIAL PROGRAMS

Graduate Study in Law

The Law School has no regular program for graduate study in law but occasionally, for an outstanding student, arranges a special program of academic work, research, and writing under the supervision of a member of the faculty leading to the degree of master of laws. Normally, however, students are advised to apply to one of the several schools that offer regular graduate programs.

Graduate Studies for Foreign Trained Lawyers

The Law School and the Graduate School of the University of Minnesota have approved a program leading to the degree of master of arts in American legal institutions. The program calls for meeting the requirements of Plan B under the rules of the Graduate School with concentration in a field of law. Inquiries about this program should be addressed to the Graduate School of the University.

The program of work leading to this degree is designed to familiarize the foreign student who has studied law in his own country with American legal institutions. Only foreign graduate law students, therefore, may be awarded this degree.

The program of work will be selected to suit the particular needs of each foreign student. Normally, at least 3 quarters of graduate study

is required with concentration in the field of law. Courses accounting for 21-27 quarter credits must be taken in the Law School. The required 18 quarter credits outside the field of concentration may be taken in other departments of the University. Within the limits indicated, the number of quarter credits to be taken in the Law School and the courses to be taken outside the Law School will be agreed upon by the student and the appropriate Law School committee. The courses to be taken outside the Law School will be selected to enable the foreign student to put his studies in the Law School in their proper social, economic, political, and cultural framework.

The Law School does not provide financial assistance to foreign students. Information about assistance given by the University may be obtained from the Office of the Adviser to Foreign Students.

Combined Programs Leading to LL.B. and M.A. or M.B.A. Degrees

A law student may take a course leading to both the professional LL.B. degree and the M.A. or M.B.A. degree. Details may be obtained from the dean's office.

Training Project in Delinquency Control

The Law School jointly sponsors with the Department of Sociology and the School of Social Work a program for the training of personnel working in the field of juvenile delinquency (Sequence C in Sociology). A member of the Law School faculty gives a course, Soc 103, Law and the Legal System for Correctional and Social Workers, which is required of students in Sequence C. The seminar on criminal law is open to graduate students in the School of Social Work and the Department of Sociology upon approval of the seminar instructors and of the dean of the Law School.

Those interested in pursuing the undergraduate program should consult the Department of Sociology.

Family Law Clinical Seminar

The Family Law Clinical Seminar is designed to teach the use of practical skills necessary to adequate counseling and advocacy by exposing students to actual domestic relations cases as they are presented to the practicing lawyer; to apprise students of the methods and activities of the social service facilities of their community; to make law students aware of the problems of classes of society with which they might have had little contact; and to encourage them to take a continuing interest in these problems, their solutions, and the improvement of the social service facilities of their community.

The students enrolled in this seminar spend the year engaged in various activities in the courts and public social service agencies of Min-

neapolis which deal with problems of the family. Their experiences include participation with a Welfare Department social case worker in evaluation of an adoption application; active participation with a social case worker in a "child protection" (neglect) case; appearance as counsel in the Juvenile Court in a case in which the Welfare Department is seeking to terminate parental rights; collaboration with social case workers attached to the Family Court in making custody evaluations ordered by the court; interviewing a prospective divorce client under the observation of other students and a psychiatrist consultant to the program; assistance in the representation of the client if a divorce is sought.

During the second semester, the students attend regular seminar sessions with graduate students in social work. The seminar meetings consider both the cases in which the students participated and the teaching materials which pose, in the context of actual court, agency, and lawyers' office files, the various problems of professional responsibility which lawyers must face in the field of domestic relations law.

UNIVERSITY CALENDAR

The annual calendar will be found in the *Bulletin of General Information* which may be obtained from the Office of Admissions and Records, University of Minnesota, Minneapolis, Minnesota 55455. The Law School calendar is available as part of the registration material each fall.

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