

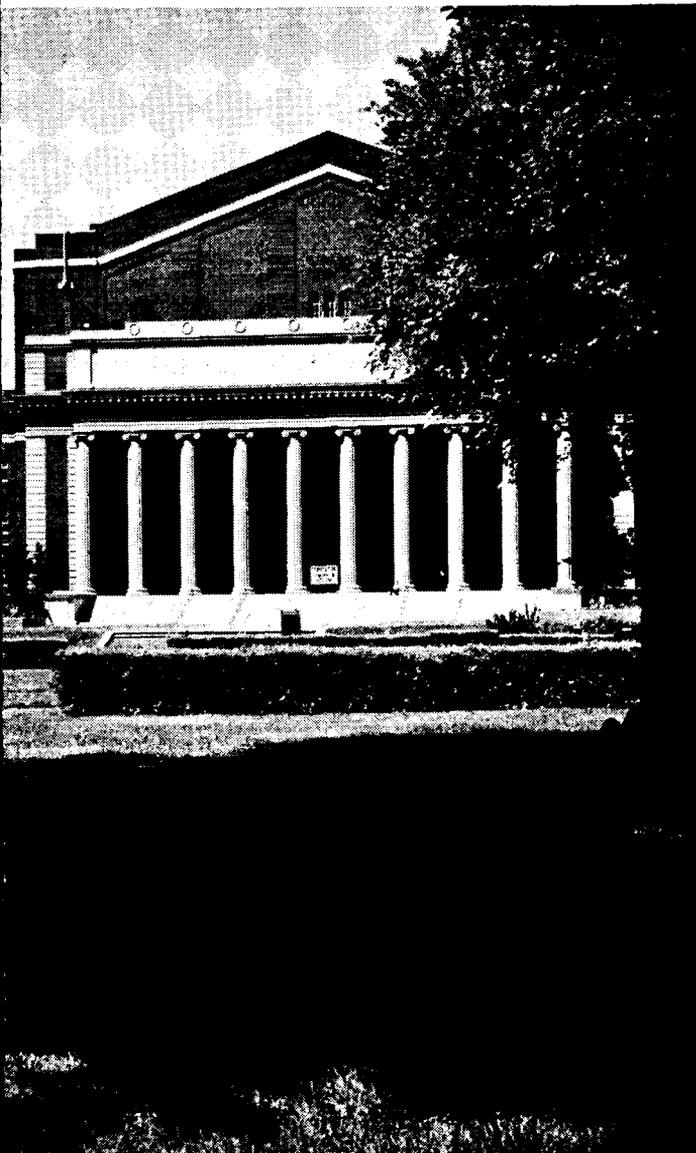
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Graduate School

1962-1964



"... dedicated to the advancement of learning and the search for truth ..."

Bulletin

of the UNIVERSITY of MINNESOTA

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 8; for the Ph.D. degree, page 12).

(2) The paragraphs headed "Time Limit for Earning the Ph.D. Degree," page 13.

(3) The section entitled "Symbols and Explanations," page 37. This is your guide to the understanding of terms and symbols used in course descriptions.

The Graduate School offices are 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 7:45 a.m. to 12 noon and 1 p.m. to 3:30 p.m.

Bulletin
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Graduate School

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UNIVERSITY OF MINNESOTA

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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 1961, the Graduate School had awarded 4,843 Ph.D. degrees and 18,448 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; Language, Literature, and Art; Medical Sciences; Education, Philosophy, Music, Psychology, Child Development, Speech Pathology; 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 four special committees which administer graduate work in American Studies, Statistics, Biophysics, and Dentistry.

Graduate work crosses the boundaries of the departments, schools, and colleges comprising the University including those at the Mayo Foundation at Rochester. Its faculty of full and associate members, numbering more than 1,000, 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 many majors, and a list of the 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. An applicant with satisfactory scholastic record from an approved college or university and with satisfactory character and professional qualifications may be admitted for graduate work by the Graduate School, with the approval of the graduate faculty of the major concerned.

The scholastic records of applicants are reviewed, special tests may be required, and the applicant may be admitted, with or without conditions, as determined in each case by the dean and an adviser in the student's proposed major.

An applicant who holds a Bachelor's degree or its equivalent from a recognized college but whose scholastic record and qualifications are questionable from the point of view of preparation for and probable success in graduate work may be admitted conditionally to the Graduate School. In such cases the Graduate School reserves the right to cancel the registration if at any time the scholastic records fall substantially below the standard for successful graduate work.

The scholastic performance of all graduate students in residence is checked at the end of each academic quarter, and records judged to be poor or borderline are

brought to the attention of the student's major adviser for special action. Continued inadequate performance on the part of any student may result in the cancellation of his registration and exclusion from further study in the Graduate School.

Certain colleges, departments, and graduate major fields require the student to complete the Miller Analogies Test, graduate level, as part of the application. These are: American Studies, Anthropology, Area Studies, Biostatistics, Business Administration, Child Development, Economics, Educational Psychology (of Master's applicants who are emphasizing counseling and guidance at the college level and of prospective Ph.D. candidates), Genetics, Industrial Relations, International Relations, Library Science, Political Science, Psychology, Public Administration, Social Work, Sociology, Speech and Theater Arts, Speech Pathology, and Zoology. The Graduate School itself may ask the student to take this and other tests, and in such cases the student will be notified where and when the tests will be given.

In addition, the results of the Graduate Record Examination may be requested as supplementary information in determining admission. It would be wise therefore for candidates to complete this test either in the senior year of undergraduate work or before filing application for admission. For further information on this examination and places where it may be taken, students should write to the Educational Testing Service, P.O. Box 592, Princeton, New Jersey. Students near the University of Minnesota may take the examination by arrangement with the director of the Student Counseling Bureau, 101 Eddy Hall, University of Minnesota, Minneapolis 14.

Information concerning admission may be obtained from the Graduate School, 316 Johnston Hall, University of Minnesota, Minneapolis 14. Applications for admission to the Graduate School must be received *complete in every detail*—2 official transcripts of all college work and, if required, test results, references, or other information—at least 4 weeks prior to the opening of the quarter or summer term in which the student expects to register.

Holders of the Bachelor's degree who are not interested in earning graduate credit may apply to the Office of Admissions and Records for admission as adult special students or register as *Summer Session only* students. These students, if they subsequently decide to make application for admission to the Graduate School, may petition to transfer *only their first term's work as an adult special student* or Summer Session only student to their graduate record. Only courses of graduate character taught by members of the graduate faculty may be transferred.

Because members of the graduate faculty are not in official residence between the close of the second term of 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. It is wise, therefore, to submit applications for admission to the fall quarter prior to August 1.

Transient Graduate Students—A student in good standing 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 office, University of Minnesota. In lieu of this form, he may present a signed statement from his graduate dean.

The registration of any student admitted on this basis terminates at the end of the quarter or the summer term for which he is enrolled. If at any later time he wishes to apply for admission to the Graduate School of this University to work toward a degree, he must, of course, make formal application and submit complete credentials. If a transient student is later given formal admission and enters upon work toward a degree at Minnesota, he may petition the dean to allow credit for courses taken during registration as a transient to apply to the work for such a degree.

REGISTRATION

Students who have received notification of admission to the Graduate School may obtain directions for registration at the Graduate School 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. Before the student can complete his first registration in the Graduate School (unless he is a teacher in service carrying 5 credits or less), he must report to the University Health Service to arrange an appointment for a physical examination.

Registration by Mail (Ph.D. Candidates)—The student who has been admitted to candidacy for the Ph.D. degree (for definition of candidacy see p. 13) and is registering for *thesis only* may register by mail. He must return his registration form and check or money order in the amount of \$20 to the Office of the Recorder, Administration Building, University of Minnesota, Minneapolis 14. Failure to maintain continuous registration will result in termination of candidacy. The student may obtain registration forms for all three academic quarters at once by writing to the Graduate School office well in advance of the opening of each academic year.

FEES

| | |
|--|----------|
| Tuition fees for residents (except in dentistry, pharmacy, clinical medicine, veterinary medicine) per quarter | |
| 6 credits or less, or thesis only | \$ 43.00 |
| More than 6 credits | 86.00 |
| Tuition fees for nonresidents per quarter | |
| 6 credits or less, or thesis only | 112.50 |
| More than 6 credits | 225.00 |
| Tuition fees for Ph.D. candidates (For definition of candidacy, see page 13.) | |
| 6 credits or less or thesis only (resident or nonresident) per quarter or summer term (These students will pay the incidental fee only if they plan to make use of any of the services covered by this fee—Library, Health Service, Coffman Union.) | 20.00 |
| 7 credits or more (residents) | 86.00 |
| 7 credits or more (nonresidents) | 225.00 |
| (These students are required to pay the incidental fee. The regular summer tuition rate plus summer incidental fees will be charged the Ph.D. candidate registering for 7 or more credits per summer term.) | |
| Tuition fees in dentistry, pharmacy, clinical medicine, and veterinary medicine, see the <i>Bulletin of General Information</i> | |
| Incidental fee (per quarter) | 20.00 |
| 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.

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 sessions, the student is required to pay for 6 summer sessions, 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—Three 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, whose graduate work is incidental to their employment 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*. For estimates of living expenses, see the *Bulletin of General Information*.

CANDIDACY FOR A 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, even though in excess of the credits required for the baccalaureate degree, can be transferred to the Graduate School only under the following conditions:

1. If not more than 9 quarter credits of undergraduate credit are lacking (taking into account required and 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.

2. Undergraduates lacking not more than 9 quarter credits (taking into account required sequence courses) may register in the Graduate School.

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 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.

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

From the Extension Division of the University of Minnesota—A graduate student may, upon the approval of his graduate adviser, petition the dean of the Graduate School to have transferred to his graduate record not more than 9 quarter credits for the Master's degree in courses numbered 100 and above offered by the Extension Division of the University of Minnesota taught by approved members of the graduate faculty. No graduate credits earned in any other institution through extension courses may be transferred.

From Adult Special Status or Summer Special Status—A student admitted to 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 required to be present at commencement unless specially 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 nontechnical study; the degree of master of science, for advanced technical study in such areas as agriculture, industrial chemistry, engineering, etc. It is the field of graduate work

** 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.

and not the Bachelor's degree that determines whether the degree is master of arts or master of science. In the sciences usually called basic or fundamental 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 2 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.†† 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.

Grading System—In courses *open to graduates only*, the student may receive a grade of "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. In courses open to both graduates and undergraduates the system of marking by letters is used.

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 opening of the quarter preceding the final quarter or final summer term, the student who expects to obtain a Master's degree shall present (for Plan A) his program and his thesis title or (for Plan B) his program for his adviser's recommendation and transmission to the appropriate group committee. 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 the appropriate form 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 grade not lower than B in any course

†† 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.

offered as fulfilling the requirements in the major, and a grade not lower than C in minor courses. 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 substantially below B grades in the major field and C grades in the minor field.

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, 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 by passing the proficiency examination or by presenting to the appropriate language department certification of 15 credit hours with grade of A or 20 credit hours with grade of B, assuming: (1) that the course work was completed at the University of Minnesota; (2) that the course work was completed no longer than 5 years from the time the student applies for language certification; and (3) that any language department at Minnesota has the right to specify minimal course requirements in excess of those mentioned above. For further information, consult the Graduate School office and the major department. Blanks for making application for the language examination may be obtained in the Graduate School office.

The candidate shall present to the office of the dean of the Graduate School a certificate of proficiency in the designated language before he may be admitted to the written or oral examinations required for this degree. The certificate must be signed by a representative of the appropriate foreign language department.

For regulations on transfer of language certificates, see page 16.

Master's Thesis—Not later than the opening of the quarter preceding the quarter in which he takes his degree, the student shall submit the title of his thesis and a complete program of the work to be offered for the degree on a special blank secured at the Graduate School office. The thesis title must be approved by his adviser and by the corresponding 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 the 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), 1 for the candidate, and normally 1 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 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 copy must contain all illustrative material. Ample margins should be left for binding purposes. Samples in the dean's office of the papers to be used should be examined before the thesis is typewritten. The body of the thesis should be double spaced, but foot-notes may be single spaced.

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 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 2 representatives of the major field and 1 representative of the minor field. Unanimous approval by this committee will be necessary for the acceptance of the thesis, and a record of this approval 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; the Graduate School in any case should be informed, on the appropriate blank, of the action of the thesis committee.

If the thesis is accepted, the candidate must pay to the bursar, *at least 5 weeks* before commencement, \$5 for binding the 2 copies of his thesis which will be catalogued and deposited in the University Library, 1 copy for reserve and 1 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.

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 approval of the thesis must precede the final oral examination.

Candidates eligible for the "preliminary examination" for the Doctor's degree may substitute this examination for the final oral examination for the Master's degree, if all other requirements for the preliminary examination have been met.

Reports—Special blanks 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 candidacy with approval of thesis subject and degree program | Committee, normally from the major department, division, or college, adviser, group committee, and dean | After completion of 9 to 15 credits or no later than the opening of quarter preceding final quarter |
| Language requirement | Adviser and language department | Before admission to written or oral examination |
| Registering of thesis | Graduate School office | 8 weeks before graduation** |
| Approval 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 may be required to take either a final written examination or a final oral examination or both, at the discretion of his committee. 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 22). While it does not permit an indiscriminate scattering of courses over unrelated fields, it does not stress concentration on 1 major and 1 minor field. It is understood that more than one field will be included outside the field of concentration. Programs that simply represent more hours distributed between a major and a minor will be especially scrutinized by the graduate group committee. 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 an average of B, a minimum of 45 quarter credits in graduate courses. No graduate credit is allowed for course work of D quality. At least 21 of the 45 credit hours should be in a single field of concentration. Not less than 18 of the 45 credits should be offered in at least 2 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. Written reports representing the quality but not the range of the Master's thesis shall be prepared in 3 advanced courses or seminars or in courses involving 9 quarter credits or in independent work under faculty supervision either in the field of concentration or in related fields. Such courses are identified by a single asterisk.

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.

** Medical students should consult the Graduate School office for dates when their theses must be registered.

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 the student's program the adviser 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, 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 adviser 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 examination 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

| <i>Requirements</i> | <i>Under the Direction of</i> | <i>Date</i> |
|--|---|--|
| Initial registration | Adviser and dean of the Graduate School | On entrance |
| Approval of candidacy after filing program of all graduate work, with credits showing field of concentration, etc. | Committee, normally from the major department, division, or college, adviser, 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 | 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 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 the preparation of a thesis, and second, by passing the required examinations covering both the general and the special fields of the candidate's subjects as detailed later. Grades of B or better are required in the major and grades of C or better in the minor.

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 chief concern during the first year is completion of required courses. 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 secure from 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 Blank—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 courses already completed in the major and minor.
2. A list of proposed additional course work in the major and minor.
3. Courses offered as a collateral field or special research technique when either is being proposed.
4. A detailed list of graduate courses taken elsewhere if the candidate wishes to present such work toward the Ph.D. degree from the University of Minnesota. 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. 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 graduate work the student has taken must accompany the program.

Programs should be submitted to the Graduate School office by the second week of any quarter to insure action within the quarter by the appropriate graduate group committee. These committees are convened only once 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 successfully (a) met the foreign language requirement (or research option), (b) completed the minor, and (c) 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 will necessitate retaking the oral preliminary examination.

2. Register continuously and pay fees during the academic year (fall, winter, spring) from the date of the preliminary oral until the Ph.D. is awarded. 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. 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. Exceptions to this rule are students who hold University appointments and are required to be registered in the Graduate School during the period of appointment.
3. Pay tuition, incidental, and late fees, whether resident or nonresident, as listed under section on fees.

Students who have established candidacy for the Ph.D. degree prior to the effective date of the new regulation (fall quarter, 1962) shall register continuously, pay fees as applicable, and be subject to the 5-year time limit beginning with the *fall quarter of 1962*. The foregoing regulations apply to all Ph.D. candidates including those holding University appointments.

Registration by Mail—The student who has been admitted to candidacy for the Ph.D. degree (for definition of candidacy see above) and is registering for *thesis only* may register by mail. He must return his registration form and check or money order in the amount of \$20 to the Office of the Recorder, Administration Building, University of Minnesota, Minneapolis 14. Failure to maintain continuous registration will result in termination of candidacy. The student may obtain registration for all three academic quarters at once by writing to the Graduate School office well in advance of the opening of each academic year.

Thesis Title Form—At the time of submission of the 3-year 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. When it is filed it will be accompanied by a statement, some 250 words in length, describing the research to be undertaken and the methods to be employed in carrying it out.

Language Requirements

The following regulations are effective for all Ph.D. candidates. The reading knowledge of one foreign language is always required. The requirement can be satisfied either by passing the proficiency examination or by presenting to the appropriate language department certification of 15 credit hours with grade of A or 20 credit hours with grade of B, assuming: (1) that the course work was completed at the University of Minnesota; (2) that the course work was completed no longer than 5 years prior to the time the student applies for language certification; and (3) that any language department at Minnesota has the right to specify minimal course requirements in excess of those mentioned above.

General Regulations

1. The Ph.D. candidate shall, with the approval of his major adviser, file in the Graduate School office upon successful completion of the equivalent of a full academic year of course work his plans for meeting the requirements of the foreign language and the research technique or the collateral field of knowledge. Graduate School Form 79 for this purpose is available in the Graduate School office.

2. The foreign language and the special research technique requirements (as defined in 10 and 11) must be completed before the student is admitted to the preliminary examinations for the Ph.D., and the work to be presented in meeting the research technique shall be entered on the student's program. The special research technique requirements may be met by special proficiency examinations where such examinations are feasible and practical.

3. Repetition of any examination taken under regulation 2 is considered a special examination for which a fee of \$5 is charged.

4. Where a collateral field of knowledge (as defined in 12) is offered in place of 1 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.

5. In meeting either the foreign language requirements or the requirements of a special research technique, credits earned or proficiency demonstrated in other approved institutions are transferable to the Minnesota record if these have been completed within a 3-year period immediately prior to entering this Graduate School. To meet the requirements of a collateral field of knowledge, credits earned in other approved institutions are transferable to the Minnesota record in accordance with existing regulations governing transfer of credits for the Ph.D. degree.

6. Course credits presented to fulfill the requirements of a special research technique or a collateral field of knowledge shall be recorded on the student's permanent grade record and must represent a quality of work no lower than C. Any group committee may require a standard of performance higher than this minimum standard 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 collateral field or as a research technique.

7. 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.

8. In no case may the special research technique subject or 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. The special research technique subject should represent the acquisition of any special skill that will effectively contribute to the research proficiency of the candidate. 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.

9. The burden of proof of the significance or relevance of options other than the foreign language 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.

10. The foreign language or 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 options rests upon the candidate and his major adviser. In no case may English be submitted as a foreign language.

11. 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.

12. 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 transferred from the Extension Division, provided that the courses are taught by approved members of the graduate faculty.

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.

All 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 candidate who fails in a language examination for an advanced degree shall not be given a second examination until the following quarter.

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

Major Work

The major work must be in a department in which the candidate has had, in his undergraduate study, a minimum of 27 quarter credits if it be a department open to freshmen, or a minimum of 18 quarter credits if it be a department not open to freshmen. Part or all of this preliminary work may consist of designated prerequisite courses in the same or allied departments.

While working for the Doctor's degree, a student shall 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 designated "for undergraduate and graduate students" and 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 related fields. This requires recommendation by the major adviser, by a representative of each of the two minor fields, and by the appropriate group committee as well as approval by the dean.

Not less than one-sixth of the total work of the 3 years shall be devoted to the minor subject, which must be completed before admission to the preliminary examination.

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. 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.

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 will be represented by at least one committee member. Unanimous approval of the thesis by this committee is necessary before the final oral examination can be held, and 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 \$5 plus 1¼ cents per page for 2 positive microfilm copies of his thesis, which will be deposited in the Library of Congress.

Two copies of the thesis on heavy bond paper are to be bound and deposited in the Graduate School office.

Each candidate for the Doctor's degree shall submit with his final oral examination report 2 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.

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.

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 op-

** 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.

portunity 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, 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 committee shall ordinarily include the 3 members of the thesis review committee, plus at least 2 additional members. 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 5 members, 3 from the field of the major and 2 from the field of the minor, 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 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 1 of 3 possible ways: examination passed, examination failed, examination passed with reservations. The voting proportions necessary for 1 of these decisions are as follows: in the case of a 5-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 6 members, a unanimous vote or a vote of 5-1 or 4-2 will pass the candidate; and if the committee consists of 7 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 may, upon recommendation of the examining committee, be excluded from further candidacy for the degree, and in any case no re-examination shall be held until at least 1 full academic quarter has passed.

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 acceptance of the thesis by the thesis review committee, after successful completion of final written examinations, when required, and not less than *5 weeks* before gradu-

ation, the final oral examination shall be given. Ordinarily this examination shall be conducted by a committee consisting of the adviser, the 2 other members of the thesis review committee, and at least 2 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 *1 week in advance* in the office of the Graduate School.

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.

Reports—Special blanks 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 of these must be filed with the Graduate School office: the report on the written examination in the major before the preliminary oral ex-

Summary of Requirements for the Doctor's Degree

| Requirements | Under the Direction of | Date |
|---|---|---|
| Selection of major | } Adviser and dean of Graduate School | |
| Selection of minor | | |
| Doctoral 3-year program | Adviser, minor faculty, appropriate graduate group committee, and dean of Graduate School | After first year or at least 5 months before preliminary oral examination |
| Thesis title | | When 3-year program is submitted or at least 5 months before final oral examination |
| Completion of minor | Course instructors | } Before admission to preliminary examination |
| Language requirement | Adviser and language departments | |
| Written examination | Graduate faculty of the major field | Before preliminary oral or before the final oral examination or both |
| Preliminary examination, oral | Committee | At least 1 academic quarter before degree is to be conferred |
| Filing of completed thesis | Graduate School office | 8 weeks before graduation** |
| Approval 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 | |
| Release card | Graduate School office | |
| Office of Scientific Personnel Survey Form | Graduate School office | |
| Graduation fee | Office of Admissions and Records | |

** Medical students should consult the Graduate School office for dates when their theses must be registered.

amination 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.

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 Botany | Agricultural Botany |
| Agricultural Economics | Agricultural Economics |
| Agricultural Engineering | |
| Agronomy | Agronomy |
| American Studies | American Studies |
| Anatomy | Anatomy |
| Anesthesiology | |
| Animal Husbandry | Animal Husbandry |
| Anthropology | Anthropology |
| Architecture | |
| Area Studies | |
| Art | Art (History and Criticism) |
| Astronomy | |
| Biophysics | Biophysics |
| Biostatistics | Biostatistics |
| Botany | Botany |
| Business Administration | Business Administration |
| Chemical Engineering | Chemical Engineering |
| Chemistry | Chemical Physics |
| Analytical Chemistry | Chemistry |
| Inorganic Chemistry | Analytical Chemistry |
| Organic Chemistry | Inorganic Chemistry |
| Physical Chemistry | Organic Chemistry |
| Child Development | Physical Chemistry |
| Civil Engineering | Child Development |
| Classical Civilization | Civil Engineering |
| Classics | Classical Civilization |
| Comparative Literature | Classics |
| Dairy Husbandry | Comparative Literature |
| Dairy Industries | Dairy Husbandry |
| Dentistry | Dairy Industries |
| Dermatology | Dermatology |
| Economics | Economics |
| Education | Education |
| Agricultural Education | |
| Art Education | Education |
| Curriculum and Instruction | Educational Administration |
| Education | Educational Psychology |
| Educational Administration | |
| Educational Psychology | |
| History and Philosophy of Education | |
| Home Economics Education | |
| Industrial Education | |
| Music Education | |
| Physical Education | |
| Electrical Engineering | Electrical Engineering |
| Electrical Science | |
| English | English |

| Master's Degree | Ph.D. Degree |
|--|---|
| Entomology | Entomology Environmental Health Epidemiology |
| Fine Arts Fishery and Wildlife Management | Fishery and Wildlife Management Fluid Mechanics Forestry French |
| Forestry French | Genetics Geography Geology |
| Genetics Geography Geology Geophysics German Greek | German Greek |
| History Home Economics Horticulture | History Home Economics Horticulture Hospital Administration |
| Industrial Engineering Industrial Relations International Relations | International Relations |
| Journalism | Journalism |
| Latin Library Science Linguistics and Comparative Philology | Latin |
| Mathematics Mechanical Engineering Mechanics and Materials Medical Technology Medicine (Internal) Metallurgical Engineering Metallurgy Microbiology Mineral Engineering Museology Music | Mathematics Mechanical Engineering Mechanics and Materials Medicine (Internal) Metallurgical Engineering Metallurgy Microbiology Mineral Engineering |
| Neurology Neurosurgery | Music Neurology Neurosurgery |
| Obstetrics and Gynecology Ophthalmology Orthopedic Surgery Otolaryngology | Obstetrics and Gynecology Orthopedic Surgery Otolaryngology |
| Pathology Pediatrics Pharmaceutical Chemistry Pharmaceutical Technology Pharmacognosy Pharmacology Philosophy Physical Medicine and Rehabilitation Physics Physiological Chemistry Physiological Hygiene Physiology Plant Pathology Plastic Surgery Political Science Poultry Husbandry Proctology Psychiatry Psychology Public Administration Public Health | Pathology Pediatrics Pharmaceutical Chemistry Pharmaceutical Technology Pharmacognosy Pharmacology Philosophy Physical Medicine and Rehabilitation Physics Physiological Chemistry Physiological Hygiene Physiology Plant Pathology Political Science Poultry Husbandry Psychiatry Psychology |
| Radiology | Radiology |

| Master's Degree | Ph.D. Degree |
|--|--|
| Scandinavian | Social Work |
| Social Work | Sociology |
| Sociology | Soils |
| Soils | Spanish |
| Spanish | Speech and Theater Arts |
| Speech and Theater Arts | Speech Pathology and Audiology |
| Speech Pathology and Audiology | Statistics |
| Statistics | Surgery |
| Surgery | |
| Urology | |
| Veterinary Anatomy | Veterinary Anatomy |
| Veterinary Bacteriology | Veterinary Bacteriology |
| Veterinary Medicine | Veterinary Medicine |
| Veterinary Parasitology | Veterinary Parasitology |
| Veterinary Pathology | Veterinary Pathology |
| Veterinary Physiology and Pharmacology | Veterinary Physiology and Pharmacology |
| Zoology | Zoology |

GRADUATE WORK IN THE SUMMER SESSION

Graduate work in many fields of special interest to teachers is open in the Summer Session. Students interested in graduate summer study for purposes other than teaching will find offerings in such fields as home economics, child development, and economics, as well as in the College of Science, Literature, and the Arts, the College of Education, and the Institute of Technology. Announcement of these courses may be found in the *Bulletin of the Summer Session*. Graduate courses in the biological sciences are given during the summer at Lake Itasca Forestry and Biological Station.

Students planning to use credits earned in Summer Session toward a graduate degree or who expect to receive graduate credit for such work should apply for admission directly to the Graduate School. Applications must be received *complete in every detail*—2 official transcripts of all college work and, if required, test results, references, or other information—at least 4 weeks prior to the opening of the summer term in which the student expects to register.

Work of graduate character done in the Summer Session of the University of Minnesota may be counted for residence credit for the Master's degree. A limited amount of graduate work done in the Summer Session may be counted for residence credit for the doctoral degree. One summer term is the equivalent in residence of one-half a school quarter of the regular academic year.

Master's Degree, Plan A

Course work for the Master's degree, Plan A (see page 8), may be completed in 4 summer terms of 5 weeks each. The candidate may be permitted to register for thesis and carry *in absentia* thesis work to complete the equivalent of 3 quarters. All requirements for the Master's degree under Plan A must be completed within 7 years after initiation of the degree program. Students working for the Master's degree under Plan A in summer terms must secure approval of candidacy after earning from 9 to 15 quarter credits and must file the subjects of their theses before completion of the first half of the required work. Theses of Summer Session students must be completed at least 8 weeks before the end of the term in which they take the degree.

(See Requirements for the Master's degree.)

Master's Degree, Plan B

All requirements for Plan B may be completed in 6 summer terms of 5 weeks each and must be completed within 7 years following the initiation of the degree program.

DENTISTRY

Graduate education in dentistry is offered to meet needs in two areas: (a) preparation of qualified teachers and investigators in the various areas of dentistry; and (b) preparation of fully trained specialists for the various specialties in dentistry.

The course of study for the former includes a major in a basic science, a minor in an area of dentistry, and selected courses in appropriate pedagogy. Students are provided with stipends, the amount varying with qualifications. They are expected to participate in teaching in clinical dentistry during the tenure of this Ph.D. program, in addition to completing the necessary requisites for the degree.

The course of study for the latter leads to the degree of M.S. in Dentistry, a combination of the conventional program for the M.S. degree plus achievement of proficiency in some phase of clinical dentistry. Applicants must be graduates of accredited schools of dentistry who have achieved superior scholastic records both in pre dental and dental requirements. They must also present or acquire sufficient training in one of the basic sciences, such as anatomy, bacteriology, pathology, pharmacology, physiology, and physiological chemistry, to enable them to apply this discipline to research in some of the problems facing dentistry as one of the health sciences. This requirement is met by the completion of at least 9 quarter credits in 1 of the basic sciences at the graduate level. Basic science courses necessary as a foundation for advanced study are outlined under the departmental offerings in the bulletin, *Graduate Programs in Medicine, Dentistry, and Pharmacy*. When full time is devoted to study, 2 to 3 years in residence are needed to complete the program for the master of science in dentistry degree. Although a reading knowledge of German is recommended as highly desirable, candidates for the Master's degree in dentistry are exempt from the foreign language requirement.

MEDICAL FIELDS

The University of Minnesota offers graduate work leading to advanced degrees in both the fundamental laboratory departments and the clinical branches of medicine. This work is under the direction of the Graduate School, and candidates for admission and degrees must meet the requirements of the Graduate School as outlined in this bulletin. The work is offered by members of the graduate medical faculty in Minneapolis and the Mayo Foundation at Rochester, Minnesota, where part or all of the residence work may be done. Fellowships and assistantships both on the Minneapolis Campus and at the Mayo Foundation are offered to qualified students pursuing graduate work in clinical medicine or in the laboratory branches. The *Bulletin of Graduate Programs in Medicine, Dentistry, and Pharmacy* should be consulted for graduate work in the clinical fields and in the basic sciences of medicine.

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. Depart-

ments participating in the Nuclear Engineering Committee include Mechanical Engineering, Chemistry, Physics, Chemical Engineering, Electrical Engineering, and Metallurgy.

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 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.

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.

Assistantships—More than 1,000 teaching and research assistantships are offered through the various colleges, divisions, and departments of the University. Stipends for these appointments vary from \$1,057 for 25 per cent of full-time service to \$2,115 for half-time service for the academic year, to \$2,820 for half-time service for the 12-month period. The amount of graduate work that can be carried is proportionate to the service burden of the assistantship.

Applications are due 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 14, 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 School of Dentistry, the College of Education, the School of Home Economics, the School of Journalism, the Department of Political Science, the Audio-Visual Education Service, the Department of Radio and Television Broadcasting, Coffman Memorial Union, the University Village Union, the Student Counseling Bureau, the Bureau of Student Loans and Scholarships, the Office of Admissions and Records, and the Office of the Dean of Students.

Residence Counselorships (146) 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 20 hours of work a week provide room and board and a stipend of \$65 a quarter for new counselors and \$75 a quarter for counselors who are reappointed. Residence hall counselorships which require 30 hours of work a week are civil service positions which allow out-of-state students to pay tuition fees at the resident rate. All other residence counselors pay tuition fees according to their status as residents or nonresidents. 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, 402 Eddy Hall, University of Minnesota, Minneapolis 14.

Fellowships and Scholarships

Applications are due each February 15 unless otherwise stipulated.

Fellowships Unrestricted as to Field

Foreign student tuition scholarships (40 to 75) open in any department or college are offered to qualified foreign graduate and undergraduate students. Applications should be sent by *April 15* to the Office of the Foreign Student Adviser, 302 Eddy Hall, University of Minnesota, Minneapolis 14.

***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 1962-63.

John Cowles Foundation Fellowships (25 or more) in amounts from \$300 to \$500, depending on students' needs, are open to nationals of Aden, Afghanistan, Bahrein, Burma, Cambodia, Ceylon, Ethiopia, Ghana, India, Indonesia, Iran, Iraq, Israel, Jordan, Kuwait, Laos, Lebanon, Liberia, Libya, Malaya, Morocco, Nepal, Nigeria, Oman, Pakistan, Qatar, Saudi Arabia, Singapore, Sudan, Thailand, Trucial Oman, Tunisia, Turkey, United Arab Republic, South Viet Nam, and Yemen with no restriction as to field of study. Recipients pay fees at the resident rate. Applications should be sent by *April 15* to the Office of the Foreign Student Adviser, 302 Eddy Hall, University of Minnesota, Minneapolis 14.

Norwegian-American Graduate Fellowships at \$1,500 available to Norwegian students for study in this country.

***Shevlin Fellowship** at \$1,000, offered in rotation in the College of Agriculture, Forestry, and Home Economics, the College of Science, Literature, and the Arts, and the School of Chemistry. Each of these colleges offers the fellowship once in 3 years. Offered in the College of Science, Literature, and the Arts, 1962-63.

***Minneapolis Woman's Club Fellowship** at \$1,800 available in alternate years to a woman student (a resident of Minnesota is preferred) meeting scholarship and leadership qualifications. Offered 1962-63.

Greater University Graduate Fellowships (2) 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 (6) at \$2,000 (\$2,500 if holder has minor dependents) available 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 may be granted by the dean of the Graduate School under emergency circumstances.

National Foundations—Fellowships offered by national foundations such as the Danforth Graduate Fellowships, National Science Foundation Cooperative Graduate Fellowships, National Science Foundation Summer Fellowships, and the Woodrow Wilson National Fellowships, and in

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

the programs under the National Defense Education Act Graduate Fellowship Programs, Title IV and Title VI, are available to graduate students. For most of these, applications are due before November 1 for the next academic year. Information concerning these opportunities may be received from the Graduate School Fellowship Office, 314 Johnston Hall, University of Minnesota, Minneapolis 14.

Tozer Foundation Fellowships (maximum \$500) designed to help defray expenses connected with the preparation of theses, are awarded to United States students by the Bureau of Student Loans and Scholarships, 201 Eddy Hall, University of Minnesota, Minneapolis 14.

Fellowships Restricted as to Field — 7

AGRICULTURAL SCIENCE FIELDS — 7

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

Agricultural Biochemistry — 8

Procter and Gamble Fellowship in Agricultural Biochemistry at \$1,800 (\$2,100 if student is married). Agency pays fees.

United States Public Health Service Predoctoral Trainee Fellowships (5) in Agricultural Biochemistry at \$2,400 on calendar year basis. Agency pays fees.

United States Public Health Service Postdoctoral Trainee Fellowships (2) in Agricultural Biochemistry at the basic rate of \$6,216 on calendar year basis.

Visking Fellowship at \$1,800 (\$2,100 if student is married) to alternate between Agricultural Biochemistry and Chemical Engineering. Offered in Agricultural Biochemistry 1962-63. Agency pays fees.

Agricultural Economics

Continental Grain Company Fellowship at \$900 with dependency allowance of \$500 in Agricultural Economics. Agency pays fees.

Dairy Husbandry

John Brandt Memorial Foundation Fellowship at \$2,400 for research in Dairy Science.

Dairy Industries

John Brandt Memorial Foundation Fellowship at \$2,000 in Dairy Industries.

Forestry

Charles K. Blandin Foundation Fellowships (2) at \$1,410 to \$2,820 for work in Forest Genetics in the School of Forestry.

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

Northwest Paper Foundation Fellowship at \$2,500 for work in Forest Management in the School of Forestry.

Wood Conversion Foundation Fellowship of \$2,500 for work in Forest Genetics in the School of Forestry.

Home Economics

General Foods Fund Fellowships for full-time study toward Master's or Doctor's degree in any major Home Economics area. Two 1-year fellowships at \$2,000 to \$3,000, depending upon background and degree objective of candidate.

Phi Upsilon Omicron Fellowship at \$1,000 in Home Economics.

United States Public Health Traineeships in Nutrition at from \$1,800 to \$2,400 depending on student's graduate status (dependency allowance of \$270). Agency pays fees. Offered 1963-64.

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

ARTS AND SCIENCE FIELDS

***Albert Howard Fellowship** at \$240. Offered when funds suffice; offered 1962-63. 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 Nonnatural Sciences for a student in the intermediate year of preparation for the Ph.D. degree.

Art

Art Fellowships (2) at \$1,000 each for the study of Modern American Art.

Languages and Culture of Asia or the Moslem World

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 1962-63.

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.

***Charles J. Brand, Class of 1902, Fellowship** at \$1,300 preferably for a student in his final year of work for the Ph.D. in Botany.

Caroline M. Crosby Memorial Fellowships (3 to 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 Forestry and Biological Station or a similar biological station.

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

George A. Macpherson Fellowship at \$1,700 a year to a student who will enter teaching in the fields of Botany, Chemistry, Mathematics, Physics, or Zoology.

Kettering Foundation Fellowship at up to \$2,000 in Botany for work in photosynthesis.

Business Administration

Paul Goldsborough, Jr., Memorial Fellowship. Available when funds permit. Offered 1962-63.

Haskins and Sells Foundation Grant at \$1,000 for a qualified instructor in Accounting who is preparing for a career as an accounting teacher.

Ernest Heilman Memorial Fellowship in Accounting at \$300. Student preparing for college teaching preferred.

Insurance Companies of Minnesota Fellowship at \$350 in Business Administration for a student with major interest in insurance.

Kaiser Aluminum and Chemical Corporation Fellowship at \$2,000 in Business Administration and Marketing. Agency pays tuition.

New York Life Insurance Company Fellowship at \$1,000 in Insurance.

Emmett Salisbury Sales Management Scholarship at \$300 in Business Administration for a student with strong interest in sales management.

Twin City Association of Purchasing Agents Fellowship at \$500 in Business Administration for a student with strong interest in purchasing.

Arthur Young and Company Scholarship at \$750 in Business Administration for a student with strong interest in accounting.

Child Development

United States Public Health Service Training Stipends (3) for research in Child Psychology at \$1,800 to \$3,000 depending on student's year of training. Agency pays tuition.

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

Classical Languages

John C. Hutchinson Scholarship at \$400 awarded every second year to a graduate student in Classical Languages. Offered 1962-63.

Economics

Ford Foundation Workshop Fellowships (5) with varying stipends (\$1,000-\$2,000) in Economics.

Geology

*Thomas F. Andrews Fellowship in Geology at approximately \$500, available at intervals of 2 or 3 years. Offered 1962-63.

California Company Fellowship at \$2,000 in Geology.

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

Reserve Mining Company Fellowship at \$3,000 in Geology, Metallurgical Engineering, Mineral Engineering, or Physics for 12 months of study.

United States Steel Foundation, Inc., Fellowship in Mineral Engineering, Geology, Metallurgical Engineering or Metallurgy at \$2,400 annually for 2 years (\$3,000 annually if student is married at time of designation). Applications due April 1.

Geophysics

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

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 Nonnatural Sciences for a student in the intermediate year of preparation for the Ph.D. degree.

Journalism

Carroll Binder Memorial Award at approximately \$450 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.

Minneapolis Star and Tribune "World Affairs Program" Teaching Assistantship at \$2,115 in Journalism.

David Silverman Memorial Scholarship at \$350 in Journalism for a student specializing in news-editorial aspects of journalism.

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

Library Science

John C. Hutchinson Scholarship at \$250 awarded every second year to a graduate student in Library Science. Offered 1963-64.

Lura C. Hutchinson Scholarship at \$200 in Library Science. Offered 1964-65.

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

Minnesota Library Association Scholarship at \$600 awarded every second year to a graduate student preparing for college or public librarianship. Offered 1963-64.

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

Blanche Thompson Scholarship at \$500 open to school librarians.

H. W. Wilson Scholarship at \$1,000 open to students in Library Science.

H. W. Wilson Company Scholarship at \$1,000 for 1963-64 only.

Polish History, Literature, or Art

Arthur Bliss Lane Fellowship at \$500 offered by the Polanie Club to qualified Minnesota residents of Polish descent interested in research study in Polish history, literature, or art.

Political Science

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

Psychology

Clinical Psychology—Veterans Administration: Approximately 12 work-study stipends at from \$2,677 to \$3,465 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 1 year of successful graduate work in clinical psychology. Appointees pay tuition fees according to their status as residents or nonresidents.

Clinical Psychology—United States Public Health Service: Approximately 16 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—United States Office of Vocational Rehabilitation: Approximately 25 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 pay tuition and fees.

Counseling Psychology—Veterans Administration: Approximately 12 work-study stipends at from \$2,677 to \$3,465 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 1 year of successful graduate work in psychology, either in the Department of Psychology or the Department of Educational Psychology. Appointees pay tuition fees according to their status as residents or nonresidents.

Counseling Psychology—Clinical fellowships for graduate students in counseling psychology are available in the Student Counseling Bureau.

Personality Research—United States Public Health Service: Three to five training fellowships annually for Ph.D. candidates in Psychology who are specializing in study of personality in the Center for Personality Research. Stipend varies: \$1,800 for first-year, \$2,000 for second-year, and \$2,400 for third-year students. These awards are tax-free, and agency pays tuition. Traineeships may be held throughout the student's period of doctoral training. Apply, Director, Center for Personality Research.

Social Work

Donald Abbott Miller Memorial Fellowship—pays tuition for a graduate Social Group Work student.

United States Office of Vocational Rehabilitation Traineeships 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.

United States Public Health Service, Mental Health Act, Traineeships 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 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.

Work-study Stipends (a few) at about \$170 per month in co-operation with the Veterans Administration for Medical and Psychiatric Social Work students.

Mrs. Archie Walker Scholarship Fund for Social Group Work students. Amount based on student's needs.

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

Sociology

National Institute of Mental Health Traineeships (2) at \$1,800 to \$2,000 in Mental Health. Agency pays fees.

Speech and Theater Arts

Oscar W. Firkins Scholarship at \$500 in Theater Arts.

McKnight Foundation Graduate Theater Fellowships (3 or more) at \$600 to \$3,000 in Theater Arts. Candidate must be nominated by a director of a college theater.

United States Office of Vocational Rehabilitation Traineeships (7) at \$2,400-\$3,200 in Speech and Hearing. Agency pays fees.

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.

George A. Macpherson Fellowship at \$1,700 a year to a student who will enter teaching in the fields of Botany, Chemistry, Mathematics, Physics, or Zoology.

Charles Peter Sigerfoos Fellowship at 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.

EDUCATION FIELDS

American Foundation for the Blind Graduate Fellowships (5) at \$2,000 each in Education of the Blind for students who will carry a full course load for at least 3 consecutive quarters.

Educational Administration. Six stipends at \$250 per month for 12 months are open to holders of Master's degrees who are working toward the Ph.D. in Educational Administration. Holders will give half-time service to the Bureau of Field Studies and Surveys under Professor Otto E. Domian.

United States Office of Education Fellowships (4) in Education of Mentally Retarded Children at \$2,000 for first-year graduate students, \$2,400 for second-year graduate students, and \$2,800 for third-year graduate students. Fellows must be full-time students who have had 1 year of teaching or supervisory experience with the mentally retarded. Agency pays all tuition and \$400 per dependent each academic year.

Educational Psychology. Thirty stipends (tentative), yielding \$75 per week, academic year, plus \$15 per week dependency allowance, for applicants accepted for NDEA Counseling Institute. Open only to first-year or intermediate-year graduate students in counselor-education program. Agency pays tuition.

United States Public Health Service Traineeships (3) in School Psychology Training at from \$1,800 to \$2,400 depending on student's graduate status. Agency pays tuition.

ENGINEERING AND PHYSICAL SCIENCE FIELDS

General Electric Foundation Fellowship at \$1,750 in Engineering. Agency pays fees.

United States Rubber Company Foundation Postgraduate Fellowship at \$1,800 with \$300 dependency allowance in Physical and Engineering Science. Agency pays fees.

Chemical Engineering

Allied Chemical and Dye Corporation Fellowship at \$2,000 in Chemical Engineering open to male United States citizens in the last year of work for the doctorate. Agency pays fees.

Esso Research and Engineering Company Fellowship at \$1,800 in Chemical Engineering. Agency pays fees not otherwise paid by any governmental or private agency.

John P. Fridley Fellowships (2) at \$2,000 in Chemical Engineering. Agency pays fees.

Minnesota Mining and Manufacturing Company Fellowship at \$1,800 for research in Chemical Engineering. Agency pays fees.

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

Procter and Gamble Fellowship at \$1,800 for research in Chemical Engineering. Agency pays fees.

Standard Oil Company of California Fellowship at \$1,800 in Chemical Engineering. Agency pays fees not otherwise paid by any governmental or private agency.

Visking Fellowship at \$1,800 (\$2,100 if student is married) to alternate between Agricultural Biochemistry and Chemical Engineering. Offered in Chemical Engineering 1963-64. Agency pays fees.

Chemistry

American Cyanamid Fellowship at \$1,800. Agency pays fees.

Dow Chemical Company Fellowship at \$1,800 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.

Eastman Kodak Company Fellowship at \$2,500 (\$3,000 for married student) in Chemistry. Agency pays fees.

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 \$2,000. Agency pays fees. Offered in Chemistry 1962-63.

General Electric Fellowship at \$1,750 (\$2,100 if student is married; \$2,500 if married with children) in Chemistry. Agency pays fees not otherwise paid by any governmental or private agency.

George A. Macpherson Fellowship at \$1,700 a year to a student who will enter teaching in the fields of Chemistry, Physics, Mathematics, or Zoology.

Minnesota Mining and Manufacturing Company Fellowship at \$1,800 for research in Chemistry. Agency pays fees.

Shell Fellowship at \$1,800 (\$2,100 for married student with one child) in Chemistry. Agency pays fees not otherwise paid by any governmental or private agency.

Sinclair Fellowship at \$1,800 in Organic Chemistry under Professor W. E. Parham. Agency pays fees.

Sun Oil Company Fellowship in Chemistry at \$1,800 for a single or childless married man (\$2,300 for a married man with one or more children). Agency pays fees.

Union Carbide and Carbon Chemicals Corporation Fellowship at \$1,500 (\$2,100 if student is married) in Organic Chemistry under Professor C. F. Koelsch. Agency pays fees.

United States Rubber Company Fellowship in Chemistry at \$1,800 if student is single or married without children (\$2,100 if married with children). Agency pays fees not otherwise paid by any governmental or private agency.

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 Scholarships (2) at \$500 in Electrical Engineering 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 Foundation. May be held for a maximum of 2 years. Stipend commensurate with current salaries for graduates in electrical engineering.

Raytheon Predoctoral Fellowship at \$1,800 (\$2,100 for married student with children) in Electrical Engineering. Holder is expected to finish his doctoral research within a year and to work in a field related to the interests of the company: noise, communication theory, microwave propagation and devices, applications of solid state physics, plasma physics. Agency pays tuition.

Mathematics

George A. Macpherson Fellowship at \$1,700 a year to a student who will enter teaching in the fields of Chemistry, Physics, Mathematics, or Zoology.

Mechanical Engineering

General Electric Fellowship in the fields of Thermodynamics and Kinetics at \$1,750 (\$2,100 for married student, no dependent children; \$2,500 for married student with one or more dependent children). Agency pays fees not otherwise paid by a governmental or private agency.

Walter C. Seeger Graduate Fellowship at \$2,000 in Mechanical Engineering.

Trane Fellowship at \$2,000 for research in Mechanical Engineering.

Metallurgical Engineering

Jones and Laughlin Steel Corporation Fellowship yielding up to \$2,400 in Metallurgical Engineering under Professors T. L. Joseph and Gust Bitsianes. Agency pays allowance for supplies and equipment.

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

United States Bureau of Mines Fellowships (2) up to \$3,000 in Metallurgical Engineering under Professor S. R. B. Cooke.

National Steel Corporation Fellowship up to \$3,600 in Metallurgical Engineering under Professors T. L. Joseph and Gust Bitsianes.

Reserve Mining Company Fellowship at \$3,500 for the calendar year in Metallurgical Engineering, Mineral Engineering, Geology, or Physics.

United States Steel Foundation, Inc., Fellowship in Mineral Engineering, Geology, Metallurgical Engineering, or Metallurgy at \$3,000 annually for 2 years (\$3,600 annually if student is married at time of designation).

Metallurgy

Atomic Energy Commission Research Assistantships (3) at \$1,890 in Metallurgy.

Office of Naval Research Research Assistantships (5) at \$1,890 in Metallurgy.

Office of Naval Research Fellowship at \$473 in Metallurgy.

United States Steel Foundation, Inc., Fellowship in Metallurgy, Mineral Engineering, Geology, or Metallurgical Engineering at \$3,000 annually for 2 years (\$3,600 annually if student is married at time of designation). Offered 1963-65.

Mineral Engineering

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

Mines Experiment Station Research Assistantship at \$3,000 for the calendar year in Mineral Engineering or Mineral Economics.

Reserve Mining Company Fellowship at \$3,500 in Metallurgical Engineering, Mineral Engineering, Geology, or Physics.

United States Bureau of Mines Fellowship at up to \$3,000 in Mineral Engineering, under Professor E. P. Pfeider.

United States Bureau of Mines Fellowship at up to \$4,000 annually for 2 years in Mineral Economics. Open to male United States citizens desiring doctoral degree. Agency pays allowance for travel and expenses.

United States Steel Foundation, Inc., Fellowship in Mineral Engineering, Geology, Metallurgical Engineering, or Metallurgy at \$3,000 annually for 2 years (\$3,600 annually if student is married at time of designation).

Physics

George A. Macpherson Fellowship at \$1,700 a year to a student who will enter teaching in the fields of Physics, Chemistry, Mathematics, or Zoology.

Reserve Mining Company Fellowship at \$3,500 in Metallurgical Engineering, Mineral Engineering, Geology, or Physics.

MEDICAL AND HEALTH SCIENCE FIELDS**Dight Institute**

United States Public Health Service Traineeships at from \$2,700 to \$3,000 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 \$1,500 maximum (\$1,800 for married students). Agency pays fees.

Samuel W. Melendy Memorial Fellowships (5) 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.

Rowell Laboratories, Incorporated, Fellowship in Pharmaceutical Chemistry at \$1,500 plus \$350 for supplies and fees. Work is to be done under Professor T. O. Soine.

Upjohn Company Fellowship at \$2,000 in Pharmaceutical Sciences.

School of Public Health

United States Public Health Service Training Fellowships in Biostatistics ranging from \$1,000 to \$4,500, depending upon need and qualifications of students, under Professor J. E. Bearman. Renewable. Agency pays fees.

United States Public Health Service Traineeships in Epidemiology at \$3,000 to \$5,400 per year, plus allowance of \$360 per year per dependent, under Dr. L. M. Schuman. Renewable with annual 10 per cent increase in base stipend. Agency pays tuition.

Kellogg Foundation Hospital Administration Doctoral Fellowships (3) with stipend of \$3,600 for 12-month year (\$5,000 for married student).

United States Public Health Service, Mental Health Institute, Traineeships for graduate study in Mental Health. Open to public health nurses, at \$2,400 per year. Agency pays tuition.

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

United States Public Health Service Traineeships in Public Health Nursing at \$250 per month plus dependent allowance and tuition. Open to graduate students who are graduate nurses preparing for leadership positions.

United States Public Health Service Traineeships in Radiological Health at \$250 to \$400 per month plus dependent allowance. Renewable. Agency pays tuition.

College of Veterinary Medicine

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

United States Public Health Service Training Grants (10) for students holding their professional degrees for graduate study in the Divisions of Veterinary Anatomy, Veterinary Pathology and Parasitology, Veterinary Bacteriology and Hygiene, and Veterinary Physiology and Pharmacology.

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 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 17, Administration Building, University of Minnesota, Minneapolis 14, Minnesota.

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, 201 Eddy Hall.

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 matters of language adjustment; 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, 302 Eddy Hall, University of Minnesota, Minneapolis 14.

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 14.

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, 108 Wesbrook Hall, University of Minnesota, Minneapolis 14. 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 Campus, or 101 Coffey Hall, St. Paul Campus.

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 1961-1962 rates ranged from \$3.21 to \$3.84 per day for board and room (\$241-288 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 without penalty if the residence hall is notified by September 1 or immediately following nonacceptance by the University.

Minneapolis Campus—*Sanford Hall*, accommodating 280 freshman, upperclass, and graduate women, is located on University Avenue S.E. near the northwest entrance to the campus. Priority is given to freshman women up to July 15.

Comstock Hall accommodates 540 sophomore, junior, senior, and graduate 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 freshman, sophomore, junior, and senior women. It is located on the edge of the campus near the East River Road.

Pioneer, Centennial, Territorial, and Frontier Halls for men are located in a quadrangle on the 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 the halls. For additional information, contact the Director of Housing, 108 Wesbrook Hall, University of Minnesota, Minneapolis 14.

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 and Meredith Halls*.

University Housing for Married Students—*Commonwealth Terrace*, new permanent apartments for married students located on the St. Paul Campus, provides housing for 360 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 1-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 Director of Housing, 108 Wesbrook Hall, University of Minnesota, Minneapolis 14.

** For information about residence counselorships in these units, see page 25.

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 14.

AIR FORCE ROTC PROGRAM

Students in the Graduate School may pursue the Air Force ROTC program. To be eligible for the basic corps, applicants must have 2 years of academic work remaining. If the applicant has had 2 years of basic Air Force ROTC and has 2 years of academic work remaining, he is eligible for the advanced corps. (A personal interview is required of all applicants for entry into the Air Force ROTC program.) No graduate credit may be earned.

** For information about residence counselorships in these units, see page 25.

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.

‡ Students may enter any quarter preceding the double dagger.

§ 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 These following a course number indicate fall, winter, spring, or summer quarters.

Courses numbered from 100 to 199 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

Benjamin J. Lazan
Chieh-Chien Chang
Lawrence E. Goodman
Helmut G. Heinrich
William C. Meecham
Robert Plunkett

Associate Professor

Allan A. Blatherwick
Carl N. De Silva
Walter T. Graves
Chih-Chun Hsiao
Theodore J. Mentel
Patarasp R. Sethna
Eugene Stolarik
William H. Warner

Assistant Professor

August R. Hanson
Thomas S. Lundgren

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.

100. **Aerodynamics I.** Kinematics of fluid field including continuity equation, vorticity, circulation, velocity potential, source, and doublet. Application of Gauss and Stokes's theorem to fluid flow. Flow about cylinder. (3 cr; prereq ITM 26A, MM 27)
101. **Aerodynamics II.** Irrotational incompressible flow in two dimensions. Method of complex variable, effect of branch line. Irrotational incompressible flow in three dimensions. Curvilinear co-ordinate systems, cylindrical and spherical. Dynamics, Euler's equation, Bernoulli's equation. Aerostatics. (3 cr; prereq 100)
102. **Aerodynamics III.** Viscous incompressible flow. Thin airfoil theory. Stress and strain rate. Navier-Stokes's equation. Boundary layer equation and solution along a plate. Von Karman momentum integral. Pohlhausen method. Turbulent boundary layer. (3 cr; prereq 101)
103. **Aerodynamics IV.** Basic concepts of thermodynamics. One-dimensional steady isentropic flow. Laval nozzle. Normal and oblique shock waves and reflections. Prandtl-Meyer flow. Thin airfoil theory. (3 cr; prereq 102)
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 103)
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 106)
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 106)
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 103)
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 boundary layer interaction. (3 cr; prereq 103)
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 41)
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 Aero 5th yr or #)
131. **Aerospace Systems Design.** Preliminary design synthesis of a selected system. Planning and scheduling. (4 cr; prereq 130)
- 145-146-147. **Aeromechanics Laboratory.** 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 103 or ♪, MM 142, MM 193)
148. **Experimental Supersonics and Hypersonics.** Wind tunnel techniques and instrumentation. Flow and model studies. (3 cr; prereq 147)
150. **Aeroelasticity I.** Aeroelastic oscillations of simple structures, wires, cylinders, suspension bridges. Wing divergence, aileron reversal and tail efficiency. Flutter and buffeting. Control surface balancing and flutter prevention. (3 cr; prereq 103 and MM 193) De Silva
159. **Aerodynamic Deceleration.** Aerodynamics of subsonic and supersonic retardation devices. Wake and interference effects. Trajectory calculations, re-entry problems and recovery systems. (3 cr; prereq 103 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 29)

184. **Intermediate Gas Dynamics.** One-dimensional channel flow with friction and heat addition. One-dimensional wave motion. Flow in ducts and wind tunnels. Two-dimensional and axially symmetric characteristics method. Supersonic source integration method for wing and body of revolution. Piston theory. (3 cr; prereq 103)
185. **Rarefied Gas Dynamics.** Flow regimes, free molecular flow, slip flow and transition. (3 cr; prereq 110 or #)
190. **Introduction to Magnetohydrodynamics.** Fundamental equations and concepts of magnetohydrodynamics. Transport of magnetic field; magnetohydrodynamic channel flow. Alfvén waves. (3 cr per qtr; prereq 103, ITM 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, 202, 203. **Compressible Fluid Dynamics.** Fundamental equations of motion. Isentropic, adiabatic and nonadiabatic one-dimensional flow. Shock wave. Spiral flow. Prandtl-Meyer flow. Characteristic method. Supersonic flow past a cone. Similarity rules in different flow regimes. Subsonic, supersonic linearized theory of wings and bodies of revolution. Transonic flows. (3 cr per qtr; prereq 103 and ¶ITM 149, or #) Lundgren, Chang, Meecham
- 205-206-207. **Viscous Fluid Flow and Boundary Layer Theory.** Navier-Stokes's equations of compressible viscous fluid, exact solutions; concepts of boundary-layer theory; boundary layer on a plate; axially symmetrical and three-dimensional boundary layer, nonsteady case; stability and turbulent flow. (3 cr per qtr; prereq 103, and ¶ITM 175 or #) Meecham, Chang
- 210-211-212.† **Selected Topics in Fluid Mechanics.** Topics of current interest. (0-3 cr per qtr ar; prereq #) Graduate staff
- 215-216-217. **Theory of Turbulence.** Review of statistical mathematics necessary for turbulence studies. Statistical assumptions and correlation tensors; major theories of turbulence, Heisenberg, Chandrasekhar, Kolmogoroff, and similarity results. Magneto-fluiddynamic turbulence and interaction of sound with turbulence. (3 cr per qtr; prereq 203, ¶ITM 173, ¶ITM 174, ¶ITM 175, respectively, or #) Meecham
- 220-221. **Astronautics and Re-entry.** Aerodynamic performance, thrust and trajectories of rocket-powered ballistic vehicles. Satellite and space vehicles, orbital maneuvers. Optimization considerations. Hypersonic flow regimes, dissociation, ionization and control during re-entry. (3 cr per qtr; prereq 201, ITM 151, or #)
- 230-231-232. **Transonic and Hypersonic Flow.** Transonic similarity rules. Curved shocks, ionization effects, chemical reaction. (3 cr per qtr; prereq 203 and ITM 173-174-175 or ¶)
- 250-251-252. **Magneto-fluiddynamics.** (3 cr; prereq 203 or Phys 104 or ITM 234 or #) Chang
- 297-298-299.† **Fluid Mechanics Seminar.** (0-1 cr per qtr)

AGRICULTURAL BIOCHEMISTRY

Professor

David R. Briggs
Robert Jenness
Irvin E. Liener

Walter O. Lundberg
Max O. Schultze
Fred Smith

Associate Professor

Samuel Kirkwood

Assistant Professor

Robert L. Glass

Prerequisites—For major work undergraduate courses satisfactory to the student's adviser are required in mathematics through integral calculus, general physics, inorganic chemistry, qualitative and quantitative analysis, organic chemistry, biochemistry, general biology (or botany or zoology), and general bacteriology. Physical chemistry is advised. For minor work the student must satisfy the department graduate faculty that he has an adequate background.

Major—Candidates for the Ph.D. degree must have completed 1 year of physical chemistry, 1 year of advanced organic chemistry, and have accumulated 6 credits in course 224. Candidates for the M.S. degree must have completed 3 credits in course 224. With the approval of the adviser, courses in mathematics, physics, chemistry, biology, agricultural and medical sciences may be included as part of the major course of study.

The thesis may be conducted in such subfields of biochemistry as colloids, proteins, carbohydrates, lipids, enzymes, cereal chemistry, dairy chemistry, animal nutrition, and plant biochemistry.

Minor—Courses 100, 101, 102, 110, 111, 112, 119, 124, and 216 to 223 provide a basic training in biochemistry. A selection from these courses is particularly recommended to students registered for the Ph.D. degree.

Language Requirement—For the Ph.D. degree, a reading knowledge of 2 foreign languages, 1 of which must be German. For the M.S. degree, one foreign language, French or German. In special cases some other language may be substituted by petition.

Master's Degree—In general, offered only under Plan A.

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

- 100-101-102. General Biochemistry.** Structure, physical and chemical properties, and functions of compounds of biological importance. (3 cr per qtr; prereq ¶110-111-112 except with consent of dept head, AgBi 3 or 1 yr organic chemistry) Staff
- 103. Advanced Dairy Chemistry.** Physical, colloidal, and chemical properties of milk and dairy products. (3 cr; prereq ¶113 except with #, 10, 102) Jenness
- 105. Plant Biochemistry.** Introduction to chemistry and metabolism of plants. (3 cr; prereq 3 or equiv) Kirkwood
- 106. Animal Biochemistry.** Introduction to chemistry, metabolism, and nutrition of animals. (3 cr; prereq 3 or equiv) Schultze
- 108. Chemistry of Cereal and Cereal Products.** Lecture course on chemistry and technology of cereals. (3 cr; prereq 5 or 102) Glass
- 109. Cereal Laboratory Methods.** (3-5 cr; prereq 108 or ¶108, AnCh 57 or equiv) Glass
- 110-111-112. General Biochemistry Laboratory.** Parallels AgBi 100-101-102. (2 cr per qtr; prereq ¶100-101-102 except with consent of dept head) Staff
- 113. Advanced Dairy Chemistry Laboratory.** Parallels AgBi 103. (2 cr; prereq ¶103 or #) Jenness
- 118x. Laboratory Problems in Biochemistry.** Preparation and isolation of pure compounds; methods of identification or determination of biochemical products. (3-5 cr per qtr; prereq #) Staff
- 119. Physical Biochemistry.** Lectures and assigned reading on colloid chemistry, surface chemistry, molecular kinetics and their applications to biochemical materials and processes. (3 cr; prereq 102 or #...Phys 9 advised) Briggs
- 124. Vitamins.** Lectures and reading on biochemistry of vitamins and their physiological action. (3 cr; prereq 6, 102 or #) Schultze
- 203x. Research Problems.** (2-5 cr per qtr; prereq #) Staff
- 204. Tracer Techniques.** Laboratory work on the application of radioisotopes to study of metabolic processes. (3 cr; prereq 110, 111, 112, MeAg 127 or #) Kirkwood
- 205x. Special Topics in Biochemical Literature.** (1-3 cr per qtr; prereq #) Staff
- 216. Advanced Metabolism.** Biochemistry of intermediary metabolism. (3 cr; prereq 102 or #) Schultze
- 219. Advanced Physical Biochemistry.** Lectures and assigned reading on selected topics in physical biochemistry. (2 cr; prereq 119 or #) Briggs
- 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 102 or #; offered 1962-63 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 102 or #; offered 1963-64 and alt yrs) Smith
- 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 102 or #; offered 1963-64 and alt yrs) Lundberg
- 223. Advanced Enzyme Chemistry.** Lectures and assigned reading on nature and function of enzymes. (2 cr; prereq 102 or #, PCh 102 or equiv; offered 1962-63 and alt yrs) Liener, Kirkwood
- 308x. Cereal Chemistry Seminar.** (1 cr per qtr; prereq 108 or #) Glass
- 313x. Seminar in Dairy Chemistry.** (1 cr; prereq 103 and #) Jenness
- 316x. Nutrition and Enzymes Seminar.** (1 cr; prereq 102 and #) Schultze, Liener

- 319x. Colloid Chemistry Seminar.** (1 cr; prereq 119 and §) Briggs
- 320x. Protein Chemistry Seminar.** (1 cr; prereq 102 and §) Briggs, Jenness
- 321x. Carbohydrate Chemistry Seminar.** (1 cr; prereq 102 and §) Smith, Kirkwood
- 322x. Chemistry of Lipids Seminar.** (1 cr; prereq 102 and §) Lundberg
- 324x. General Seminar.** Reports on recent developments in biochemistry and on research work carried out in the department. (1 cr) Staff

AGRICULTURAL ECONOMICS

Professor

Sherwood O. Berg
 Marguerite C. Burk
 Willard W. Cochrane
 Selmer A. Engene
 Carroll V. Hess

Harald R. Jensen
 E. Fred Koller
 Truman R. Nodland
 Philip M. Raup

Associate Professor

Reynold P. Dahl
 Darrell F. Fienup
 Elmer W. Learn
 W. Burton Sundquist

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, land 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) 2 foreign languages or (b) 1 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.

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) Learn
- 107. Farm Work Simplification.** Principles and methods of accomplishing work in less time and with less effort. Methods of analyzing jobs, principles of motion economy, efficient working methods for different farm enterprises. Practice in planning improved working methods. (3 cr; prereq 2) Engene
- 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, §8) Berg
- 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 §2) 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) Cochrane
140. **Grain Marketing.** (3 cr; prereq 40) Dahl
141. **Dairy Marketing.** (3 cr; prereq 40) Koller
142. **Fruit and Vegetable Marketing.** (2 cr; prereq 40) Dahl
143. **Livestock and Poultry Marketing.** (3 cr; prereq 40) Fienup
- 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 1962-63 and alt yrs) 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 1963-64 and alt yrs) Koller
- 150.° **Advanced Farm Finance.** (3 cr; prereq 50 or equiv) 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, internal organization and techniques, comparative advantage, world trade in agricultural products, national and international policies relating to agriculture, future trends and prospects. (3 cr) Raup
180. **Farm Accounting.** Class of 80 plus a special problem. (3 cr; prereq #) Nodland
183. **Advanced Farm Planning.** Special problems. (3 cr; prereq #) Engene
- 200-201-202.° **General Seminar in 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) Berg and staff
- 208.° **Seminar in 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, Berg
- 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, Sundquist
- 226.° **Seminar in 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 #) Cochrane, Learn
- 241.° **Seminar: Marketing.** (3 cr; offered when demand warrants) Fienup
- 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

AGRICULTURAL ENGINEERING

Professor

Arthur J. Schwantes
Evan R. Allred
Andrew Hustrulid
Philip W. Manson
Charles K. Otis

Associate Professor

Clarence H. Christopherson
Arnold M. Flikke
Curtis L. Larson
John Strait

Research Fellow

Lee F. Hermsmeier

Prerequisites—For a major in agricultural engineering the general prerequisite comprises all work in the undergraduate professional curriculum in agricultural engineering at the University of Minnesota or its equivalent in general character, and in

extent and value. For a minor in agricultural engineering, the student must satisfy the department staff as to his preparation.

Major and Minor—With the approval of the adviser, courses in other branches of engineering and in agricultural or allied sciences may be included in the major. The minor may be taken in one of the other branches of engineering or some other related field of study approved by the adviser.

Language Requirement—No language is required.

Master's Degree—Offered under Plan A. In special cases Plan B is accepted when approved by the department graduate faculty.

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

106. **Hydrology and Erosion Control.** Hydrologic cycle and its various phases: precipitation, infiltration, transpiration, runoff, evaporation. Climate. Engineering methods for controlling soil erosion: strip cropping, terracing, grass waterways, and structures. Farm ponds. (3 cr; prereq Soil 1, or 3 or 19 and Math H; not open to engineers) Larson
107. **Drainage and Irrigation.** General theory, design, economical feasibility, and legal responsibilities of drainage and irrigation practices. (3 cr; prereq Math H, Soil 1 or 3 or 19; not open to engineers) Allred
108. **Field Problems in Soil and Water Conservation.** Elementary surveying, design and layout of drainage, erosion control, and irrigation systems for conservation of soil and water. (4 cr; prereq 106 or 107; not open to engineers) Manson
114. **Special Problems in Farm Buildings.** Problems based on work given in the prerequisite courses. (2-4 cr; prereq 3, 7, and 14; not open to engineers) Otis, Christopherson
124. **Agricultural Machinery and Mechanical Power Management.** Machinery and power management and use and its cost as a factor in agricultural production. (3 cr; not open to engineers; prereq 9 cr in mechanized agriculture incl 12 and 23) Schwantes, Flikke
125. **Topics in Agricultural Physics.** Advanced study of the essential physical principles involved in the utilization of electricity in agriculture. (3 cr; prereq Phys 50 or integral calculus and 25 or equiv) Hustrulid
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 4, 23, AgEd 91 or ¶) Marvin
131. **Problems and Field Studies in Advanced Farm Mechanics.** Farm mechanics principles and skills necessary for efficient operation, maintenance, and service of modern mechanical farm equipment. (3-9 cr; prereq 130) Marvin
141. **Agricultural Drainage.** Soil-water-plant relationships. Design, cost, and construction of tile drainage and open ditch systems. Economics and legal aspects of drainage. (3 cr; prereq 82, Hydr 103, Soil 19) Manson
142. **Erosion Control Engineering.** Design and construction of terraces, diversions, grass waterways, and earth dams. Hydraulic design of drop spillways, chutes, culverts, and conduit spillways. (3 cr; prereq 82, Hydr 103, Soil 19) Larson
143. **Irrigation.** Principles and practices of irrigation in arid and humid regions. Plant water requirements, water supply development, theory and operation of irrigation pumps. Design, cost, and construction of irrigation systems and structures. (3 cr; prereq 82, Hydr 103, Soil 19) Allred
147. **Design and Management of Farm Machinery.** Principles of operation and performance characteristics of farm machinery. Design of machine elements and assemblies. Management of machinery. (3 cr; prereq 72) Strait
149. **Radioisotope Measurements.** Properties of nuclear radiation. Geiger-Muller, proportional, and scintillation detectors. Gamma ray spectrometer. Statistics of nuclear radiation measurement. Applications of radioisotope measurements in agricultural engineering. (3 cr; prereq Phys 50, ITM 26A) Hustrulid

159. **Agricultural Engineering Instrumentation.** Application of basic electrical instruments to measurement and control. Controls and control circuits. Pyrometry, psychrometry, and pressure measurement and control. Physical measurements relating to soils and crops. Radioactive and tracer instrumentation. (3 cr; prereq EE 37) Hustrulid
167. **Advanced Farm Structures.** Design of structural members and assemblies for farm buildings. Wind resistant construction. Insulation and ventilation. Building equipment. Cost estimating. (3 cr; prereq ME 160, CE 37) Otis
170. **Agricultural Tractors.** Engines, transmissions, and final drives. Auxiliary drive systems. Chassis mechanics and tractor stability. Hitches and hydraulic systems. Tractor performance and tests. (3 cr; prereq ME 24, 150) Strait
- 171.^o **Design of Agricultural Machinery.** Operating principles and problems. (3 cr; prereq 147, ME 24) Strait
- 172.^o **Agricultural Machine Analysis.** Advanced design problems. Application of principles of dynamics to design of agricultural machinery. Experimental measurement of working forces and stresses. Motion analysis. (3 cr; prereq 171, MM 142) Strait
176. **Management of Power and Machinery.** Principles. (3 cr; prereq 147) Schwantes
179. **Agricultural Process Engineering.** Size reduction, cleaning, and sorting of agricultural products. Principles of materials handling. Refrigeration theory and application. Steam generation and use. Heating, cooling, drying, and concentrating processes. Fans and pumps. Process control, flow diagrams, plant design, and cost analysis. (3 cr; prereq ME 160) Hustrulid
180. **Agricultural Hydrology and Flood Control.** Runoff measurements and estimation of runoff. Hydrograph analysis. Water storage, detention, and flood routing. Floods, flood damages, and flood control in agricultural areas. (3 cr; prereq 142 or ¶) Larson
181. **Field Problems in Soil-Water Management.** Survey, design, and layout of drainage, erosion control, and irrigation systems and structures for the management and conservation of soil and water. (3 cr; prereq 141, 142, 143 or ¶) Allred, Larson
- 191-192-193.^o† **Problems in Agricultural Engineering.** Special problems in: (S) Soil Moisture, (P) Power and Machinery, (F) Farmstead Equipment and Operations. (2-6 cr per qtr; prereq §)
- 200f,w,s. **Seminar.** Reports on current topics and department research. (1 cr; prereq §)
- 211-212-213.^o‡ **Advanced Problems and Research.** (2-6 cr per qtr; prereq 191, 192, or 193) Staff

AGRONOMY AND PLANT GENETICS

Professor

Will M. Myers
Elmer R. Ausemus
Charles R. Burnham
Jean W. Lambert
Ernest H. Rinke
Leon A. Snyder

Associate Professor

Richard Behrens
Richard S. Caldecott
Laddie J. Elling
Robert G. Robinson
Alois R. Schmid
James C. Sentz
Horace L. Thomas

Assistant Professor

Robert N. Andersen
William M. Clement
Verne E. Comstock
Donald C. Rasmussen
Lawrence H. Smith

Prerequisites—In agronomy, 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 agricultural biochemistry, botany, genetics, horticulture, plant pathology, plant physiology, soils, and other biological sciences may be accepted as major work in agronomy.

Attention of students is also 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) 2 foreign languages or (b) 1 foreign language and the option of a special research technique or a collateral field of knowledge. The student will find it to his advantage to prepare himself in advance for the language examinations. This is particularly true of those who are unable to spend more than 1 or 2 quarters at a time in residence at the University of Minnesota while doing graduate work.

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

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

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.** Organization and functions of public and private research and extension agencies for weed control and federal and state regulatory bodies; preventive, cultural, and chemical methods of weed control; equipment and techniques for weed control research. (3 cr; prereq 1, PIPa 3 or #) Behrens
- 201f,w,s,su.* Research in Farm Crops.** Problems in physiology, production, and classification of crop plants. (Cr ar; prereq 121, 127) Behrens, Robinson, Schmid
- 202f,w.* Farm Crops Seminar.** Reviews and discussions of important agronomic literature. (1 cr per qtr; prereq 9 cr in farm crops) Graduate staff
- 203w. Advanced Studies in Agronomy.** Concepts of yield, quality, forage production, cropping systems, world food potential, and crop adaptation. (3 cr; prereq 21, 27; offered 1962-63 and alt yrs) Behrens, Schmid, Robinson, Myers
- 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 Genetics

The following courses may be accepted for agronomy but are primarily of interest to students in genetics.

- 131f.* Principles of Genetics.** Intermediate consideration of physical basis of heredity. Mendel's laws, linkage, chromosomal aberrations, mutation, sex determination, cytoplasmic inheritance, and genes in populations. (4 cr; prereq 30 or equiv) Lambert
- 132w. Farm Crops Plant Breeding.** Applied genetics. Methods of breeding and testing each of the important agricultural crops. (4 cr; prereq 30 or equiv) Rinke
- 235f. Radiation Biology.** Effects of irradiation on living systems, especially their genetic consequences. (3 cr; prereq VSR 219 or equiv and #) Loken, Marvin, Spurrell, Caldecott
- 240w. Advanced Genetics.** An advanced consideration of genetic principles and mechanisms. (3 cr; prereq 131 or equiv) Snyder
- 241f,w,s,su.* Research in Plant Genetics.** May be taken as major or minor work. (Cr ar) Myers, Burnham, Rinke, Ausemus, Thomas, Lambert, Snyder, Caldecott, Sentz
- 242f,s.* Plant Breeding Seminar.** (1 cr per qtr) Plant Genetics and Horticulture graduate staffs
- 243s. Methods in Plant Breeding.** Methods applicable to improving self- and cross-pollinated crop plants, the effects of inbreeding, selection, hybridization, and heterosis. (3 cr; prereq 132 and 240 or equiv) Myers
- 244f,su. Laboratory Methods in Plant Breeding.** Practice in plant breeding technique, methods of controlling pollination, and handling of plant cultures. (Cr ar; prereq 132 or equiv) Staff
- 245s. Topics: Plant Breeding.** (2 cr; prereq 240, 243, and 244 or equiv or consent of staff) Staff
- 246w.* Genetics Seminar.** Contributions to genetic theory and practice. (1 cr) Plant Genetics, Horticulture, and Animal Husbandry graduate staffs
- 252f. Cytogenetics.** Advanced material on chromosomes in relation to genetics. (4 cr; prereq 240, Bot 118) Burnham
- 253s. Methods in Plant Genetics.** Planning and analysis of genetic experiments. (3 cr; prereq 252) Burnham

- 255s. **Special Topics in Genetics.** (2 cr [can be taken for cr more than once]; prereq 252 or consent of staff) Graduate staff
256. **Radiation Genetics.** Characteristics of physical and chemical mutagens in relation to their biological effects. Organization of genetic materials, nature and reversibility of mutagen induced changes, modifying effects of environmental parameters. Utilization of chemical and physical mutagenic agents in genetic studies. (3 cr; prereq 240 and #) Caldecott, Snyder
257. **Special Topics in Radiation Plant Biology.** Consideration of advanced topics in utilization of radiation and radioisotopes in biological experiments, with particular emphasis on genetics. (3 cr; prereq 256, PlPa 214 and #) Caldecott and staff
- 261w. **Quantitative Inheritance.** Development of a logical framework of reference for study of genetic populations; systems of mating. (3 cr; prereq 131 or equiv, 248 or equiv) Sentz

AMERICAN STUDIES

Professor

Bernard R. Bowron, Jr.
Charles H. Foster
George Hage
Jacob C. Levenson
Johannes Riedel

Arnold M. Rose
Ralph G. Ross
Mulford Q. Sibley
Robert F. Spencer
Donald R. Torbert
Dimitri T. Tselos

Associate Professor

Clarke A. Chambers
David Cooperman
Joseph J. Kwiat
Paul Murphy
David W. Noble
Mary C. Turpie
Brom Weber

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 Brom Weber, secretary.

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.

Minor—Consult the chairman of American Studies.

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 4 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) Bowron and staff
210. **Seminar in American Studies: Bibliography.** (3 cr; prereq PhD candidate) Weber
- 211-212-213. **Seminar in American Studies.** Problems and methods in the study of American culture. (3 cr per qtr; prereq PhD candidate) C Foster
- 240-241-242. **Materials for the Study of American Civilization.** (2 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

Arnold Lazarow, M.D., Ph.D.
J. Francis Hartmann, Ph.D.
Charles F. Morgan, Ph.D.
R. Dorothy Sundberg, Ph.D., M.D.
Lemen J. Wells, Ph.D.

Associate Professor

Anna-Mary Carpenter, Ph.D., M.D.
William J. L. Felts, Ph.D.

Assistant Professor

Carl B. Heggstad, M.D., Ph.D.
Morris Smithberg, 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. For the Ph.D. degree, either (a) 2 foreign languages (preferred) or (b) 1 foreign language and the option of a collateral field of knowledge.

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. (15 cr for both qtrs; prereq #; enrollment limited) Hartmann, Lazarow, Morgan, Smithberg, Wells
- 103f-104s.† Human Histology.** Microscopic structure, cytochemical and functional aspects of cells, tissues, and organs. (7 cr for both qtrs; prereq #; enrollment limited) Lazarow, Carpenter, Heggstad
- 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 102)
- 107w. Human Embryology.** Development of the human body. (4 cr; prereq #; enrollment limited) Wells, Heggstad
- 108w. Gross Anatomy for Dental Students.** Lectures and dissection of extremities and abdomen and pelvis. (6 cr; prereq #; enrollment limited) Felts and staff
- 109s. Gross Human Anatomy for Dental Students.** Lectures and dissection of thorax and head and neck. (6 cr; prereq #; enrollment limited) Felts and staff
- 111s. Human Neuroanatomy.** Structure of the nervous system including the organs of special sense. (5 cr; prereq 104 or Zool 150, #; enrollment limited) Hartmann
- 131. Biological Electron Microscopy.** (Cr and hrs ar; prereq #) Hartmann
- 132. Experimental Study of the Fetus.** (Cr and hrs ar; prereq #) Wells
- 140f. 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; 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

160. **Introduction to Histological and Morphologic-Histochemical Techniques.** Fixation, embedding, and staining of cytological components and enzymes. (2 cr; prereq 103-104, §) Carpenter
161. **Experimental Cytochemistry.** (Cr and hrs ar; prereq 103-104, PhCh 100-101, §) Lazarow
- 165w-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 in Hematology.** (1 cr; prereq 166) Sundberg
180. **Endocrinology of the Reproductive Tract.** Relationship of endocrines to reproduction studied by use of the experimental techniques of physiology, cytochemistry, and radioautography. (Cr and hrs ar; prereq 103, 104, PhCh 100-101, §) Morgan
- 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 §) Carpenter, Felts, Hartmann, Lazarow, Morgan, Sundberg, Wells
- 205, 206, 207. **Anatomy Seminar.** Reviews of current literature and discussion of research work being carried on in the department. (1 cr per qtr; prereq §) Lazarow and staff

ANESTHESIOLOGY

For staff and courses of study offered, see the *Bulletin of Graduate Programs in Medicine, Dentistry, and Pharmacy, 1961-1963.*

ANIMAL HUSBANDRY

Professor

Lester E. Hanson
Ralph E. Comstock
Alfred L. Harvey
Robert J. Meade

Associate Professor

Woodrow J. Aunan
Eldon G. Hill
Robert M. Jordan
Olaf E. Kolari
William E. Rempel

Assistant Professor

Frank D. Enfield
Jay C. Meiske
Joseph V. Scaletti
John D. Smith

Prerequisites—For major work, 24 quarter credits in animal husbandry or closely allied subjects; for minor work, 12 quarter credits.

Major and Minor—Candidates doing major work for the Doctor's degree may emphasize breeding, genetics, meats, nutrition, or physiology but must select a minor in some other field. With the approval of the adviser, graduate courses in chemistry, genetics, zoology, veterinary medicine, economics, microbiology, dairy husbandry, statistics, physiology, and mathematics may be accepted for major work.

Language Requirement—For the Master's degree, none. For the Ph.D. degree, this requirement may be fulfilled by (a) 2 foreign languages or (b) 1 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.

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

101. **Livestock Selection.** Advanced training in selection and judging of livestock. **Visits to stock farms.** (3 cr; prereq 9 or §) Jordan
107. **Meat Problems.** Wholesale cuts and grades of meat; processing industry and merchandising establishments. (3 cr; prereq 53) Aunan
162. **Animal Breeding.** Applications of the physiology of reproduction and genetics to breeding of farm animals. (3 cr; prereq Agro 30 or equiv) Rempel
163. **Swine Production.** Adaptability, breeding, feeding, care and management of commercial and purebred swine. (3 cr; prereq 37, 37A, 62 or §; also offered SSI 1962) Meade
164. **Sheep Production.** Adaptability, breeding, feeding, care and management of commercial and purebred sheep. (3 cr; prereq 37, 37A, 62 or §; also offered SSI 1964) Jordan
165. **Beef Cattle Production.** Adaptability, breeding, feeding, care and management of commercial and purebred beef cattle. (3 cr; prereq 37, 37A, 62 or §; also offered SSI 1963) Harvey

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; prereq 37, AgBi 6 or ♯) Smith
- 201.* **Advanced Animal Breeding I.** Assigned readings and lectures on more recently proposed techniques and their likely application to farm animals. (3 cr; prereq 162, Agro 136, Zool 171) Rempel
204. **Quantitative Inheritance II.** Selection with reference to population changes in quantitative characters. How information required for predicting effects of selection is obtained. (3 cr; prereq Agro 261) Comstock
205. **Quantitative Inheritance III.** Application of principles in quantitative genetics to improvement of economic species. Selection indexes and choice of breeding systems. (3 cr; prereq 204) Enfield
- 208, 209, 210.* **Animal Husbandry Seminar.** Review of literature and discussion of problems in animal breeding, nutrition, management, meats, and related fields. (1 cr per qtr) Staff
211. **Experimental Methods.** Theory, plan, and conduct of experimental work in animal husbandry. Factors affecting results, sources of error, interpretation of data. (3 cr; prereq Biom 201) Enfield
- 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 37, 37A, AgBi 6 or ♯...AgBi 116 recommended; offered 1962-63 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 interrelationships with other nutrients. (3 cr; prereq 37, 37A, AgBi 6 or equiv or ♯...AgBi 116 recommended; offered 1962-63 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 AgBi 6 or ♯...AgBi 124 recommended; offered 1963-64 and alt yrs) Waibel
- 225.* **Mineral Nutrition.** Principles of mineral nutrition for poultry, swine, sheep, dairy and beef cattle; mineral requirements, interrelationships, utilization, and metabolism are stressed. (3 cr; prereq AgBi 6; offered 1963-64 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 37, 37A, AgBi 6 or ♯...MicB 121, 123 recommended; offered 1962-63 and alt yrs) Kolari

ANTHROPOLOGY

| | | |
|--|---------------------------------------|----------------------------|
| Professor | Associate Professor | Assistant Professor |
| E. Adamson Hoebel Robert F. Spencer | O. Elden Johnson Rupert I. Murrill | James L. Gibbs |

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

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 Anthropology.** Intensive introduction to elements of anthropology. Prehistoric development of man and culture. Analysis of primitive societies as to range and variability of human behavior. Principles of cultural dynamics. (3 cr, §1A or §2A) 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 Δ) Hoebel

- 116.° **Indians of the Southwest.** Prehistoric origins of Southwestern (New Mexico, Arizona, southern Utah and California, and northern Mexico) Indians. Cultures of Pueblos, Navaho, Apache, and Yuman tribes. (3 cr; prereq 2A or 100 or Δ ; offered when feasible) 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) Johnson
- 118.° **Pre-Columbian Civilizations of Middle America.** Prehistoric origins and cultures of Middle-American area. Mayas, Aztecs, and their neighbors. (3 cr; prereq 1A or 100 or Δ) Johnson
- 119.° **Contemporary Middle-American Communities.** Mexican and Guatemalan village communities, particularly those composed entirely or in part of Indian-speaking peoples. Application of anthropological concepts and methods to study of folk cultures. (3 cr; prereq 2A or 100, waived for majors in Latin-American Area Studies) Altschuler
- 120.° **Peoples and Cultures of Africa.** Racial groupings and tribes of Africa, excluding the Mediterranean civilizations. (3 cr; prereq 1A and 2A or 100) Gibbs
- 121.° **Peoples and Cultures of the South Seas.** Oceania, Polynesia, Micronesia, and Melanesia. (3 cr; prereq 1A and 2A or 100 or Δ ; offered when feasible) Murrill
- 124.° **Culture Sphere of China.** Development of Chinese institutions and other cultural manifestations. Their influences in development of cultures of Viet Nam, Korea, and Japan. (3 cr; prereq 2A or 100 or Δ) Spencer
- 125.° **Peoples and Cultures of India.** Primitive tribes, Hindu caste society, and modern communities of India. (3 cr; prereq 2A or 100 or Δ) 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 1A and 2A or 100 or Δ) Spencer
- 127.° **Islamic Culture Sphere.** Mohammed and founding of Islam. Islamic culture as intermediary between (a) classical and ancient Oriental civilizations, and (b) medieval Europe. Legal, political, and theological developments in Islam. (3 cr; prereq 1A and 2A or 100 or Δ) Spencer

Group II—Archaeology

130. **Archaeological Methods and Techniques.** Lectures and laboratory exercises in techniques of excavation, recordation, and methodological interpretations of archaeological data. (3 cr; prereq 90 and $\#$) Johnson
- 132.° **Archaeology of Mississippi Drainage.** Archaeological record of prehistoric cultures of Mississippi River area, Minnesota to Gulf of Mexico. (3 cr; prereq 90; offered 1962-63 and alt yrs) Johnson
- 133.° **Archaeology of Southwest United States.** Archaeological record of prehistoric cultures. Paleo-Indian, Basket Maker, and Pueblo prehistory. (3 cr; prereq 1A or 100; offered when feasible) Johnson
- 136.° **Prehistoric Archaeology of the Old World.** Physical anthropology of pleistocene fossil men. Archaeological record of cultural evolution in Europe, Africa, and Asia. (3 cr; prereq 1A or 100 or $\#$) 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 cr [may be taken for cr only once]; prereq 90 and $\#$) Johnson

Group III—Cultural Anthropology

- 150.° **Contact of Cultures.** Processes of acculturation. Impact of civilizations on native cultures. (3 cr; prereq 1A and 2A or 100) Altschuler
- 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 UNESCO and technical aid, public health, and other administrative activities for native peoples in the modern world. (3 cr; prereq 150 or Δ ; offered 1962-63 and alt yrs) Altschuler
- 152.° **Stability of Cultures.** (3 cr; prereq 2A or 100, or major in other social sciences)
- 154.° **Ethnological Field Techniques.** Field interviewing techniques, recordation, and interpretation of results through report writing. Laboratory exercises with informants from American Indian, African, or Asiatic societies. (3 cr; prereq $\#$; offered when feasible) Gibbs

- 160.^o **Law-Ways of Primitive Man.** Social control, law, and government in primitive societies. Theory and method of comparative legal dynamics. Relation of law to whole cultures. Functions and evolution of law revealed in study of type primitive societies ranging from simplest to most complex. (3 cr; prereq 2A or 100, or major in other social sciences or law) Hoebel, Gibbs
- 161.^o **Primitive Religion.** Beliefs and practices in primitive religious systems, roles of the sacred, the supernatural, and beliefs in continuance of life after death, and role of the dead in life-ways of primitive peoples. (3 cr; prereq 2A or 100) Spencer
162. **Primitive Technology.** Analysis of the material culture of primitive peoples; historical development and distribution; techniques and methods of manufacture; use and function within a society. Problems of art and design. The role of the craftsman in primitive societies. (3 cr; prereq 1A and 2A or 100; offered when feasible) Hatcher
- 163.^o **Economic Activities in Primitive Cultures.** Varied systems of making a living in preliterate groups. Economy of hunting and fishing tribes, primitive agriculturists, and simple herders. Relations between habitat, technology, social organization, and goals and attitudes as focused in the area of economic life. (3 cr; prereq 2A or 100, waived for majors in economics and business administration; offered when feasible)
- 164.^o **Social Anthropology.** Forms of social structure, especially kinship systems and their relation to economic, religious, and politico-legal activities in primitive and folk culture. Theories and methods of structural analysis. (3 cr; prereq 2A or 100) Gibbs
- 165x.^o **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 Δ , waived for majors in public health nursing, psychology, sociology, and social work) Hoebel (f), Spencer (w), Gibbs (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 Δ ; waived for art majors) Hatcher
169. **Comprehensive Survey.** Integrated review of major anthropological concepts, methodologies, and theorists. (3 cr; prereq Δ) Gibbs

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 100 and Δ) Murrill
- 171-172. **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. (8 cr) Murrill
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; prereq 1A or Δ) 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. Comparative adolescent physiology. (3 cr; prereq 1A or Φ , or waived for majors in child development) 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 Δ) Spencer
185. **Language and Culture.** The relation of language to behavior; languages as systems of thought, logic, and orientation and their impact on cultures. Semantics and symbols in linguistic structures around the world; analysis of selected linguistic and cultural systems. Glottochronology. (3 cr; prereq 2A, or 100, or Δ) Spencer
- 190^o-191^o-192.^o **Directed Research.** (Cr ar; prereq Δ) Staff
- 196.^o **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

- 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
- 202.* Proseminar: Introduction to Research Methods.** (3 cr; required of all new grad students) Gibbs
- 204-205-206.* Seminar in Anthropology.** Individually directed research. (3 cr per qtr) Staff
- 240.* Ethnological Field Session.** Field research in social anthropology of American Indian or non-European communities. (Cr ar; offered when feasible)
- 251-252-253. Seminar in Culture and Personality.** (Cr ar)

ARCHITECTURE

Professor

Ralph E. Rapson
Robert G. Cerny
Walter K. Vivrett

Prerequisites—Students with evidence of professional promise may be admitted to the graduate course upon completion of the bachelor of architecture degree or equivalent degree with high academic standing from a professional undergraduate course in architecture at an institution of recognized standing.

Language Requirement—None.

Master's Degree—Offered under Plan A. In special cases Plan B may be accepted when approved by the graduate faculty in architecture.

- 101-102-103. Tutorial Work in History of Architecture.** Reading and written reports on special historical problems. (2 cr per qtr; prereq 53) Koeper
- 104f. Planning.** (Same as Pol 123, Soc 106) Social, economic, political, geographic, and technical phases of modern city planning. (3 cr) Vivrett, Borchert, Sirjamaki, Warp
- 105w. Planning.** Techniques of planning. (3 cr; prereq 104) Vivrett
- 106s. Planning.** Housing. (3 cr; prereq 104) Vivrett
- 107. Dwelling Unit Design.** Open to seniors and graduates in home economics. (2 cr) Vivrett
- 110f. Planning.** Field and laboratory work in planning. (Cr ar; prereq 105) Vivrett
- 115. Skeleton Frame Structures.** Contemporary structural systems composed with linear elements; investigation into their behavior and their relationship to form and space. (3 cr; prereq MM 92)
- 116. Surface Resistant Structures.** Contemporary structural systems composed with planar elements; investigation into their behavior and their relationship to form and space. (3 cr; prereq 115)
- 126. Professional Relations.** Relations of the architect to clients, contractors, and fellow practitioners. Procedures of architectural practice. (3 cr) Cavin
- 201.* Special Research in Architectural History.** (Cr ar; prereq 53) Koeper
- 231-232-233.* Planning.** Individual problems and research in planning work. (Cr ar; prereq consent of grad adviser in School of Architecture)
- 251-252-253.* Architectural Design VI.** Problems involving individual research in either composition or construction. (Cr ar; prereq 123 or equiv) Cerny, Rapson

ART

Professor

Donald Torbert
Allen Downs
Lorenz Eitner
Malcolm H. Myers
Walter Quirt
Josephine L. Rollins
John Rood

Hylton A. Thomas
Dimitri T. Tselos

Associate Professor

Jerome Liebling
Warren MacKenzie
Sidney Simon
Melvin Waldfogel

Assistant Professor

Marion Nelson

Prerequisites—For the *master of arts degree*, undergraduate preparation of approximately 27 Upper Division credits in the history of art or its equivalent.

For the *master of fine arts degree*, admission to candidacy is limited to students who provide evidence of exceptional promise as creative artists in one or more of the following subfields: painting, printmaking, sculpture, design (film and photography, ceramics).

Language Requirement—For any of the 4 Master's degrees, reading knowledge of 1 foreign language, French or German. For the Ph.D. degree, two foreign languages, preferably German and French.

Master of Arts Degree (Art History and Criticism)

Plan A—The thesis subject and major work will be in the historical aspects of art. A total program of 36 credits and a thesis are required.

Plan B—The candidate will offer a program of 45 credits, of which 27 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, after completion of Museology I. A very limited number of candidates can be accepted.

To earn the degree a candidate must offer 50 credits of course work, of which 27 will be earned in art history, 3 in Museology I, with the 20 additional credits (which comprise the internship program) earned in full-time apprentice work in 2 of the participating museums.

Master of Fine Arts Degree (Studio)—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, and submit a thesis in the form of creative work supported by a critical or research paper. Eighteen quarter credits will be earned in courses in the history and criticism of art. The remainder of the credits will be in studio courses in art and in such areas of study outside the Department of Art as are approved for the individual student by the M.F.A. committee.

Doctor's Degree—Work is offered leading to the Ph.D. degree in the history and criticism of art.

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.

History of Art

100f. Art in Ancient Egypt, Mesopotamia, and Greece. Architecture, sculpture, and painting of the pre-Hellenic civilizations in Egypt, Mesopotamia, and the Aegean. Development of Greek art from beginning to Periclean age. (3 cr; prereq ***) Eitner, Tselos

** Nine credits in history of art or 9 credits in literature or history with consent of department.

- 101w. Hellenistic Through Early Christian Art.** Art of Hellenistic kingdoms. Hellenic and Etruscan art in Italy. Art of Roman Empire. Transformation of classical styles under influence of Oriental traditions and of Christian religion. Development of Christian art. Art of Byzantine Empire. Survivals of classical forms in early medieval art. (3 cr; prereq **) Eitner, Tselos
- 102s.* Romanesque and Gothic Art.** Development of architecture, sculpture, and painting in western Europe and Italy from 10th to 15th century. Art of cathedrals. Romanesque and Gothic monumental and manuscript painting. Development of Gothic art as manifestation of currents in medieval culture. (3 cr; prereq **) Eitner, Tselos
- 110. Art of India.** Development of architecture, painting, sculpture, and the minor arts. (3 cr; prereq **; offered when feasible) Rundorff
- 111. Art of China.** Development of painting, sculpture, and minor arts from earliest times to present. (3 cr; prereq **...Hist 62-63 recommended) Mather
- 112. Art of Japan.** Development of painting, sculpture, and minor arts in Japan from earliest times to present. (3 cr; prereq **; offered when feasible) Copeland
- 116f. Fifteenth-Century Painting in Europe.** Major trends and artists. Renaissance in Florence (Masaccio and followers; Fra Angelico and Fra F. Lippi; leading later 15th-century masters—Pollaiuolo, Ghirlandaio, Botticelli), in Umbria (Piero della Francesca, Perugino, Signorelli), in Padua (Mantegna), and in Venice (Antonello da Messina, the Bellini family). Early Renaissance in France, Flanders, Germany. (3 cr; prereq **; offered 1963-64 and alt yrs) Thomas
- 117w. Sixteenth-Century Painting in Europe.** Masters of High Renaissance in Florence (Da Vinci, Fra Bartolommeo, Sarto), Rome (Raphael, Michelangelo), Parma (Correggio), and Venice (Giorgione, Titian, Tintoretto, Veronese). Mannerism in Italy and the North. French, Flemish (Bosch, Brueghel), and German masters (Dürer, Grünewald, Holbein, the Danube School). (3 cr; prereq **; offered 1963-64 and alt yrs) Thomas
- 118s.* Seventeenth-Century Painting in Europe.** Baroque beginnings in Italy (Caravaggio, the Carracci, and their schools). Roman, Neapolitan, and North Italian high baroque. Seventeenth-century landscape painting in Italy (Rosa), France (Poussin, Lorrain), and Holland. French baroque painting; Dutch baroque masters (Rembrandt; the portraitists; genre painters); Spanish baroque masters (Velazquez, Ribera, Zurbaran). (3 cr; prereq **; offered 1963-64 and alt yrs) Thomas
- 126f-127w-128s.* Eighteenth-Century Art.** Italian, French, German, and English architecture, sculpture, painting, and decorative arts of the 18th century. In each quarter independent discussion of major personalities, styles, regions, and problems of iconography. (3 cr per qtr; prereq **; offered 1962-63 and alt yrs) 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 1963-64 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 1962-63 and alt yrs) Thomas
- 136f. Art in the United States.** Origins. Painting, sculpture, and architecture through the Revolution. Relations with England and the European continent. Copley, Stuart, West, and their followers. Early weeks of the quarter are devoted to analysis of means of visual expression common to architecture, sculpture, and painting. (3 cr; prereq **) Torbert
- 137w. Art in the United States.** Jefferson and his influence. Rise of a national style in landscape and realistic genre. Homer, Eakins, Ryder, and their influence. Artistic relations with Europe after the Civil War. Beginnings of modern architecture. (3 cr; prereq **) Torbert
- 138s.* Art in the United States.** Contemporary movements. Armory Show, modern realism, expressionism, and abstraction. Frank Lloyd Wright and modern American architecture. (3 cr; prereq **) Torbert
- 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

** Nine credits in history of art or 9 credits in literature or history with consent of department.

- 141w. Scandinavian Painting.** Medieval 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
- 142s. Scandinavian Sculpture and the Minor Arts.** Decorative wood carving from Viking period to 19th century; wood sculpture of Middle Ages. Modern period represented chiefly by Carl Milles, Gustav Vigeland, and Kai Nielsen. Section on jewelry and metal will concentrate on pre-Christian era; present day will be emphasized in discussion of ceramics and glass. (3 cr; prereq ***) Nelson
- 146f. European and American Architecture: 1775-1850.** Revivalist and progressive movements; neoclassic and neo-Gothic styles; genesis of modern style under rationalism and industrial revolution. Contributions of important architects of France, England, and United States. (3 cr; prereq **) Tselos
- 147w. European and American Architecture: 1850-1900.** Victorian Gothic eclecticism, and modern pragmatism in architecture within historical and antihistorical currents; influence of Victorian Gothic and French academism on American architecture and divergent reactions. (3 cr; prereq **) Tselos
- 148s.* Modern Architecture: 1900-1950.** Protomodern architecture in European and American centers; new international style in its various phases; its relation to modern sculpture and painting and its meaning in the new aesthetic directions. (3 cr; prereq **) Tselos
- 156f-157w-158s.* European and American Painting: 1775-1900.** Neoclassicism and neobaroque romanticism; modern realism in France, England, and the United States; landscape painting—importance for the realist movement. Realist painting in Courbet's time and its climax in impressionism; postimpressionist reactions and their significance for modern art; diffusion of impressionist and postimpressionist phases in America; conservative lag in pre-Raphaelite England. (3 cr per qtr; prereq **; offered 1962-63 and alt yrs) Eitner
- 166f. The Renaissance Tradition in Sculpture.** Rapid survey of sculptural background from 15th to mid-18th centuries; neoclassic movement in Europe and America; academic and realistic currents culminating in impressionistic realism of Rodin. (3 cr; prereq **) Tselos
- 167w. Origins of Modern Sculpture.** Rodin, Maillol, and streams of classicism and romantic realism. Painters as sculptors. German expressionism; the direction toward the archaic, primitive, and medieval. Impact of abstract painting. (3 cr; prereq **) Tselos
- 168s.* Contemporary Sculpture.** Constructivism and experiments with new materials. Kinetic sculpture. Growing influence of the United States. New directions in English and Italian sculpture. Problems of realism and abstraction at the mid-century. (3 cr; prereq **) Tselos
- 176f-177w-178s.* † Twentieth-Century European and American Painting.** Growth of modern painting and of postimpressionist inheritance; French Fauves and German expressionists; impact of primitive art and its assimilation in cubism; purist defections and rise of Dada and surrealism; the new objectivity, the new romanticism, and the new eclecticism; attention to peculiarly American assimilation of European phases of painting. (3 cr per qtr; prereq **) Simon, Waldfoegel, Tselos
- 186f. The Art of the Film.** Aesthetics of the film medium. Motion picture as an art form. Discussions of editing, montage, sound, use of camera, etc. Illustrated with feature-length films and short subjects. (3 cr; prereq 87 or Δ) Amberg
- 196f-197w-198s. † Readings in Art History and Criticism.** (3 cr per qtr; prereq Δ) Eitner, Thomas, Torbert, Tselos
- 206f-207w-208s. Seminar: European and American Architecture.** (3 cr per qtr; prereq **) Tselos
- 216f-217w-218s. Seminar: European and American Painting and Sculpture.** (3 cr per qtr; prereq **) Graduate staff
- 226. 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 Δ) Simon
- 227-228-229-230.* 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 226 and Δ) Simon
- 236f-237w-238s. Seminar Problems in Art History and Criticism.** (Cr ar; prereq Δ) Graduate staff
- 250f-251w-252s. Seminar.** Creative and critical research and methodology. (No cr; may be required of grad students in art history; prereq consent of grad adviser) Graduate staff

** Nine credits in history of art or 9 credits in literature or history with consent of department.

Studio Courses

- 113-114-115. Design in Jewelry.** Problems of design. Techniques of soldering, forming, forging. Lectures correlate contemporary craft movement with modern art (a wide range of problems gives art education students background for setting up or carrying on adequate high school teaching program). (3 cr per qtr; prereq 25 and **; offered when feasible)
- 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 54 or equiv, §70-71-72) 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 Δ) Downs, Liebling
- 150-151x-152x. Problems in Painting.** (Cr ar; prereq 72 and Δ) Quint
- 180x-181x-182x. Problems in Sculpture.** Advanced work in wood, stone, plaster, metal, and other materials of sculpture. Students work individually on projects. (Cr ar; prereq 82, 82A or Δ) Rood
- 190x-191x-192x. Problems in Printmaking.** Advanced work in black and white and color in metal, lithograph, and wood block. (Cr ar; prereq 92 or Δ) Myers
- 193x-194x-195x. Advanced Problems in Design.** Creative problems in design with guidance in practice and research methods. Discussions of common denominators of art in ceramics, film, and photography. Aesthetic, economic, and social implications of design. (Cr ar; prereq §) Graduate staff
- 200x-201x-202x. Advanced Problems in Studio Work.** (Cr ar; prereq §) Graduate staff
- 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

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 Gènevoise.

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.

Master's Degree—Offered under Plans A and B.

- 101. Celestial Mechanics.** (3 cr; prereq Math 51 or ITM 25) Luyten
- 104f-105w-106s. Celestial Mechanics.** The two-body problem. Computation of an ephemeris. Determination of an orbit from observations. 105: Numerical methods for computation of perturbations. Lagrange solutions to the three-body problem. External potential of the earth. Precession and nutation. Libration of the moon. 106: Hamilton-Jacobi theory. General perturbations. Motion of a satellite in the field of an oblate planet. Theory of the motion of the moon. (3 cr per qtr; prereq Math 59)
- 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

** Prerequisite is 9 credits in history of art or 9 credits in literature or history with consent of department.

BIOMETRICS

Courses in Which Graduate Credit May Be Earned

100. **Introduction to Statistical Analysis I.** Introduction to statistical procedures in agricultural research; tests of significance, simple regression and correlation analyses, introduction to analysis of variance. (4 cr; prereq college algebra and 90 or grad) Gates
101. **Introduction to 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) Gates
201. **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) Sentz

BIOPHYSICS

*Committee:***Professor**

Rufus W. Lumry, *chairman*
 Robert M. Benolken
 Kenneth N. Ogle*
 A. Glenn Richards
 Otto H. Schmitt
 Carlo A. Terzuolo

*Staff:***Professor**

Edward J. Baldes
 Kenneth N. Ogle
 Otto H. Schmitt
 Marvin M. D. Williams

Associate Professor

Eugene Ackerman

Assistant Professor

Robert M. Benolken, Ph.D.
 Alan L. Orvis, Ph.D.

Additional staff for course work in biophysics is drawn from the departments of Botany and Zoology, from the School of Physics, the School of Chemistry, the Medical School, and from the Mayo Clinic.

Prerequisites—Basic preparation in botany, zoology, physics, chemistry, and mathematics with an undergraduate major in one of these subjects is required.

Language Requirement—For the Master's degree, reading knowledge of one foreign language (Russian or German is recommended). For the Ph.D. degree, reading knowledge of 2 foreign languages 1 of which should be Russian or German. In special cases where another language is needed for development of the thesis it may be substituted by petition.

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 pervading other 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 a core of biophysics 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 in Biophysics and General Physiology.** (Cr ar) Staff

Zool 153. **Molecular Biology.** (3 cr; offered 1963-64 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 (biostatics) as revealed by hyper-microscopy, 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 general 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. **Radiobiology Seminar.** 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. **Radioisotope Seminar.** (1 cr; prereq #) Loken

296°-297°-298.° **Seminar in Biophysics.** (Cr ar) Schmitt, Benolken

BIostatistics

Professor

Jacob E. Bearman, Ph.D.
Joseph Berkson, M.D., D.Sc.
Richard B. McHugh, Ph.D.
I. Richard Savage, Ph.D.

Associate Professor

Byron W. Brown, Jr., Ph.D.

Assistant Professor
Marion W. Thornton, Ph.D.

Instructor

Franklin W. Briesse, M.S.
Ruth Loewenson, M.S.

Prerequisites—For major work, completion of the premedical curriculum. Acceptable alternatives include the equivalent of an undergraduate major in 1 of the following 2 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) 2 foreign languages or (b) 1 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. [See the *Bulletin of the School of Public Health* for the master of public health degree.]

Doctor's Degree—Work for the Ph.D. degree is offered in accordance with the general requirements of the Graduate School.

For students minoring in biostatistics the sequence PubH 110-111, 120-121, 130-131, or equivalent, is required. The remainder of the program should be planned with the minor adviser before any other courses in the minor are taken.

PubH 110. Biostatistics I. Role of statistics in research; estimation; sampling distribution; tests of significance; power; regression; correlation; other measures of association; standard distributions including normal, t , χ^2 , F , binomial, Poisson; special distributions arising from non-parametric procedures. (3 cr; prereq ¶111, Math 10 or #) Bearman, Brown

PubH 111f, 121w. Biostatistics Laboratory I, II. Presentation of data; descriptive statistics; coding and short-cut computational procedures; use of desk calculators; practical application of principles and methods covered in 110 and 120. (2 cr per qtr; prereq for 111, ¶110...for 121, ¶120) Briesse, Loewenson

PubH 120. Biostatistics II. Continuation of 110. (3 cr; prereq ¶110 with grade not lower than C, ¶121) Brown, Bearman

PubH 130s.° Biostatistics III. Principles and methods of analysis of components of variance and effects in surveys and experiments; 1-way, 2-way, and higher nested, crossed, or mixed classifications; simple and multiple analysis of covariance. (3 cr; prereq 120 with grade not lower than C, ¶131) Bearman, Brown

PubH 131s. Biostatistics Laboratory III. Practical exercises associated with 130. (2 cr; prereq ¶130) Briesse, Loewenson

PubH 140f. Vital Statistics I. Official sources; population changes; rates; trends; significant differences. (3 cr) Bearman, Thornton

- PubH 150.* Vital Statistics II.** Life table techniques and follow-up studies; survivorship curves; problem of bias and selection connected with retrospective studies. (3 cr; prereq #) Staff
- 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 120, 130 and #) Bearman and staff
- PubH 203f*-205w*-207s.* 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 130 or #) McHugh
- PubH 204f*-206w*-208s.* 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 ¶203-205-207) McHugh
- PubH 211x.* Seminar in Biometry.** (Cr ar) Graduate staff
- PubH 216f*-218w.* Biomedical Measurement Problems, Assays.** Qualitative and quantitative response surface assays, density determination by plate counts and serial dilution, source and magnitude of variation associated with advanced measurement techniques. (3 cr per qtr; prereq 120 or #) Brown
- PubH 217f*-219w.* Theory of Biomedical Measurement Problems, Assays.** (2 cr per qtr; prereq ¶216-218 and #) Brown
- PubH 250f*-251w*-252s.* Foundations of Biometry.** Measurement models, theories of probability, logic of induction, alternative theories of inference. (2 cr per qtr; prereq 208, 219 or #) Staff

BOTANY

Professor

Gerald B. Ownbey
Ernst C. Abbe
Allan H. Brown
A. Orville Dahl
Albert W. Frenkel
Donald B. Lawrence

Associate Professor

Eville Gorham
John W. Hall
Thomas Morley
Richard E. Norris

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 or German. For the Ph.D. degree, 2 languages, 1 of which must be 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 plant pathology and mycology, see Plant Pathology; for courses in genetics and cytogenetics, see Agronomy and Plant Genetics, Genetics, and Zoology.

- 103f. Plant Embryology.** Early stages of somatic development with emphasis on vascular plants. (3 cr; prereq 54 or 104 or #; offered when feasible) Abbe
- 104s. Survey of the Plant Kingdom.** A brief consideration of evolutionary relationships throughout the plant kingdom, illustrated by life histories. (5 cr, §54; prereq 3 or 5 or Biol 2 or NSci 9) 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 1962-63 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 1963-64 and alt yrs) Ownbey
- 110f. Gymnosperms.** Taxonomy and phylogeny of gymnosperms; emphasis on living representatives. (3 cr; prereq 52 or #; offered 1962-63 and alt yrs) Ownbey
- MicB 112w. General Mycology.** (3 cr; prereq MicB 53 or #) Bradley
- 112su.* Aquatic Flowering Plants.** The higher plants of aquatic and marsh habitats. Identification and adaptive morphology. (6 cr; prereq 10 cr in biology, 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 1963-64 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.** (Offered only at Itasca Biology Session) (6 cr; prereq 10 cr in biology or #)
- 118f. 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, cytotoxicology, and cytochemistry. (5 cr; prereq 10 cr in biology, botany, or zoology, elementary genetics or #) Dahl
- 119w.* Experimental Cytology.** Experimental analysis of suitable, specialized phases of cytological materials. Application of phase contrast and electron microscopy, together with other specialized methods, to analyses of cells *in vivo* and *in vitro*. Use of tissue culture methods in cytology. (5 cr; prereq 118 or Zool 161; offered 1962-63 and alt yrs) Dahl
- 120s.* Research Methods in Cytology.** Principles and practice in preparing materials for cytological investigation; methods of investigating such preparations and presenting the results. (3-5 cr; prereq 3 or 5 or Biol 2 or old NSci 9, 118 or 119, and #; offered 1962-63 and alt yrs) Dahl, Hansen
- 121w.* Plant Anatomy.** Microscopic structure of vascular plants; development in root, stem, and leaf. (5 cr, §53; prereq 10 cr in botany or zoology) Abbe, Hall
- 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 1963-64 and alt yrs) Abbe
- 127f.* Morphology of Vascular Plants.** Vegetative and reproductive structure of living and fossil vascular plants. Their evolutionary relationships based on phylogenetic principles. (5 cr; prereq 54 or 104 or #; offered 1962-63 and alt yrs) Abbe, Hall
- 128s. Introduction to Paleobotany.** Identification and structure of fossil plants. Relationship of fossil plants to modern groups. (3 cr; prereq #) Hall
- 130f.* General Plant Ecology.** Introduction to interrelations of plants and environment, to provide a foundation for further ecological work in pure or applied fields, and to provide a basis for understanding relationships of man to biotic resources. (3 cr, §50; prereq 10 cr in botany or biology) Lawrence
- 130Af. General Plant Ecology Laboratory.** Laboratory and field exercises to accompany Bot 130. (2 cr, §50A; prereq 10 cr in botany or biology or #) Gorham
- 133w.* Phytogeography.** Ecological principles of plant distribution and landscape analysis, vegetation regions of North America, interpretation of regional vegetation patterns. (3 or 5 cr; prereq 50 or 130 or #)
- 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. (6 cr; prereq 10 cr in biology or #; offered only at Itasca Biology Session)
- 136su. Organism, Microclimate, and Weather.** (6 cr; prereq 10 cr in biology, botany, or zoology... physics recommended; offered only at Itasca Biology Session)
- 137s.* Advanced Ecology.** Ecological life history studies; 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 50 and 50A or 130 and 130A, 51 or 140 with lab, and #) Lawrence

- 140s. Advanced Survey of Plant Physiology.** Major topics in plant physiology. Cell physiology including: membrane phenomena, enzyme catalysis, respiration, fermentation, and photosynthesis; mineral nutrition; water metabolism; translocation of solutes; growth; hormones; tropisms. (3 or 5 cr [students registering for 5 cr will take lab work in use of modern methods and apparatus for physiological research]; students who have had Bot 51 should not enroll in 140; prereq elementary course in botany, zoology, or biology, or #, and a course in organic chemistry or biochemistry) Brown
- 150f.* Phycology I.** Reproduction, anatomy, and phylogeny of algae including green algae, Euglenophyta, Chrysophyta, and Dinoflagellates. (5 cr; prereq 10 cr in botany or biology or #; offered 1962-63 and alt yrs) Norris
- 151f.* Phycology II.** Reproduction, anatomy, and phylogeny of algae including brown algae, red algae, and blue-green algae. (5 cr; prereq 10 cr in botany or biology or #; offered 1963-64 and alt yrs) Norris
- 154. Spectroscopy and Photochemistry Applied to Biology.** (3-5 cr; offered when feasible)
- 155s,su. Fresh-Water Algae.** Morphology and taxonomy of fresh-water algae; collection and identification of local algae. (4 or 6 cr; prereq 10 cr in biology or #; in summer offered only at Itasca Biology Session)
- 157su. Bryophytes and Pteridophytes.** (6 cr; prereq 10 cr in biology or #; offered only at Itasca Biology Session)
- 165w. Introduction to Pollen Analysis.** Ontogeny, comparative morphology, and identification of pollen grains; preparation of reference collections, applications of pollen analysis to allergy, ecology, and phylogeny; practice in atmospheric analysis. (3 cr; prereq 10 cr in biology or #; offered 1963-64 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 Zool 161 or #; offered 1963-64 and alt yrs) Dahl
- 177w. Photosynthesis.** Detailed survey of the present state of knowledge of photosynthesis. (3 cr; prereq #) Brown, Frenkel
- 182f. Advanced Topics in Plant Physiology.** Mineral metabolism (1963); plant growth and development (1964). (3 cr; prereq 51 or 140 or #) Brown, Frenkel
- 185w.* Physiology of Photosynthetic Microorganisms.** Primarily a laboratory course. Application of spectrophotometry, manometry, and other techniques toward elucidation of physiological behavior, chemical make-up, and intermediary metabolism of algae and photosynthetic bacteria. Suitable as a laboratory course accompanying Bot 177. (3-5 cr; prereq #; offered 1962-63 and alt yrs) Frenkel
- 194su.* 195su.* 196su.* 197f.* 198w.* 199s.* Problems.** Advanced work in a specialized field. (1-5 cr per qtr; prereq 20 cr in natural science and #)
- 201f.* 202w.* 203s.* 204su.* Research Problems in the Morphology of Vascular Plants.** (Cr ar) Abbe
- 205f.* 206w.* 207s.* 208su.* Research Problems in Taxonomy.** (Cr ar) Ownbey, Morley
- 209f.* 210w.* 211s.* Research Problems in Paleobotany.** (Cr ar) Hall
- 221f.* 222w.* 223s.* 224su.* Research Problems in Ecology.** (Cr ar) Lawrence, Gorham
- 225f.* 226w.* 227s.* 228su.* Research Problems in Plant Physiology.** (Cr ar) Brown, Frenkel
- 229f.* 230w.* 231s.* 232su.* Research Problems in Cytology.** (Cr ar) Dahl
- 233f.* 234w.* 235s.* 236su.* Research Problems in Phycology.** (Cr ar) Norris
- 240f, 241w, 242s. Seminar: Morphology.** (1 cr per qtr) Abbe
- 243f, 244w, 245s. Seminar: Taxonomy.** (1 cr per qtr) Ownbey, Morley
- 246f, 247w, 248s. Seminar: Paleobotany.** (1 cr per qtr) Hall
- 249f, 250w, 251s. Seminar: Ecology.** (1 cr per qtr) Lawrence, Gorham
- 252f, 253w, 254s. Seminar: Plant Physiology.** (1 cr per qtr) Brown, Frenkel
- 255f, 256w, 257s. Seminar: Cytology.** (1 cr per qtr) Dahl
- 258f, 259w, 260s. Seminar: Cryptogamic Plants.** (1 cr per qtr) Norris

BUSINESS ADMINISTRATION

Professor

Albert K. Wickesberg
 George W. England
 Richard K. Gaumnitz
 Paul V. Grambsch
 Robert S. Hancock
 Delbert C. Hastings
 Herbert G. Heneman, Jr.
 Robert J. Holloway
 Richard L. Kozelka
 Edwin H. Lewis

Thomas A. Mahoney
 Carl L. Nelson
 John Neter
 Edmund A. Nightingale
 George Seltzer
 C. Arthur Williams, Jr.

Associate Professor

Robert G. Berryman
 Ernestine C. Donaldson
 Nicholas Glaskowsky

Donald V. Harper
 Reuel I. Lund
 Harold W. Stevenson

Assistant Professor

Gordon B. Davis

Lecturer

Philip T. Meyers

Master of Business Administration

1. **Purpose**—This degree is offered for students who desire unspecialized training for business leadership. The program can be completed in 1 to 2 years, depending on the candidate's undergraduate preparation.

2. **Admission Requirements to Second-Year Work**—Students can proceed to the second-year work in the M.B.A. program in 1 of the following 3 ways:

- a. Holders of the bachelor of science in business degree from the University of Minnesota or the equivalent degree from another institution will normally be allowed to proceed immediately to the second-year work of the M.B.A. program.
- b. Students with little or no previous preparation in business and economics will take the following core program before being permitted to begin the second-year work of the M.B.A. program: 2 introductory courses in managerial accounting (Acct 155A-B) and 1 introductory course in each of the following: managerial economics (Econ 165), national income and employment (Econ 166); money and banking, public finance, statistics (QA 151), business law (BLaw 158), business finance (BFin 156), insurance (Ins 153); labor economics and industrial relations (IR 152), marketing (Mktg 157), production management (Prod 150), transportation (Tran 154), and fundamentals of management (Mgmt 150A). This core program can normally be completed in 1 year.
- c. Students with some previous preparation in business and economics must take such additional courses as to enable them to meet substantially the core requirements in paragraph 2b.

Courses in the first-year core in paragraph 2b, or any other equivalent courses used to satisfy the admission requirements to the second-year work, may not be used for meeting the second-year requirements of the M.B.A. degree.

3. **Second-Year Work**—The second-year work in the M.B.A. program consists of the following:

- a. **Core**—21 credits in the following courses: 6 credits in Quantitative Approaches to Administrative Problems, 6 credits in Government and Business Enterprise, 3 credits in Executive Leadership, 3 credits in Policy Formulation and Administration, and 3 credits in Business Research Methods and Techniques.
- b. **Additional Courses**—24 credits selected from courses in at least 4 of the following 9 subfields, with a minimum of 6 credits each in at least 2 subfields and a maximum of 9 credits in any 1 subfield:

Accounting
 Business Finance
 Industrial Management and Administration
 Industrial Relations
 Insurance

Marketing
 Office Management
 Statistics
 Transportation

Credits earned in any major field of the Graduate School may be substituted for 1 of the 9 subfields in business administration.

- c. *Written Reports*—At least 9 credit hours of the requirements in paragraphs 3a and 3b must be earned in courses requiring the preparation of written reports representing the quality but not the range of a Master's thesis. Students may use any courses for meeting this requirement, subject to the approval of the major adviser and the instructor.
- d. *Final Examination*—All candidates will be required to take a final written examination. The graduate faculty in business administration also reserves the right to examine any candidate orally.
- e. *Foreign Language*—A foreign language is not required.

Master of Science

1. **Purpose**—This degree is offered for students who desire specialized training in a particular subfield of business. The M.S. degree is offered under either Plan A or Plan B.

2. **Admission Requirements, Plan A and Plan B**—To be admitted to the M.S. program, students must have completed satisfactorily:

- a. 6 credits in economics, and
- b. Introductory courses or their equivalent in 5 of the following 8 subfields of specialization:

| | |
|--|----------------|
| Accounting | Insurance |
| Business Finance | Marketing |
| Industrial Management and Administration | Statistics |
| Industrial Relations | Transportation |

If a student has not completed these admission requirements as part of his previous college work, he may take the required courses in the School of Business Administration and then be admitted to the M.S. program.

Courses used to satisfy the admission requirements may not be used for meeting the M.S. requirements.

3. **Degree Requirements, Plan B (without thesis)**—

- a. *Course Requirements*—45 quarter credits in graduate courses divided between:

MAJOR FIELD OF CONCENTRATION—A minimum of 21 and a maximum of 27 credits in 1 of the 8 subfields of specialization given in paragraph 2b. Upon approval of the adviser two of these subfields of specialization may be considered as the field of concentration.

RELATED FIELDS—A minimum of 18 and a maximum of 24 credits in 2 or more related fields with a minimum of 6 credits in each of these fields. The related fields are to be selected from among those subfields of specialization in business administration not offered in the major field of concentration or any other major field in the Graduate School. Where the undergraduate program has been concentrated in business administration, one related field must be selected from outside business administration.

It is strongly recommended that, wherever appropriate, such courses as Quantitative Approaches to Administrative Problems, Policy Formulation and Administration, Executive Leadership, Government and Business Enterprise, and Business Research Methods and Techniques be utilized toward fulfilling the requirement for related fields.

- b. *Written Reports*—At least 9 credit hours of the above requirements must be earned in courses requiring the preparation of written reports representing the quality but not the range of a Master's thesis. Students may use any courses for meeting this requirement, subject to the approval of the major adviser and the instructor.
- c. *Final Examination*—A final oral or written examination is required.
- d. *Foreign Language*—A foreign language is not required.
4. **Degree Requirements, Plan A (with thesis)**—
- a. *Major Field of Concentration*—18 credits in business administration. At least 12 credits must be in 1 of the 8 subfields of specialization given in paragraph 2b. Upon approval of the adviser, courses within business administration but outside the subfield of specialization may be considered as part of the subfield of specialization.
- b. *Minor Field*—9 credits in a related field outside business administration.
- c. *Thesis*
- d. *Final Examination*—A final oral or written examination is required.
- e. *Foreign Language*—A foreign language is not required.

Doctor of Philosophy

1. For admission to this program, a prospective candidate will be expected to meet the substantial equivalent of the core group requirement for the B.S. with a major in business. This requirement may also be satisfied by an M.B.A. degree from an accredited institution. Prospective candidates for this degree are also urged to obtain the Master's degree first.

2. Students must pass (a) 2 written examinations in a field of concentration from Group A below; (b) 1 written examination in each of 2 of the following 3 subfields: business statistical methods and/or operations research, economic theory, and management theory; and (c) a written examination in 1 *other* subfield chosen from Group A or Group B below. [If statistics and/or management are chosen under (b), they cannot be used to meet requirement (c).] Further, satisfactory completion of at least 9 credits of graduate course work in business statistical methods and/or operations research, economic theory, or management theory is also required if the student elects not to take an examination in that subfield.

| Group A | Group B |
|--|-----------------------------|
| Accounting | European Economic History |
| Business Finance | History of Economic Thought |
| Industrial Relations | Industrial Organization |
| Insurance | International Economics |
| Industrial Management and Administration | Manpower Economics |
| Marketing | Monetary Theory |
| Statistics | Public Finance |
| Transportation | |

With the consent of the adviser, an examination in an additional Group A subfield may be substituted for the second examination in the field of concentration. A student whose field of concentration is statistics must take 2 examinations in that field, plus 1 examination in either economic theory or management theory, and 2 examinations in other subfields, at least 1 of which must be in Group A. A student whose

subfield of concentration is management must take 2 examinations in that field, 1 examination in either economic theory or business statistical methods and/or operations research, and 2 examinations in other subfields, at least 1 of which must be in Group A.

3. No courses or subfields included in the minor may be included in the major.

4. Within a reasonable time after successful completion of preliminary written examinations, students will take an oral examination. This examination may cover any work in the student's approved graduate program with the exception of the thesis. Successful completion of this examination formally admits the student to candidacy for the degree.

5. Reading knowledge of 2 foreign languages or reading knowledge of 1 foreign language and either a collateral field or an approved research technique is required.

6. The written examinations will be given only at stated periods, generally in March, June, September, and December.

Industrial Relations—See index for page reference to this program.

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, §old 70, §old 160, §old 170) Glaskowsky

Mgmt 250. Executive Leadership. Development of leadership abilities in areas of superior-subordinate relationships, conference leadership, communications both oral and written. Case studies, role playing, conference groups, and discussions used in presenting individual and group situations for the student to resolve. (3 cr; prereq 2nd yr grad or equiv) Glaskowsky

Mgmt 260. Policy Formulation and Administration. Integrating course in area of policy formulation and administration. Duties and responsibilities of top management in establishing objectives and in 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 2nd yr grad or equiv) Wickesberg and others

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, §70; prereq 2nd yr grad or equiv)

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 360. Seminar in Management. (3 cr; prereq 260 or equiv) Gaumnitz and others

Production

Prod 100. Problems in Production Management. Current problems and techniques in the area of production management. Builds upon the introductory course in developing maturity and insight into production factors. Problem areas similar to those in the introductory course. (3 cr; prereq 50 or equiv) Glaskowsky

- Prod 110. Systems and Procedures Analysis: Work Measurement.** Role of work standards, analysis of work relationships for both individual and group, development of standard procedures, work simplification. Methods of establishing standards of output relative to the time factor. Develops awareness of concepts as well as analytical approach to work relationships. (3 cr; prereq 50 or equiv) Wickesberg
- 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, §old 150; prereq 150A or §) Gaumnitz
- Prod 290A. Readings in Production.** Intensive research into a particular subject; with 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.** 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)
- Prod 350. Seminar in Production.** (3 cr; prereq 100 or equiv)

Statistics

- QA 151. Elements of Statistics.** Sources, collection, and presentation of statistical data; frequency distributions, probability, sampling; introduction to statistical estimation and decision-making; introduction to time series analysis. (3 cr, §5, §Soc 45; prereq Math 10 or equiv) Neter and others
- QA 161. Business Statistics.** Basic concepts of regression and correlation; statistical estimation and decision-making, with applications to such fields as survey sampling, acceptance sampling, and statistical quality control; index numbers. (3 cr, §51; prereq 151 or equiv) Neter and others
- 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 161 or equiv) Hastings
- 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 161 or equiv) 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 161 or Econ 121A or §, 191A for 191B) Neter
- QA 291A. Readings in Statistics.** 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 instructor in field covered)
- QA 291B. Graduate Research in Statistics.** (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 121A-B-C—Theory of Statistics
- Econ 181A, B, C—Topics in Statistics
- Econ 201A—Econometrics A
- Econ 201B—Econometrics B
- Econ 201C—Econometrics C
- Econ 301—Seminar in 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. Principles of Industrial Relations: Labor Marketing.
- IR 172. Principles of Industrial Relations: Manpower Management.
- IR 182A. Intermediate Labor Marketing.
- IR 182B. Intermediate Manpower Management.
- IR 192. Industrial Relations Practices and Techniques.
- IR 202. Organization and Staffing.
- IR 212A. Labor Education.
- IR 212B. Employee Development and Training.
- IR 222. Wage and Salary Administration.
- IR 232. Collective Bargaining Policies and Practices.
- IR 242. Management Development.
- IR 262, 272, 282. Graduate Topics in Industrial Relations.
- IR 292A. Readings in Manpower Economics and Industrial Relations.
- IR 292B. Graduate Research in Manpower Economics and Industrial Relations.
- IR 352. Seminar: Labor Marketing.
- IR 362. Seminar: Manpower Management.
- IR 372. Seminar: Industrial Relations Research Methods.
- IR 382. Seminar: Current Industrial Relations Research.

See also the following courses in economics in the subfield of labor.

IR 162—Union Government and Policies

Econ 182—Economic Security

Insurance

- Ins 113. Actuarial Science Principles—Personal Insurance. Construction and characteristics of mortality and morbidity tables; computation of life and accidental injury and sickness insurance premiums and reserves; nonforfeiture values; dividend calculations. (3 cr, §Math 21; prereq 53 or 153 or #) Williams
- Ins 153. Risk Management and Insurance. The recognition, measurement, and evaluation of insurable personal, property, and liability risks of economic units. The tools of risk management including assumption, loss prevention, transfer, and others with particular emphasis on insurance. Design and implementation of the optimum risk management program. Government regulation of insurance. (3 cr, §53; prereq Econ 2) Williams
- Ins 173. Senior Topics: Insurance. Individual student reports on topics of special interest and discussion of important current problems in insurance. (3 cr; prereq 6 cr in insurance) Williams
- Ins 193. Actuarial Science Principles—Property and Liability Insurance. Rate-making methods in fire, inland marine, casualty, and multiple-line insurance; statistical plans; determination of reserves. (3 cr; prereq 53 or 153 or #) Williams
- Ins 203. Life and Accidental Injury and Sickness Insurance. Nature and relative importance of insurable personal risks; analysis of life and accidental injury and sickness contracts; programming; estate planning; business insurance; pricing, underwriting, and marketing methods. (3 cr, §73; prereq 153) Williams
- Ins 213. Group Insurance. Group life insurance (term and permanent plans); group pensions (fixed and variable annuities); and group accidental injury and sickness 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 153) 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 153) Williams

- Ins 233. Advanced Personal 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) 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 153...223 advised) Williams
- Ins 293A. Readings in Insurance.** 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)
- Ins 293B. Graduate Research in Insurance.** (Cr ar)
- Ins 303. Seminar in Personal Insurance.** Selected current problems in life insurance and accidental injury and sickness insurance. Oral and written student reports on individual research. (3 cr; prereq 153) Williams
- Ins 313. Seminar: Property and Liability Insurance.** Selected current problems. Oral and written student reports on individual research. (3 cr; prereq 153) Williams

Transportation

- Tran 154. Transportation I: Principles.** Roles, interests, and relationships of users of the service, carriers, and regulatory agencies. Organization of national transportation system and nature of the transportation function in business administration. Economic aspects of transportation facilities, carrier services, rate making, regulation and agencies of control, and industrial location. Current transportation problems and evaluation of national transportation policy. (3 cr, §54; prereq Econ 2 or equiv) Nightingale
- Tran 174. Transportation II: Traffic Management.** Principles of transport control and their application within the industrial (noncarrier) firm; carrier traffic management. Principles governing construction, interpretation, and application of rail, motor, water, express, pipeline, freight forwarder, and air freight classifications and tariffs. Problems involving determination of charges on typical movements within and between major freight-rate territories. (3 cr; prereq 54 or 154) Nightingale
- Tran 184A. Highway Transportation.** Economic aspects of the American highway transportation system and motor transportation; national policy; services, pricing, operations, and management of the motor carrier industry; federal and state regulatory policies and problems, including I.C.C. motor carrier cost studies; inter-city and urban passenger operations and problems including transit problem of cities. (3 cr; prereq 54 or 154) Harper
- Tran 184B. International Transportation: Water and Air.** Economic aspects of international ocean and air transportation. Overseas trade routes and shipping services. American Merchant Marine: operation, management, and finance of American shipping. Regulatory policies and problems; Federal Maritime Board and Federal Maritime Administration. International air routes and services; national policy; operation, management, and finance of American overseas air carriers. Economic regulation and problems, including competition; Civil Aeronautics Board. International agreements and conventions among governments and among carriers. (3 cr; prereq 54 or 154) Nightingale
- Tran 194A-B-C. Topics in Transportation and Traffic Management.**
- 194A. Advanced Traffic Management I.** Transportation rates, transport control practices, and their application within the industrial firm. Problems. (3 cr; prereq 174 or §) Nightingale
- 194B. Advanced Traffic Management II.** Transportation rates, transport control practices, and their application within the industrial firm. Problems and individual research project. (3 cr; prereq 174 or §) Nightingale
- 194C. General Transportation Management.** Case studies in railway, motor carrier, pipeline, domestic water, air transport, and industrial traffic management. Analysis of recent leading decisions of Interstate Commerce Commission and Civil Aeronautics Board. Individual research project. Nationally known guest speakers. (3 cr, §264; prereq 194B or equiv, §) Nightingale
- Tran 264. General Transportation Management.** Advanced management studies in railway, motor carrier, pipeline, inland water and ocean, air transport, and industrial transport control. Impact of regulation. Individual research. (3 cr; prereq 154 and 174 or equiv)
- Tran 294A. Readings in Transportation.** 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) Nightingale, Harper
- Tran 294B. Graduate Research in Transportation.** (Cr ar) Nightingale, Harper

Tran 304. **Seminar in Transportation.** Selected current problems in the field of national transportation policy. (3 cr; prereq 54) Nightingale

Accounting

- Acct 105A. Intermediate Accounting I.** Review of accounting processes, nature and measurement of business income, accounting treatment of inventories and plant assets. (3 cr; prereq 26 or equiv) C Nelson
- Acct 105B. Intermediate Accounting II.** Accounting treatment of cash, receivables, investments, intangible assets, and applications of actuarial mathematics. (3 cr; prereq 105A) C Nelson
- Acct 105C. Intermediate Accounting III.** Accounting treatment of stockholders' equity, interpretation and analysis of financial statements. (3 cr, §55D; prereq 105A) C Nelson
- Acct 115A. Cost Accounting.** Practices, principles, and procedures of handling production costs for use in inventory valuation and income determination. An examination of job order, process, and standard cost systems. A brief introduction to standard cost as a tool of cost control. (3 cr, §55C; prereq 26 or equiv) Bentley
- Acct 115B. Cost Accounting.** Analysis of the use of cost information in managerial decision making. (3 cr, §55C; prereq 115A) Meyers
- Acct 125. Auditing Principles and Procedures.** Instruction combined with a laboratory in which a set of working papers and an audit report are prepared. (4 cr; prereq 105C or ¶105C and 105B) Lund
- 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 §) C Nelson
- 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 in Upper Division accounting) C Nelson
- 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) C Nelson
- 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) Berryman
- Acct 175A. Advanced Cost Accounting.** Analysis of use of cost information for managerial control. (3 cr; prereq 115B) Meyers
- Acct 175B. Data Processing.** Fundamentals underlying processing of data within a business organization; application of such fundamentals in manual, tabulating, and electronic data-processing systems, including programming of such activities as billing, payroll, inventory control, and costing. (3 cr; prereq 115B) Davis
- Acct 175C. Controllorship Functions and Procedures.** Place and functions of controller and internal auditor in business enterprises. Examination of accounting systems and methods related to such functions as internal check and audit control of routine transactions. (3 cr; prereq 115B) Bentley
- Acct 175D. Budgetary Control.** Fundamentals of establishing and operating a budget. Budgetary control and relationship to break-even analysis. (3 cr; prereq 115B) C Nelson
- Acct 185A. Advanced Accounting.** Consolidated statements, fiduciary and fund accounting, partnership accounting. (3 cr; prereq 105C or ¶105C) C Nelson
- Acct 185B. Auditing and Public Accounting.** Work of public accountants, including internal controls, fraud, programming, standards of practice, reporting, ethics, legal responsibility, non-audit work. (3 cr; prereq 125) Berryman
- Acct 185C. Governmental Accounting.** Government budgets and fund accounting. (2 cr; prereq 105A) C Nelson
- Acct 195A. Internship in Public Accounting.** Student will work full time for a public accounting firm. In addition to performing duties for his employer, he will write a report on his activities. (Cr ar; prereq 125 and §) C Nelson
- Acct 195B. Internship in Internal Accounting.** Student will work full time in the accounting department of an industrial organization. In addition to performing duties for his employer, he will write a report on his activities. (Cr ar; prereq 115B and §) Meyers
- 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) C Nelson

- Acct 235A. Taxation and Business Planning.** (3 cr; prereq 155B or equiv) C Nelson
- Acct 235B. Tax Accounting Problems.** (3 cr; prereq 135) C Nelson
- 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) Bentley
- Acct 265B. Corporate Statements.** Preparation of corporate statements and analysis from management, investment, and credit viewpoint. (3 cr, §55D, 105C; prereq 26 or equiv) C Nelson
- Acct 275A. Internal Auditing.** Relationships between internal auditor and the accounting and operating departments. Audit of financial and nonfinancial activities. (3 cr; prereq 115A) C Nelson
- Acct 275B. Case Studies in Specialized Accounting.** (3 cr) C Nelson
- Acct 285. Accounting Under Government Regulation.** (3 cr) C Nelson
- 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 instructor in field covered)
- Acct 295B. Graduate Research in Accounting.** (Cr ar)
- Acct 305A. Seminar in Accounting Theory: Valuation and Principles.** (3 cr) C Nelson
- Acct 305B. Seminar in Accounting Theory: Income Determination and Statement Presentation.** (3 cr) C Nelson
- Acct 305C. Seminar in Accounting Theory: Financial Statements.** (3 cr) C Nelson
- Acct 315. Seminar: Cost Accounting.** (3 cr) Meyers
- Acct 345A-B. Advanced Accounting Problems.** (3 cr per qtr) C Nelson

Business Finance

- BFin 106. Securities Markets.** Institutional structure of stock and bond markets. Internal organization and operation of the exchanges, co-ordination of markets, problems of price behavior of the market as a whole and of specific types of securities. (3 cr; prereq 56 or 156) J R Nelson
- BFin 116. Investments.** Analyzes the nature of different types of securities and characteristics of industrial, utility, and financial enterprises and various government units from viewpoint of the individual investor. Introduction to security analysis and to portfolio needs. (3 cr; prereq 56 or 156) J R Nelson
- BFin 126. Investment Management.** Development of principles and policies governing management of investment funds for individuals and institutions through use of cases. Attention to interest-rate changes and business fluctuations and relative performance of industry and security types. (3 cr; prereq 116) Stevenson
- BFin 146. Real Estate.** Valuation of urban real estate, with a consideration of problems of real estate financing, rent control, housing, land development, zoning, and other factors affecting real estate values. (3 cr; prereq 1)
- BFin 156. Corporation Finance.** Principles governing the planning, raising, and control of short- and long-term funds for a business enterprise through problem and text material. Includes capital structures, valuation, investment banking, dividend policy, merger and reorganization. (3 cr, §56; prereq 155A) Stevenson
- BFin 196. Corporation Financial Topics.** Intensive treatment of certain financial topics including capital budgeting, valuation, mergers, investment banking, refundings, and reorganizations. Presentation through readings, student projects, and case material. (3 cr; prereq 76 or 276) Stevenson
- BFin 276. Financial Management.** Analysis of financial problems of business concerns presented in case materials. Application of principles to such situations as budgeting short- and long-term fund needs, debt and equity choices, valuation, mergers, and reorganizations. (3 cr, §76; prereq 56 or 156) Stevenson
- BFin 296A. Readings in Business Finance.** 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)
- BFin 296B. Graduate Research in Business Finance.** (Cr ar)
- BFin 306. Finance Seminar.** Business finance, investment management, and securities markets. (3 cr; prereq 156)

Marketing

- Mktg 107A. Retail Management for Pharmacy Students.** Principles of retail store management including planning and control of store operation, nature of consumer demand, and analysis of retailing costs. (3 cr; open to pharmacy students only; prereq 25)
- 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 Fundamentals.** Basic concepts. Work on functions, institutions, channels, pricing. Marketing policies and methods for consumers' goods, producers' goods, and raw materials. (3 cr, §57; prereq Econ 2 or equiv) Hancock
- Mktg 177. Foreign Trade.** 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 equiv) Holloway
- Mktg 187. Price Policy.** Managerial and economic problems concerning market price and price policy. Methods by which goods and services are priced in industrial and consumer markets. Price behavior, administered pricing, price leadership, price lining, and governmental intervention. (3 cr; prereq 57) Harper
- 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) Holloway
- Mktg 207. Advertising.** A survey of advertising including functions of advertising, budgets, advertising agencies, media, copy, layout, printing processes, research, and economics of advertising. (3 cr, §77; prereq 57...Psy 156 recommended) Lewis
- Mktg 217. Market Analysis and Research.** Techniques used in marketing research, marketing information which can aid in the solution of marketing problems; selected nonsurvey and survey research techniques. (3 cr, §97; prereq 51 or 151 and 57 or 157) Holloway, Hancock
- Mktg 217C. Marketing Research II.** Selected topics. Attempt is made to examine 1 or 2 important marketing problems intensively. (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) Hancock
- Mktg 227C. Retail Management II.** Selected topics in retail store management. (3 cr, §107C; prereq 107) Hancock
- Mktg 237. Sales Management.** Sales policies and planning; sales organization; selection, training, and compensation of salesmen; control of sales performance, sales budgets; and cost control. Case materials. (3 cr, §117; prereq 57) Lewis
- Mktg 237C. Marketing Topics.** Analysis of marketing costs, channels of distribution, marketing of selected commodities. (3 cr, §117C; prereq 57) Lewis
- 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 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 instructor in field covered)
- Mktg 297B. Graduate Research in Marketing.** (Cr ar)
- Mktg 307. Seminar: Marketing.** (3 cr; prereq 57 or 157) Lewis
- Mktg 317. Seminar: Marketing Management.** (3 cr; prereq 57 or 157) Holloway

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

Office Management

- OMgt 119. Business Communications and Correspondence Control.** Problems of maintaining a flow of oral and written communications as an integrating force; controlling internal activities through administrative writing; initiating, evaluating, and controlling communications with customers and the public; developing correspondence improvement and cost reduction programs. (3 cr; prereq 99 or #) Donaldson
- OMgt 129. Records Administration.** Role of records in the over-all systems approach; concept of records as in information center. Information-handling problems involved in organization, control, evaluation, and disposition of records; protection of vital papers; maintenance of semi-active records depository control of archives. (3 cr; prereq 36, 99 or #) Donaldson
- OMgt 139. Analysis of Office Functions.** Fact finding and analysis applied to organization, work distribution, procedure flow, methods, layout, forms, equipment. Selected projects involving a management audit of administrative services. Written reports on an analysis, evaluation, and redesign of present practices with consideration of problems involved in application of automation. (3 cr; prereq 99 or #) Donaldson
- OMgt 149. Practice Course.** Peterson

M.B.A. Second Year Core

- Mgmt 250. Executive Leadership.** See under Management.
- QA 251. Business Research Methods and Techniques.** Introduction to sources of business information. Examination of research methods and techniques and their application to individual problems. Place of business research in business management. (3 cr; prereq 51 or 151) Hastings
- 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 the maintenance of competitive markets. Purpose, substance, and problems of antitrust law and administration. Desirability, feasibility, and effectiveness of antitrust policy. Meaning and significance of such concepts as “effective competition,” “workable competition,” and “countervailing power.” Considers: (a) the relation between business size and efficiency; and (b) compatibility of antitrust and the range of other governmental policies. (3 cr; prereq 256) Seltzer
- 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; prereq 151, 155A, 155B, Econ 65 or 165 or equiv) Willis and others
- Mgmt 260. Policy Formulation and Administration.** See under Industrial Management and Administration.

CHEMICAL ENGINEERING

Professor

Neal R. Amundson
Norman H. Ceaglske
Herbert S. Isbin
Edgar L. Piret
William E. Rans

Associate Professor

Rutherford Aris
John S. Dahler
Arthur J. Madden
George W. Preckshot
Henry M. Tsuchiya

Assistant Professor

Arnold G. Fredrickson
L. Edward Scriven II

Prerequisites—For major work, the Bachelor's degree in chemical engineering or its equivalent. If he has not met this requirement, the student must pursue such additional preparatory studies as may be prescribed by his adviser.

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, a reading knowledge of German. In special cases approved by the graduate faculty, French or another language may be submitted. For the Doctor's degree, 2 foreign languages, 1 of which must be German. The second language must have the approval of the graduate faculty.

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.

[Professional degrees in engineering—These degrees are all administered by the Institute of Technology.]

101. **Principles of Chemical Engineering.** Fluid dynamics and its application to chemical engineering unit operations. (5 cr; prereq ¶PCh 101) Scriven
102. **Principles of Chemical Engineering.** Heat and mass transfer and its application to chemical engineering unit operations. (5 cr; prereq 101) Ranz
103. **Principles of Chemical Engineering.** Equilibrium stage separations applied to chemical engineering unit operations. (3 cr; prereq 102) Isbin
111. **Chemical Engineering Laboratory.** Applications of unit operations principles in fluid flow, heat and mass transfer experiments, with reports. (2 cr; prereq 101) Fredrickson
112. **Chemical Engineering Laboratory.** (See ChEn 111) (2 cr; prereq 102) Fredrickson
113. **Chemical Engineering Laboratory.** (See ChEn 111) (2 cr; prereq 103) Fredrickson
- 116-117-118. **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) Preckshot
- 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 equilibria. (3 cr per qtr; prereq PCh 101) Dahler
122. **Biochemical Engineering.** Application of biochemical and microbiological principles to industrial processes. (3 cr; prereq 103, MicB 53 or #) Tsuchiya
123. **Biochemical Engineering Laboratory.** Application of chemical engineering, microbiological and biochemical principles to fermentations, food processing, waste stabilization, etc. (3 cr; prereq 122, MicB 53) Tsuchiya
- 131-132. **Chemical Reactor Analysis.** Principles of reactor design for homogeneous and heterogeneous reactions. Analysis of the chemical reactor from a kinetic and thermodynamic point of view. Applications to some specific processes. (3 cr per qtr; prereq 120, PCh 109) Aris
152. **Chemical Process Laboratory.** Applications of principles covered in 131-132 in pilot or semi-plant laboratory. (2 cr; prereq 103, 132) 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 multi-stage 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 #) Ranz, 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 #)
- 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; offered 1963-64 [alts with 225-226-227]) Amundson
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 #) Preckshot
- 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 #)
- 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 #) Aris
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 examination 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

John E. Wertz
Bryce L. Crawford
Edward L. Hill
Rufus W. Lumry
Alfred O. C. Nier

Associate Professor

John S. Dahler
Stephen Prager
T. Michael Sanders

Assistant Professor

Sanford Lipsky
C. Alden Mead
Albert J. Moscowitz
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 3 chemistry and 3 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 1 of the courses PCh 117, 118, 119, 211, 212, or passing the preliminary written examination in physics, will reduce this requirement to 3 cumulative examinations. The preliminary oral examination may be taken after 3 cumulative examinations have been passed and 3 required course examinations in Quantum Mechanics have also been passed and the language requirements have been satisfied.

Three-Year Program—The usual Graduate School rules apply. Since there is no minor field of study, all courses on the 3-year program must be passed with a grade of B or better.

CHEMISTRY

Professor

Stuart W. Fenton, *chairman*
Paul R. O'Connor, *associate chairman*

Work in the Department of Chemistry is organized in four divisions—analytical, inorganic, organic, and physical chemistry.

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 first 3 years of the chemistry curriculum, at least 1 year of college physics, and 1 year of college mathematics.

For a minor in chemistry, students must present at least 12 credits of general inorganic chemistry and qualitative analysis, 5 credits of quantitative analysis, and 2 quarters of organic chemistry or its equivalent.

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.

Copies of typical examinations may be obtained by writing to the Department of Chemistry. 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 text such as Kolthoff and Sandell, *Textbook of Quantitative Analysis* (omitting sections in fine print); Willard and Furman, *Elementary Quantitative Analysis*; or Blaedel and Meloche, *Elementary Quantitative Analysis*.

Inorganic: An inorganic text such as Gould, *Inorganic Reactions and Structure*; Sneed, Maynard, and Brasted, *General College Chemistry*; Laubengayer (1958), *General Chemistry*; and a standard introductory qualitative analysis text such as Hogness and Johnson, *Qualitative Analysis and Chemical Equilibrium* (fourth edition).

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, 2 foreign languages are required, 1 of which must be German.

Preliminary Examinations—Written and oral preliminary examinations in chemistry for the Doctor's degree will be given at only 2 periods during each year. Normally, the written examinations will be given in the second week of fall and spring quarters. The exact schedule will be announced at the beginning of these 2 quarters.

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

Associate Professor
Stanley Bruckenstein

Professor
Edward J. Meehan
Ernest B. Sandell

Assistant Professor
Harold S. Swofford

100. Theory of Gravimetric Analysis. (2 cr; prereq GeCh 26) Meehan
101. Theory of Volumetric Analysis. (3 cr; prereq 100) Meehan
102. Laboratory in Gravimetric and Volumetric Analysis. (4 cr; prereq 101) Meehan
- 102A. Laboratory in Gravimetric and Volumetric Analysis. (3 cr; prereq 101; for chem engineers) Meehan
103. Quantitative Inorganic Microanalysis. Representative methods of micro- and semimicroanalysis; gravimetric, volumetric, and colorimetric. (3 cr; limited to 16 students; prereq 100, 101, 102 or 102A) Sandell
104. 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 100, 101, 102 or 102A) Sandell

105. **Polarizing Microscope.** Its use and application to chemistry. Identification of substances. (3 cr; limited to 16 students; prereq PCh 101) 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 or 3 cr per qtr; prereq 100, 101, 102 or 102A) Sandell
111. **Physicochemical Methods of Analysis.** Lecture. Optical and electrochemical methods and methods of separation. (3 cr; prereq 102 or 102A, PCh 103) Staff
112. **Physicochemical Methods of Analysis.** Laboratory. Quantitative application of electrochemical, optical, and other physical techniques. (2 cr; prereq 111) Bruckenstein
113. **Physicochemical Methods of Analysis.** Laboratory. More advanced treatment of material covered in 112. (3 cr; prereq 111) Bruckenstein
115. **Advanced Analytical Chemistry.** Condensed review of fundamentals of gravimetric and volumetric analysis. (2 cr; prereq 100, 101, 102 or 102A) Meehan
- 116.* **Solution Equilibria.** Lecture. Systematic treatment of aqueous and nonaqueous equilibria. The principles underlying volumetric endpoint detection techniques. (3 cr; prereq 115 and PCh 103) Bruckenstein
- 117.* **Electrochemical Methods of Analysis.** Lecture. Potentiometric, coulometric, polarographic, and other electrical methods. (4 cr; prereq 111) Bruckenstein
- 123.* **Analysis of Complex Materials.** Literature study, critical selection, and application of fundamentals of analysis to complex materials. (1-3 cr; prereq 112)
- 127.* **Optical Methods of Analysis.** Lecture. (2 cr; prereq PCh 103; offered 1963-64 and alt yrs) Meehan
- 134-135. **Electrochemical Methods of Analysis.** Laboratory course. (1-2 cr per qtr; prereq 132 or ¶132 for 134 and 133 or ¶133 for 135) Bruckenstein
138. **Advanced Volumetric Analysis.** (3 cr; prereq 131)
140. **Water Analysis.** Analysis of potable water with interpretation of results. (2 cr; prereq 100, 101, 102 or 102A) Sandell
- 141-142-143.*† **Seminar: Modern Problems in Analytical Chemistry.** (1 cr per qtr; prereq 100, 101, 102 or 102A and PCh 103)
- 201-202-203.*† **Selected Topics in Analytical Chemistry.** (Cr ar; prereq 100, 101, 102 or 102A) Staff
- 235-236-237.† **Research Seminar in 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 Quantitative Analysis.** (Cr ar) Staff

Inorganic Chemistry

Professor

Paul R. O'Connor
Robert C. Brasted
Otto H. Johnson

Associate Professor

Henry A. Bent
John D. Britton
Z Z. Hugus, Jr.
Warren L. Reynolds

Assistant Professor

Lawrence E. Conroy
R. Stuart Tobias

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 is required for the Ph.D. degree, but another language may be substituted by petition.

Master's Degree—Offered under Plan A or Plan B.

Doctor's Degree—Candidates must maintain better than a B average.

- 103.^o **Atomic Structure and Properties of Elements Based Thereon.** Nature of atomic and molecular electronic systems and the properties of various elements, including the transition elements. (3 cr; prereq PCh 103) Reynolds
- 104.^o **Chemistry of the More Representative Elements.** Preparation, reactions, and chemical properties of regular group elements and their compounds. (4 cr; prereq 103 or #) Brasted
- 107.^o **Oxidation-Reduction Systematics.** Application of tabulated thermodynamic data, including potential diagrams, to prediction of chemical reactions. (3 cr; prereq PCh 101; offered 1962-63 and alt yrs) Hugus
- 111.^o **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 1963-64 and alt yrs) Johnson
- 112.^o **Radioactivity and Nuclear Chemistry.** Properties of nuclei, disintegration, properties of radiation; natural and artificial radioactivity; modern views of nuclear structure. (3 cr; prereq PCh 103; offered 1963-64 and alt yrs) O'Connor
- 113.^o **Mechanisms of Inorganic Reactions.** Prevalent ideas concerning mechanisms of inorganic oxidation-reduction and substitution reactions. (3 cr; prereq PCh 103; offered 1963-64 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 100, 101, 102 or 102A and PCh 103) Hugus, Reynolds, Britton
- 134-135-136.† **Seminar: Modern Problems in Inorganic Chemistry.** (1 cr per qtr; prereq PCh 103) Staff
- 203.^o **Atomic Structure and the Chemical Bond.** A nonmathematical introduction to application of quantum theory to atomic and molecular electronic systems. Atomic structure, valence bond and molecular orbital approaches to molecular structure, and ligand field theory as applied to transition metal compounds. (4 cr; prereq PCh 103 or 103H, OrCh 62) Staff
204. **Advanced Inorganic Chemistry.** Reactions and properties of the more important chemical elements and their compounds. (4 cr; prereq 203 or #) Staff
205. **Advanced Inorganic Chemistry.** Topics of inorganic chemistry such as co-ordination compounds, oxidation potentials, the rare earths. (4 cr; prereq 203, 204 or #) Staff
- 211, 212, 213. **Selected Topics in Inorganic Chemistry.** (Cr ar; prereq Δ)
- 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) O'Connor, Brasted, Johnson, Hugus, Britton, Reynolds, Bent, Conroy, Tobias

Organic Chemistry

Professor

Stuart W. Fenton
Raymond M. Dodson
C. Frederick Koelsch
Walter M. Lauer
William E. Parham

Associate Professor

Maurice M. Kreevoy
Edward Leete
Wayland E. Noland

Assistant Professor

E. Alexander Hill

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.

- 101w. Intermediate Organic Chemistry.** Survey course which considers important modern topics: organic theory, unusual types of aliphatic, aromatic, and heterocyclic compounds. (3 cr; prereq 63 or equiv) Lauer
- 102f. Organic Qualitative Analysis.** Elementary course. Reactions of typical functional groups and introduction to methods of organic qualitative analysis. (4 cr; prereq 63, 64 or equiv) Koelsch
- 130f,w,s. Organic Quantitative Analysis.** Microcombustion analyses of the elements usually found in organic compounds. (3 cr; prereq 63 and 64, AnCh 102 and #) Lauer
- 139w. Advanced Organic Chemistry Laboratory Work.** Selected laboratory synthetic problems, which may include original work. Includes considerable individual instruction. (2-5 cr; prereq 64 or equiv; 6-15 hrs lab work ar) Noland
- 142w. Chemistry of Natural Products.** Including acetogenins, terpenes, alkaloids, biogenesis. (3 cr; prereq 63; offered 1963-64 and alt yrs) Leete
- 143s. Chemistry of Natural Products.** Hormones both steroidal and polypeptide, their isolation, proof of structure, synthesis and action. (3 cr; prereq 63; offered 1962-63 and alt yrs) Dodson
- 144w. Heterocyclic Compounds.** Typical classes of heterocyclic compounds, their chemical and physical properties and uses, synthesis. (3 cr; prereq 63 and 64; offered 1962-63 and alt yrs) Leete
- 201f-202w-203s.* Organic Chemistry Seminar.** (1 cr per qtr; required of all grad students taking major work in organic chemistry) Staff
- 220f.* Graduate Survey.** Nonquantitative theory and mechanism, reactions and synthesis of aliphatic functional groups. (4 cr; prereq 63 or equiv) Parham
- 221w.* Graduate Survey.** Nonquantitative theory, aromatic and free radical chemistry, synthesis. (4 cr; prereq 220 or #) Fenton
- 222s.* Graduate Survey.** Nonquantitative theory, chemistry of functional groups. (4 cr; prereq 221 or #) Dodson (1962-63), Noland (1963-64)
- 223f.* Stereochemistry.** Stereochemistry of carbon compounds and of organic reactions. (3 cr; prereq 220 or #) Lauer
- 224w.* Theoretical Organic Chemistry.** More quantitative aspects of organic theory including kinetics and equilibrium studies. (3 cr; prereq 220, PCh 103 and calculus, or #) Noland
- 238f. Introduction to Research.** Including problems involved in organic qualitative analysis. Laboratory work in advanced organic qualitative analysis for those who are deficient. (4 cr; prereq 63, 102, or equiv) Koelsch
- 239w-240s. Introduction to Research.** Advanced laboratory problems, including original work. (4 cr; prereq 102, 238, or #) Noland and staff
- 246s. Organic Instrumental Analysis.** Practical application of nuclear magnetic resonance, infrared and ultraviolet spectral analysis to the solution of organic problems. (3 cr; prereq #; one 3 hr lect per wk) Fenton, Kreevoy
- 250s. Theoretical Organic Chemistry.** Application of chemical kinetics, thermodynamics, and simple quantum mechanics to problems of organic chemistry. (3 cr; prereq 220, 224 or #, PCh 103 and integral calculus) Kreevoy
- 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
- 301f-302w-303s.* Research in Organic Chemistry.** (Cr ar; prereq 238, 239, and Δ) 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

Robert S. Livingston
 Bryce L. Crawford, Jr.
 Edward L. Hill
 Rufus W. Lumry
 Paul R. O'Connor
 John E. Wertz

Associate Professor

J. Doyle Britton
 Z. Z. Hugus, Jr.
 Stephen Prager

Assistant Professor

Henry A. Bent
 John S. Dahler
 Sanford Lipsky
 C. Alden Mead
 Albert Moscovitz
 John Overend

Candidates for an advanced degree in the Graduate School who are not majoring in chemistry may offer PCh 101(or 101H)-102(or 102H)-103(or 103H), 104-105-106, or 107-108 in partial fulfillment of the course requirements for a minor in physical chemistry.

- 101-102-103. Physical Chemistry.** General survey of the subject. (4 cr per qtr; prereq 1 yr college chemistry, Phys 9 or ¶Phys 9 with Δ , ITM 25A or Math 53) Mead
- 101H-102H-103H. Honors Course: Physical Chemistry.** General survey of the subject. For students with GPA greater than 2.75 in mathematics, physics, and chemistry and recommended for graduate students. (4 cr per qtr; prereq 1 yr college chemistry, Phys 9 or ¶Phys 9 with Δ , ITM 25A or Math 53) Lumry
- 104-105-106. Physical Chemistry Laboratory.** (1 or 2 cr per qtr; prereq 101 or ¶101 for 104, 102 or ¶102 for 105, 103 or ¶103 for 106) Overend
- 107-108.† Elementary Physical Chemistry.** Brief general survey. (3 cr per qtr; prereq 1 yr college chemistry, Phys 9 or ¶ with Δ , ITM 25A or Math 53) Lipsky
- 109.* Physical Chemistry.** Elementary atomic and molecular structure, wave mechanics, nuclear chemistry, photochemistry. (4 cr; prereq 103 or 103H) Wertz
- 110. Thermodynamics and Chemistry.** Principles of classical thermodynamics; their application to physical and chemical phenomena. (4 cr; prereq 103 or 103H and calculus) Livingston
- 111. Thermodynamics.** Application of principles of thermodynamics to chemical phenomena including those occurring in solutions of electrolytes. (2 cr; prereq 110) Livingston
- 112. Atomic and Molecular Structure.** An experimental viewpoint. (3 cr; prereq 103 or 103H) Wertz
- 113. Quantum Mechanics.** Applications to molecular structure. Theory of the chemical bond. (3 cr; prereq 112 or equiv) Wertz
- 117. Fundamentals of Reaction Kinetics.** Empirical analysis of rate measurements, collision theory, transition state theory, chain reactions. (3 cr; prereq 103 or 103H) Livingston
- 118.* Introduction to Quantum Theory.** Fundamentals of quantum mechanics and their application to simple physical and chemical problems. (3 cr; prereq 103 or 103H and calculus) Prager
- 119.* Introduction to Molecular Structure.** Methods of determining molecular structure with simple applications. Chemical and physical properties in terms of nature of chemical bonds. (3 cr; prereq 118) Crawford
- 128. Colloid and Surface Chemistry.** Fundamental principles of colloid chemistry, surface chemistry, electrokinetic phenomena, lyophobic and lyophilic colloids. (3 cr; prereq 103 or 103H) Prager
- 204-205-206. Atomistics.** Kinetic theory of gases, statistical mechanics and quantum mechanics, and their application to the interpretation of the properties of matter in terms of its microscopic structure. (4 cr per qtr; prereq 118 and 212) Moscovitz
- 211. Introduction to Statistical Mechanics.** (2 cr; prereq 103 or 103H)
- 212. Statistical Mechanics and Kinetic Theory.** (4 cr; prereq 211)
- 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, §PhCh 214; prereq 103 or 103H, §; offered 1962-63 and alt yrs) Lumry
- 215. Physical Chemistry of Proteins.** (3 cr, §PhCh 217; prereq 101, 102, 103 or equiv; offered 1963-64 and alt yrs) Lumry
- 216. Physical Chemistry of Polymers.** (3 cr; prereq 128; offered 1963-64 and alt yrs) Prager
- 221-222-223.† Seminar in Radiation Chemistry.** (Cr ar) Lipsky

- 250-251-252.† Physical Chemistry Seminar. (1 cr per qtr; required of all grad students majoring in physical chemistry) Overend
- 253-254-255.† Seminar in Molecular Spectroscopy. (Cr ar) Crawford, Overend
- 256-257-258.† Seminar in Theoretical Chemistry. (Cr ar) Moscovitz
- 259-260-261.† Seminar in 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 in Magnetochemistry. (Cr ar) Wertz
- 268-269-270.† Seminar in Statistical Mechanics. (Cr ar) Prager
- 271-272-273.† Seminar in Physical Chemistry of Biological Systems. (Cr ar) Lumry
- 274-275-276.† Seminar in 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) Crawford, Lipsky, Livingston, Lumry, Mead, Moscovitz, Overend, Prager, Wertz
- 301-302-303.† Research in Physical Chemistry. Thermodynamics, photochemistry, reaction kinetics, tracer techniques, molecular structure, adsorption, crystal structure, radiation chemistry. (Cr ar) Crawford, Livingston, Mead, Moscovitz, O'Connor, Overend, Lipsky, Lumry, Prager, Wertz, Hugus, Britton, Dahler

CHILD DEVELOPMENT

Professor

Harold W. Stevenson
Merrill F. Roff
Mildred C. Templin
Robert D. Wirt

Associate Professor

Armin Grams

Assistant Professor

James W. Barnard
William Charlesworth
Frank W. Harper
Shirley G. Moore
David S. Palermo
Herbert L. Pick, Jr.
Britton K. Ruebush
John C. Wright

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, 8 hours in social sciences, and 3 hours in statistics.

Language Requirement—For the Master's degree, one foreign language. For the Ph.D. degree, either (a) 2 foreign languages or (b) 1 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.

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

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, Palermo
126. **Case Study of Children.** Supervised intensive study of intellectual, personality, and social development and functioning of individual normal children. (3 cr; prereq 85, #) Barnard, Harper
127. **Social Behavior of Nursery School Children.** Social ecology of young children; supervised observation and experience in the nursery school. (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; prereq ††) Grams

†† Twelve credits in psychology, educational psychology, sociology, or home economics.

140. **Behavior Problems.** Types, origin, development, and treatment of behavior difficulties in normal children. (3 cr; prereq 80 or equiv) Barnard
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, legal aspects. (3 cr; prereq 80 or equiv)
144. **Psychology of Gifted Children.** Psychology and development of high intellectual ability and of special talents. (3 cr; prereq 80 or equiv) Charlesworth
170. **Parent Education.** Programs, materials, methods, organization, and administration. Comprehensive survey of related research. (3 cr; prereq 80 or equiv) Grams
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 development) Wirt
180. **Personality Development in Children.** Origins of personality in personal and interpersonal behavior. Theories of personality and socialization. (3 cr; prereq 80) Ruebush
181. **Social Development of Children.** Group formation and organization; social interaction and social relations; developmental changes. (3 cr; prereq 80) Moore
182. **Learning in Young Children.** Theories of learning; discussion of experimental literature on theoretically critical issues in thinking, problem solving, and learning in children. (3 cr; prereq 80) Wright, Stevenson
183. **Language Development in Children.** 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
185. **Children in Society.** Consideration of historical, socio-economic, cross-cultural influences, and social changes on child development. (3 cr; prereq 80 or equiv) Templin
186. **Cognitive Development in Children.** Development of thinking in children; theories; concept formation, problem solving and reasoning. (3 cr; prereq 80) Wright, Charlesworth
190. **Topics in Child Development.** Independent reading or research. (Cr ar; prereq 18 cr with B avg incl 80, Psy 70) Staff
- 210-211. **Advanced Child Psychology.** Discussion and critical evaluation of research in child psychology; motor, intellectual, emotional, social, and personality development. (3 cr per qtr; prereq #) Stevenson
212. **Design of Research in Child Development.** Review of principal research methods for study of children; design of research studies. (3 cr; prereq 210-211). Graduate staff
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 ††) Harper
- 223-224-225. **Seminar: Developmental Psychology.** Intensive study of selected topics. (2 cr per qtr; prereq #) Graduate staff
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
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.** Survey of current theory and practice with supervisory experience in the application of clinical and research findings to diagnosis and treatment of emotional disturbances in children. (3 cr; prereq #) Wirt
250. **Practicum in Clinical Child Psychology.** Supervised experience in the use of diagnostic and remedial procedures in children's behavior problems. (Cr ar; prereq #) Ruebush and staff

†† Twelve credits in psychology, educational psychology, sociology, or home economics.

- 270-271-272.* **Readings and Research in Child Development.** Reports based on independent readings, research, or projects in any field pertaining to child development or childhood education that meet the approval of the listed instructors. (Cr ar; required for MA Plan B students, open to other grad students) Graduate staff
- 282-283-284. **Experimental Child Psychology.** Current research in learning, perception, and motivation in children. (2 cr per qtr; prereq Psy 129 or equiv) Palermo, Wright, Charlesworth
- 285-286. **Theory and Practices in the Preschool.** The 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
- 287-288. **Behavior of Preschool Children.** Use of group setting for study and guidance of personality and social development of young children. (2 cr per qtr; prereq #) Moore
291. **Mental Testing of Infants and Preschool Children.** Discussion and practice in administering standard developmental and mental tests for infants and preschool children. (3 cr; prereq #) Ruebush
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. (Cr ar; prereq #) Barnard, Harper

CIVIL ENGINEERING

Professor

Lorenz G. Straub
Paul Andersen
Alvin G. Anderson
Charles E. Bowers
Miles S. Kersten
John F. Ripken

George J. Schroeffer
Edward Silberman

Associate Professor

Walter T. Graves
Theodor W. Thomas

Language Requirement—For the Master's degree, none. For the Ph.D. degree, 2 foreign languages, 1 of which must be German.

Master's Degree—Offered under Plan A; in special cases, Plan B may be accepted when approved by the student's adviser.

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

[Professional degrees in engineering—These degrees are administered by the Institute of Technology.]

Surveying

- 109f. **Geodetic Surveying.** First-order triangulation, traverse, and level nets. Least squares adjustments of survey nets. Computations and use of state-wide co-ordinate grids. Geodetic astronomy. (3 cr; prereq 23 or #) Fant
- 111s. **Land Surveying.** Study of Minnesota Public Land Survey and proper methods of resurveys. Subdivision design and computations. Preparation of standard plats and descriptions. (3 cr; prereq 23 or #) Fant
- 112w. **Aerial Surveying and Photogrammetry.** Theory and methods of making planimetric and topographic maps from aerial and terrestrial photographs. (3 cr; prereq 23 or #) Fant

Structural Engineering

- 130f. **Statically Indeterminate Structure.** Method of moment area. Williot Diagram. Slope-deflection method. (3 cr; prereq 33) Andersen
- 131w. **Structural Analysis.** Moment distribution method. (2 cr; prereq 130) Andersen
- 132s. **Structural Design.** Continuous structures of steel and concrete. (2 cr; prereq 131) Andersen
- 136f.* **Advanced Structural Analysis.** Wind bracing for buildings. Space structures. Plastic design of structural steel. (3 cr; prereq 132) Graves

- 137w. **Structural Laboratory.** Theoretical and experimental study of structural members, structural models, and strain gauges. Lectures and demonstrations on photoelasticity and dynamic strain measurements. (3 cr; prereq 141 and ¶131) Self
138. **Numerical Structural Analysis.** Application of finite difference equations, iterative procedures, and relaxation methods to solution of structural problems. Analysis of highly redundant structures by matrix methods. Solutions of continuous beams, rigid frames, space frameworks, and stiffened shell structures using flexibility and stiffness matrices. (3 cr; prereq 130 or equiv) Graves
141. **Reinforced and Prestressed Concrete.** Elastic and ultimate strength design of reinforced and prestressed concrete beam and column elements. Investigation of bond and shear stresses. (3 cr; prereq 33) Graves
142. **Design of Reinforced and Prestressed Concrete I.** Application of principles of reinforced concrete design to floor systems, complete building frames, footings, and retaining walls. Application of prestressed concrete to design of building elements. (3 cr; prereq 130 and 141) Graves
- 143A. **Design of Reinforced and Prestressed Concrete II.** Composite construction. Design of prestressed bridge girders. Deflection of concrete members. Design of selected reinforced and prestressed concrete structures including spherical domes and cylindrical tanks. (3 cr; prereq 142 or equiv) Graves, Self
- 144A. **Arch Analysis and Design.** Analysis and design of steel and reinforced concrete arches. (3 cr; prereq #) Andersen
- 145s. **Structural Design by the Ultimate Load Theory.** Methods of limit load analysis. Ultimate strength design of reinforced concrete. Plastic design of structural steel. Yield line theory for slabs. Selection of load factors and application to continuous beams, rigid frames, and shell structures. (3 cr; prereq 142) Graves
- 147w,s. **Foundations.** Design and construction of footings, cofferdams, and caissons for bridges and buildings. Piers, abutments, and sheet piling. Exploration and testing of foundation sites. Excavation and removal of materials from foundation site. (3 cr; prereq 141) Andersen
- 234f°-235w.* **Advanced Theory of Structures.** Application of theory of elasticity to structural problems involving two-dimensional state of stress. Analysis and design of plates and slabs. Analysis of members subjected to torsion. Determination of critical buckling load for structural members and frameworks. (3 cr per qtr; prereq 132, 142) Andersen, Graves
- 236s.* **Shell Structures.** Design of roof and tank structures using surfaces of revolution, cylinders, surfaces of double curvature, and folded plates. (3 cr; prereq 132) Graves
- 240f-241w-242s. **Advanced Structural Laboratory.** Experimental determination of principal strains by use of 3 or 4 intersecting gaugelines; plastic flow and shrinkage; prestressed reinforced concrete; moment redistribution; theory of limit design; theory of similitude; statistical data. Vierendell trusses. (3-5 cr per qtr; prereq 137) Staff
- 243f.* **Dynamics of Structures.** Vibrations of beams, trusses, and frameworks. Impact, and effect of suddenly applied forces. Forces on structures due to earthquakes, shocks, and explosions. Fatigue of materials. (3 cr; prereq MM 193 or equiv) Graves
- 244w.* **Dynamics of Structures Laboratory.** Vibrations of beams and trusses. (3 cr; prereq 243) Graves
- 247f°-248w-249s. **Seminar in Structures.** Special topics in the higher theory of structures. (3-6 cr per qtr; prereq 132, 142)

Highway Engineering and Soils Mechanics

- 146f,s. **Concrete and Concrete Materials.** Design and control of concrete mixtures, air-entrained concrete, properties of concrete, and constitution of cement. (3 cr; prereq 51 or ¶51) Thomas
- 148w. **Special Problems in Concrete.** Short research problems. (2-3 cr; prereq 146) Thomas
- 151s.* **Advanced Highway Laboratory.** Special experimental studies of highway materials. (3 cr; prereq 52) Thomas
- 152s.* **Highway Design.** Geometric design of rural highways. Design of intersections, interchanges, and freeways. (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) Kersten
- 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 volumes and traffic surveys. Regulations and control of traffic; parking solutions. Accidents and their relation to design. Traffic administration. (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
- 159w. Soil Mechanics.** Seepage, consolidation, strength theory. Settlement analysis; stability of slopes; bearing capacity. (3 cr; prereq 53) Kersten
- 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

Hydraulic Engineering

- 160. Applied Hydraulics.** Pipe flow, compound pipe systems, network analysis. Characteristics and applications of centrifugal pumps. Uniform and varied flow in open channels and spillways. Analysis of flow in culverts on mild and steep slopes. (3 cr; prereq Hydr 103 and 104) Bowers
- 161. Hydrology.** Basic data and methods available for analysis of precipitation and runoff, including stream flow, groundwater infiltration, unit graphs, flood frequencies, flood routing, and probable maximum floods. (3 cr; prereq Hydr 101 or 103) Bowers
- 164. Water Conservation.** Weather variations and cycles, variable stream flow and water levels with respect to control in problems of public water supply, sewage disposal, water power, navigation, floods, and low water. National and state water conservation policies with discussion of typical problems. (3 cr; prereq 161 or ¶; offered when feasible)
- 166. 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. (3 cr; prereq 161)
- 263. Advanced Hydraulic Engineering Problems.** Special hydraulic problems in laboratory, drafting room, and field. (3-5 cr; prereq Hydr 183, 190, 192, or equiv, and ¶) Straub

Sanitary Engineering

- 170f,w. 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 160) Johnson
- 171w,s. 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) Johnson
- 172f. Sanitary Laboratory.** Biological, bacteriological, physical, and chemical analyses of water, waste water, air, coagulant chemicals, disinfectants, waste water sludge, etc. (3 cr) Schroeffer
- 173f.* Sanitary Engineering Problems (Water).** Investigations of problems in water supply. Supplements 170. Collection, distribution, and purification. Economic studies. (3 cr; prereq 170) Schroeffer
- 174w.* Sanitary Engineering Problems (Waste Water).** Investigations of problems in waste water treatment and industrial waste disposal. Supplements 171. Stream pollution, stream standards, economic studies of various types and degrees of treatment. (3 cr; prereq 171) Schroeffer
- 175s.* Industrial Waste Disposal.** Investigation of various types of industrial wastes and methods of disposal. Economic studies. (3 cr; prereq 174) Schroeffer
- 176f*-177w*-178s.*† Sanitary Engineering Seminar.** Reports and discussions on assigned topics in sanitary engineering with occasional talks by practicing sanitary engineers. (1 cr per qtr; required of grad students) Schroeffer
- 261w.* Water Plant Design.** Design of water purification works. (3-5 cr; prereq 173) Schroeffer
- 262s.* Waste Water Plant Design.** Design of treatment works. (3-5 cr; prereq 174) Schroeffer
- 264w. 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 cr) Schroeffer

- 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; hrs ar) Schroeppfer
- 277s.° Advanced Sanitary Engineering (Waste Water and Industrial Wastes).** Principles of sewage collection and treatment, and of industrial waste disposal. Investigation of sewage works systems. Advanced study of certain phases of sewage treatment. (3-5 cr; prereq 174) Schroeppfer

General

- 124. Railway Engineering.** Design, construction, and maintenance of railway roadbed, track, and structures. Economic principles of railway transportation. (3 cr; prereq 23 or #)
- 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 52) Schroeppfer
- 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

CLASSICS

Professor

Norman J. DeWitt
William A. McDonald
Donald C. Swanson

Associate Professor

Roy A. Swanson

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

Master's Degree—Normally offered under Plan B in Greek, Latin, classics, and classical civilization. Plan A is permitted occasionally with the consent of the graduate faculty.

Classics—Major requirement: a minimum of 27 graduate credits in a combination of courses in Greek and Latin, with a minimum of 9 credits in 1 of the 2.

Classical Civilization—Major requirement: normally 12-18 credits in Greek or Latin, plus classics (i.e., nonlanguage) courses to a total of 27 credits.

Doctor's Degree—Work for the Doctor's degree will ordinarily be concentrated in either Greek or Latin, with a minor in Latin or Greek respectively. Another field may be offered as a minor with permission of the graduate faculty, but competence in the second classical language is expected in any case.

Comparative Literature—For information on this program, see page 88.

Greek

Prerequisites—Grk 51-52-53 or the equivalent

- 101w or s. The Structure of Greek.** Application of descriptive linguistic principles to the Greek language; contrast (e.g., to English), morpheme identification, structuralization of data, linguistic patterns. (3 cr; prereq 5 qtrs Greek and Clas 56) D Swanson
- 121f-122w-123s.† Advanced Prose Composition.** (3 cr per qtr; prereq 24 cr in Greek) McDonald
- 151f. Plato: Selections.** Meets with 51, but advanced independent work in addition to regular class assignments is required. (3 cr; prereq 3 or equiv) Staff
- 152. Greek Tragic Drama.** Meets with 52, but advanced independent work in addition to regular class assignments is required. (3 cr; prereq 3 or equiv) Staff

153. **Homer.** Meets with 53, but advanced independent work in addition to regular class assignments is required. (3 cr; prereq 3 or equiv) Staff
- 171, 172, 173.* **Advanced Reading.** Since authors read vary from term to term and from year to year, this course may be repeated for credit. (3 cr per qtr; prereq 53 or Δ) Staff
- 211-212-213.* **Seminar: Greek Epic.** (3 cr per qtr; offered 1963-64) McDonald
- 241-242-243.* **Seminar: Greek Lyric Poetry.** (3 cr per qtr; offered 1962-63) R A Swanson

Latin

Prerequisites—Lat 51-52-53 or the equivalent

- 101w or s. **The Structure of Latin.** Application of descriptive linguistic principles to the Latin language; contrast (e.g., to English), morpheme identification, structuralization of data, linguistic patterns. (3 cr; prereq 3 cr in Latin above 50 and Clas 56; offered when feasible) Forbes
- 111-112-113.† **Advanced Prose Composition.** (2 cr per qtr; prereq 73) DeWitt
- 133s. **Vulgar Latin.** Development of Latin into Romance languages. (3 cr) D Swanson
- 135s. **Medieval Latin.** Survey of Latin literature from 5th to 12th century; Carolingian and 12th-century Renaissance. (3 cr; prereq #) R Swanson
- 151, 152, 153. **Survey of Latin Literature.** Meets with 51-52-53, but advanced independent work in addition to regular class assignments is required. (3 cr per qtr, §51-52-53; prereq Δ) Staff
- 171, 172, 173.* **Advanced Reading.** Since authors read vary from term to term and from year to year, this course may be repeated for credit. (3 cr per qtr; prereq 53 or Δ) Staff
- 251-252-253.* **Seminar: Roman Drama.** (3 cr per qtr; offered 1963-64) DeWitt

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 #) D Swanson
- 122w. **Introduction to Greek Archaeology.** (3 cr) McDonald
- 123s. **Introduction to Roman Archaeology.** (3 cr) McDonald
- 124f,w,s. **Technical Terminology.** Meets with 24, but advanced independent work in addition to regular class assignments is required. (3 cr, §24) Staff
- 180f. **Classical Epic in Translation.** Meets with 80, but advanced independent work in addition to regular class assignments is required. (3 cr, §80; offered 1962-63) McDonald
- 181w. **Greek Tragedy in Translation.** Meets with 81, but advanced independent work in addition to regular class assignments is required. (3 cr, §81; offered 1962-63) McDonald
- 182s. **Aristophanes and Roman Drama in Translation.** Meets with 82, but advanced independent work in addition to regular class assignments is required. (3 cr, §82; offered 1962-63) McDonald
190. **Pro-Seminar: 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; offered 1963-64) DeWitt
- 194f, 195w, 196s. **Proseminar: Introduction to Graduate Studies.** Survey of fields of research in classical scholarship, methods and bibliography, textual history and criticism. (3 cr for 194 [required of all new graduate students], 1-3 cr as appropriate for 195-196 [required of all Ph.D. candidates]) D Swanson

Sanskrit

- 128f-129w-130s. **Readings in Sanskrit.** (3 cr per qtr; prereq at least 2 Upper Division courses in early European languages; offered 1962-63 and alt yrs) D Swanson
- 131-132. **Introduction to Sanskrit.** (3 cr per qtr; prereq at least 2 Upper Division courses in early Indo-European languages, preferably Greek, Gothic, or Latin; offered when feasible) D Swanson

COMPARATIVE LITERATURE

Committee:

Professor

Eugene H. Falk, *chairman*
(Romance Languages)
John D. Hurrell (English)

Alrik Gustafson (Scandinavian)
Norman J. DeWitt (Classics)
Frank H. Wood (German)

The rapid development in recent years of instruction in world literature, the great books, and the humanities is in part a recognition that literature, like the other arts, is an international phenomenon, profitably studied in breadth as well as in depth. The University of Minnesota is equipped to offer graduate work leading to the M.A. and Ph.D. degrees in this field to candidates well grounded in two or more foreign languages.

Comparative literature may also be offered as a minor field for those majoring for the Ph.D. in the language and literature fields.

Interested students are invited to discuss their proposals with the chairman of the Program in Comparative Literature, or with one of the designated advisers, looking toward the formulation of a tentative program, adapted to the special interests and preparation of the individual candidate, for recommendation to the graduate group committee.

Well-grounded scholarly competence in comparative literature may be regarded as especially valuable for students who are looking forward to careers in teaching literature and the humanities in general, to writing, to criticism, translating, or editorial work.

Master's Degree in Comparative Literature

1. **Master's Degree**—The Master's degree is offered under Plan B only.

2. **Prerequisite for Admission**—Undergraduate major studies in one field of language and literature acceptable for major work on the graduate level in any one of the language and literature fields.

3. **Language Requirements**—Applicants for admission to this program will be expected to pass a special sight reading examination in two foreign languages. These examinations will be administered by the foreign language departments and will require a level of achievement above that necessary for the use of language as a tool for research. Normally the examination will take place during the first quarter of residence. Students ready to pass the examination in one language only during the first quarter, but who can satisfy the committee that they may successfully pass the second language examination at a later date, may be permitted to do so. No extension of this privilege will be granted beyond the third quarter of residence.

4. **Course Requirements**—(a) At least 21 graduate credits in 1 literature satisfying the minimum requirements for the major under Plan B in the field concerned; (b) at least 9 graduate credits in another literature; (c) at least 15 credits in comparative literature courses.

Ph.D. Degree in Comparative Literature

1. **Prerequisites for Admission**—A Master's degree in comparative literature, or in any one field of language and literature, or equivalent preparation.

2. **Language Requirements**—In addition to the qualifications in two foreign languages required for the Master's degree, an applicant for admission to the program leading to the Ph.D. in comparative literature will be expected to pass a graduate reading examination in a *third foreign language* by the end of the third quarter of residence. High competence in the use of English is a prerequisite for all candidates.

3. Requirements—(a) The candidate will pass a written preliminary examination in one language and literature department and satisfy the specific requirements for this examination. (b) He must also designate in his proposal his *special subfield* of study in comparative literature. This subfield may be either a chronological period or a literary type, such as the Renaissance, the Age of Reason, romanticism, the late 19th and 20th centuries, drama, fiction, poetry, literary criticism. The designated special subfield will be that of the thesis. The courses in the special subfield will be selected from offerings of at least three participating fields. The candidate will be examined on the special subfield at the final oral examination.

Comparative Literature as a Minor

1. For the Master's Degree—Nine credits in courses in comparative literature. Reading knowledge of one foreign language is assumed for the minor.

2. For the Ph.D. Degree—(a) *Language Requirement*: two languages as defined above. For a student who majors in a foreign language, the two languages must be different from the language of his major field. (b) The candidate must designate a special subfield of study as defined above.

The following are recognized as comparative literature courses: Clas 191, 192, 193; Engl 129, 134, 180, 184, 185, 186; Ger 190-191-192, 190A-191A-192A; Scan 161, 171, 172; Span 161-162-163.

211. Epic Poetry of the Middle Ages. Reading of outstanding epics—in translation when necessary; discussion of their literary values and history of the genre. (3 cr; reading knowledge of 1 European language in the medieval form recommended) Pattison

212. Lyric Poetry of the Middle Ages. From Latin poets through Provençal troubadours; diffusion throughout Europe down to age of Petrarch. (3 cr; reading knowledge of 1 European language in medieval form recommended) Pattison

213. Romances and Tales of the Middle Ages. Medieval forerunners of the novel and short story; their origin, development, and influences. (3 cr; reading knowledge of 1 European language in medieval form recommended) Pattison

221-222-223. Seminar in Comparative Literature. Affords students opportunity for guided research in a few selected areas with due regard for methods applicable in comparative literature. (C- ar) Comparative Literature Committee

DAIRY HUSBANDRY

Professor

Clarence L. Cole
Edmund F. Graham
Jesse B. Williams

Associate Professor

John D. Donker

Assistant Professor

Charles W. Young

Prerequisites—For major work, emphasis on preparation in chemistry, genetics, animal physiology, and mathematics. When the preparation appears inadequate additional courses may be required.

Language Requirement—Reading knowledge of one foreign language is advised although not required for the Master's degree. For the Ph.D. degree, this requirement may be met by (a) 2 foreign languages or (b) 1 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.

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

105. Dairy Literature Seminar. Investigation and study of 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 3 courses in dairy husbandry)

121. **Dairy Production I.** Structure and function of cow's udder; phenomenon of milk let-down, factors involved in milking, factors affecting composition of milk. Application of principles of nutrition and economics to feeding dairy stock; feeding standards. Feed additives, nutritional disorders, and forage utilization. (4 cr; prereq AnHu 36 and 37 recommended) Donker
122. **Dairy Production II.** Methods of improving dairy cattle; application of genetic principles to breeding and selection. (4 cr; prereq 49, Agro 30 or equiv) Young
123. **Dairy Production III.** Application of fundamental theories and practices to dairy cattle management. Lectures and laboratory exercises in care of cows and bulls, breeding efficiency, arrangement of buildings and stables, preparation of feed and bedding budgets for dairy enterprise. (4 cr; prereq 49) Williams
149. **Reproduction and Artificial Insemination.** (See DyHu 49) (3 cr) Graham
199. **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.** Facilities for study and investigation. (Cr ar; open in Summer Session only to those who have had prelim grad work) Graham, Williams, Donker, Cole
216. **Dairy Husbandry Seminar.** (1 cr) Cole
217. **Dairy Cattle Inheritance.** Review of research in dairy cattle breeding and selection. (3 cr; prereq #) Young
218. **Review of Advances in Nutrition and Feeding of Dairy Cattle.** (3 cr; prereq #) 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 #) Graham
220. **Lactation.** Recent advances in field of development and functioning of mammary gland. (3 cr)
- 222w.* **Energy in Animal Nutrition.** Role; sources of energy 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 AnHu 37, 37A, AgBi 6 or #...AgBi 116 recommended; offered 1962-63 and alt yrs) Donker
- 223s.* **Protein and Amino Acid Nutrition.** Role; sources, how determined, measurements of protein quality, fate and use of ingested protein and interrelationships with other nutrients. (3 cr; prereq AnHu 37, 37A, AgBi 6 or equiv or #...AgBi 116 recommended; offered 1962-63 and alt yrs) Meade
- 224w.* **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 AgBi 6 or #...AgBi 124 recommended; offered 1963-64 and alt yrs) Waibel
- 225s.* **Mineral Nutrition.** Principles of mineral nutrition for poultry, swine, sheep, dairy and beef cattle; mineral requirements, interrelationships, utilization, and metabolism are stressed. (3 cr; prereq AgBi 6; offered 1964 and alt yrs) Suetsinger
- 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 AnHu 37, 37A, AgBi 6 or #...MicB 121, 123 recommended) Kolari

DAIRY INDUSTRIES

Professor

Samuel T. Coulter
James J. Jezeski
Harold Macy

Howard A. Morris
Joseph C. Olson, Jr.
Elmer L. Thomas

Prerequisites—For a major with emphasis on dairy products, an adequate background in microbiology, chemistry, economics, mathematics, and physics is required; for a major with emphasis on dairy bacteriology, courses in microbiology, chemistry, mathematics, physics, and dairy products are suggested. In those instances where the preparation appears inadequate, additional courses may be required.

Major and Minor—The M.S. and Ph.D. degrees may be taken with major emphasis either on dairy products or dairy bacteriology. It is suggested that students present a minor in one of the following fields: agricultural biochemistry, chemical engineering, public health, economics, or business administration. Students are discouraged from taking a minor in another food processing field.

Language Requirement—Reading knowledge of one foreign language is advised but not required for the Master's degree. For the Ph.D. degree, this requirement may be met by (a) 2 foreign languages or (b) 1 foreign language and the option of a special research technique or a collateral field of knowledge.

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. Dairy Industries Literature Seminar.** Selected topics. Dairy literature. Preparation of bibliographies. Each student presents papers and reports on assigned subjects and reviews scientific investigations in dairy industries. (2 cr) Jezeski
- 101. Condensed Milk Products.** Manufacture of condensed milk products; physical and chemical processes and engineering problems. Lectures and laboratory. (3 cr) Morris
- 102. Dry Milk Products.** Manufacture of dry milk products; physical and chemical processes and engineering problems. Lectures and laboratory. (3 cr; prereq 101) Coulter
- 103. Market Milk.** Processing and distribution of market milk and related products; physical, chemical, and bacteriological problems; organization, design, equipment, and operation of milk plants; problems of public control. Lectures and laboratory. (3 cr) Thomas
- 104. Ice Cream and Frozen Dairy Foods.** Manufacture of ice cream; chemical and physical processes. Organization, construction, equipment, and operation of such factories. Lectures and laboratory exercises. (3 cr) Thomas
- 105. Butter.** Chemical and microbiological processes in manufacture of butter. Organization, construction, equipment, and operation of such factories. Laboratory exercises. (3 cr) Coulter
- 106. Cheese.** Manufacture of cheese; chemical, microbiological, and physical processes. Lectures and laboratory exercises. (3 cr) Morris
- 107. Technical Control of Dairy Products.** Chemical and microbiological laboratory methods used in technical control of milk and its products. Lectures and laboratory. (3 cr) Jezeski
- 130. Advanced Dairy Products Judging.** Fundamentals of organoleptic examination of dairy products; psychological and physiological factors. (1 cr) Thomas
- 150. Dairy Bacteriology.** (See DInd 50) (3 cr; prereq MicB 53) Olson
- 151. Advanced Dairy Bacteriology.** Investigations of specific problems on microbiology and mycology of milk and dairy products. (3 cr; prereq 50 or equiv, 105 or 106) Jezeski
- 205x.* General Seminar.** Review of literature and discussion of research problems and developments related to dairy products and dairy bacteriology. (1 cr) Staff
- 210x.* Research in Dairy Products.** Problems assigned to fit needs of student. (2-5 cr per qtr) Staff
- 212x.* Research in Dairy Bacteriology.** Problems assigned to fit needs of student. (2-5 cr per qtr) Staff

DENTISTRY

For staff and courses of study offered, see the *Bulletin of Graduate Programs in Medicine, Dentistry, and Pharmacy*, 1961-63.

ECONOMICS

Professor

John A. Buttrick
Francis M. Boddy
Martin Bronfenbrenner
O. H. Brownlee
John S. Chipman
Walter W. Heller
James M. Henderson
Leonid Hurwicz
I. Richard Savage
Jacob Schmookler
Tore Thonstad (visiting)
John G. Turnbull

Associate Professor

Arthur M. Borak
Edward Coen
John H. Kareken
E. Scott Maynes
Herbert Mohring
Norman J. Simler
Harlan M. Smith

Assistant Professor

Edward M. Foster
Peter Gregory
John C. Hause
Anne O. Krueger
George L. Perry
Marcel K. Richter
Larry A. Sjaastad

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 2 foreign languages or of 1 foreign language and either a collateral field or an approved research technique.

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. (3 cr; prereq 101A or #) Staff
- 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, 66 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 associated with urban growth. (3 cr; prereq 165, 166 or #) Mohring
- 150A, B. Current Economic Issues.** Current controversies over economic policy and problems that underlie controversies. Selected topics. (3 cr per qtr [with # course may be taken more than once]; prereq 65, 66 or equiv) Smith
- 160. Comparative Economic Systems.** Functions of all economic systems; theories of alternative economic systems—the market economy, liberal socialism, the centrally planned economy. Analysis of American and Soviet economies. (3 cr; prereq 2 or equiv) 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
- 180A, B. History of Economic Thought.** Principal economic writings of the past. 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
- 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 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
- 290. Individual Graduate Research.** (Cr ar) Staff

- 300. Seminar in 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 53 or equiv) Chipman, Richter
- 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; evaluation of various allocative mechanisms and government policies. (3 cr; prereq 185A) Brownlee, Buttrick, Richter
- 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
- 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 #) Bronfenbrenner, Brownlee
- 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) Boddy, Bronfenbrenner
- 185B. Advanced Microeconomics.** Price and output policies under conditions of imperfect competition. Problems of choice under conditions of uncertainty. (3 cr; prereq 185A or #) Boddy
- 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) Bronfenbrenner
- 195A-B-C. Decision Making and Operations Analysis.** Applications of various mathematical techniques of maximization and minimization to business problems. Calculus, linear programming, non-linear 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 165, Math 53 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 #) Brownlee, Hurwicz
- 245A-B-C. Mathematical Economics.** Mathematical models underlying contemporary economic theory. (3 cr per qtr; prereq 135C or #) Chipman, Hurwicz
- 335. Seminar in 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.** 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 40 or ¶Math 40 for 121A, Math 53 or ¶Math 53 for 121B or #) Savage and others

- 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, 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, Hurwicz
- 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) Gregory, Simler, Turnbull

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; prereq 2 or equiv or #) Staff
- 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
- 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 economics problems: exchange controls, land reform, inflation and fluctuation in prices of basic commodities. Evaluation of foreign aid proposals. (3 cr; prereq 2 or equiv) Brownlee, Chipman, Gregory

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) Bronfenbrenner
- 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) Bronfenbrenner, Buttrick, Thonstad

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; prereq 2 or equiv) Staff
- 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 #) Coen, Krueger, Sjaastad
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, Thonstad

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) 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.** Economic effects of various kinds and amounts of taxes, public debt and public expenditures with emphasis on resource allocation, employment, and income distribution. (3 cr per qtr; prereq 65, 66 or equiv or #) Brownlee, Heller, Richter
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) Borak
- 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 in 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 economics, 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 #) Boddy, Mohring, Simler
- 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, Simler

EDUCATION

Professor

Walter W. Cook
 Robert H. Beck
 Emma M. Birkmaier
 Clarence H. Boeck
 Guy L. Bond
 Henry Borow
 Marjorie M. Brown
 Theodore W. Clymer
 Otto E. Domian
 Richard L. Donnelly
 Willis E. Dugan
 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
 Clifford P. Hooker
 Eloise M. Jaeger
 Donovan A. Johnson
 Robert J. Keller
 Harry W. Kitts
 George H. McCune
 Keith N. McFarland
 Gordon M. A. Mork
 Horace T. Morse
 Howard F. Nelson

Paul M. Oberg
 Milo J. Peterson
 Ralph A. Piper
 Raymond G. Price
 Maynard C. Reynolds
 John E. Stecklein
 Louise A. Stedman
 Gordon I. Swanson
 E. Paul Torrance
 Tracy F. Tyler
 Harold T. Widdowson
 C. Gilbert Wrenn

Associate Professor

Bruce E. Balow
 Arnold F. Caswell
 Frederick M. Chapman
 Naomi C. Chase
 Raymond O. Collier
 Mary E. Corcoran
 James R. Curtin
 Dewey G. Force
 Robert Giles
 Charles J. Glotzbach
 Amy J. Holmblade
 Cyril J. Hoyt
 Paul S. Ivory
 William Kavanaugh
 Stanley B. Kegler
 Jack C. Merwin
 Warren G. Meyer

R. Norine Odland
 Samuel H. Popper
 Vincent R. Rogers
 Helen M. Slocum
 Timothy L. Smith
 Martin Snoke
 Willard W. Tennyson
 Edith West
 Roger E. Wilk
 Marjorie U. Wilson

Assistant Professor

Ayers Bagley
 Donald H. Blocher
 Jan D. Duker
 William E. Gardner
 Joe Hogan
 Bjorn Karlsen
 Theodore E. Kellogg
 R. Paul Marvin
 Daniel C. Neale
 Robert Orlando
 Neville P. Pearson
 LaVerne F. Snoxell
 Eugene E. Stish
 Franklin J. Thompson

Lecturer

Gerald B. Fitzgerald

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) 2 foreign languages or (b) 1 foreign language and the option of a special research technique or a collateral field of knowledge.

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.

** See Notes to Applicants for Admission to Graduate School, below.

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 | History and philosophy of education |
| Art education | Home economics education |
| Curriculum and instruction** | Industrial education |
| Education (in special cases)** | Music education |
| Educational administration** | Physical education |
| Educational psychology** | |

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)

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; at the Ph.D. level this major includes programs with varying emphases, as indicated below 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

** See Notes to Applicants for Admission to Graduate School, on this page.

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 | History and philosophy of education |
| Curriculum and instruction | Home economics education |
| Education | Industrial education |
| Educational administration | Physical education |
| Educational psychology | |

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.

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 related program for the Master's

** For detailed information, write to the department concerned.

degree in secondary school administration and supervision. The program emphasizes secondary school curriculum and instruction with support in educational psychology and child development 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.

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 development, 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 the 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.

[Master of Education Degree—Advanced work leading to the professional degree of master of education is offered by the College of Education in agricultural education, art education, elementary education, English education, home economics education, industrial education, mathematics, music education, natural sciences, physical education, recreation leadership, rural education, and social studies. Students interested in any of these programs should secure a *Bulletin of the College of Education* and consult an adviser.]

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
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, etc. Developing a continuing program. Observation of adult education programs. (4 cr) 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.^o **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) 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 #; offered when feasible) Nelson
- 141x. **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) Peterson, Marvin
145. **High School Curriculum in Vocational Agriculture.** Philosophy, organization, and administration of instruction in agriculture departments in the secondary schools. (3 cr; prereq 10 cr in education) Swanson
- 156.^o **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) Swanson
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 of teaching agriculture. To assess innovations and procedures. Includes 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.^o **Research in Agricultural Education.** Investigational work in teaching of agriculture in high schools. 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; organizing supervisory activities; aids to effective supervision. (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) Peterson
286. **Current Issues in Agricultural Education.** Problems related to local school programs. (Cr ar; prereq #) Peterson, Kitts, Swanson
- 291x. **Seminar: Agricultural Education.** (Cr ar) Staff

Art Education

- 151-152-153. **Curriculum Building in Art Education.** Functions of art in society. Selection, evaluation, and organization of material for teaching units and projects. (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.** Evaluation and utilization of research findings and introduction of new materials. Development of 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. General research and 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; locating, defining, and studying basic problems. (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; registration by special consent of major adviser) Gayne, Hastie
- 296x. **Seminar: Art Education.** Reports, evaluation of problems, recent literature. (1 cr; open to advanced students in education) 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) Nolte
- 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 of 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
- 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; exploration of historical background, philosophy, related sociological and psychological problems. (3 cr; prereq #) Kenmore
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 #) Kenmore
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) Kenmore

133. **Economic and 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 143 or 144 or equiv) Bond, 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
- 171x. **Curriculum Laboratory Practice.** Analysis and construction of units, courses of study, and curriculums according to needs, interests, level, and specialization. (0-3 cr per qtr; prereq 170A or B, #) 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 Spch 61, 67, 161, 162, 163) 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 #) Kantar, Kenmore
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 #) Kenmore
- 201x.* **Problems: Teaching Social Studies.** Individual research. (3 cr per qtr; prereq 102 or 155 or 168, 204 or #) Morse, McCune, West, Gardner, Rogers
203. **Supervision and Administration of Special Education.** Administrative and supervisory 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)
240. **Workshop: Improvement of Instruction.** For school principals, superintendents, and supervisors especially responsible for instructional programs in a school system. Aims to develop understanding of instruction and instructional problems from kindergarten through secondary school—development and organization of instructional materials, programs for gifted and handicapped, courses of study, instructional planning. (1-4 cr)
243. **Recent Research in Reading.** Critical analysis of methodology and findings of current research. Appraising research methods, population limitations, and educational implications. (3 cr; prereq #) Bond, Clymer
- 271x.* **Problems: Curriculum Construction.** Individual research. (Cr ar; prereq #) Birkmaier, Boeck, Curtin, Goossen, D Johnson, Chase, Odland, Rogers
- 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 #) Bond, Clymer, Reynolds, Balow, Chase, Odland, Kegler
- 296x.* **Problems: Teaching English.** For those qualified to undertake individual research. (Cr ar) Chase, Kegler

ELEMENTARY EDUCATION

102. **Teaching and Supervision of the Social Studies in the Elementary School.** Examination of the content and organization of social studies programs; emphasis on programs of understanding, improving the learning situation, and effective use of materials. (3 cr; prereq Ed 75B or equiv)
103. **Teaching of Science in Elementary School.** Resources, materials and their application in elementary grades. (3 cr; prereq Ed 75B or tchg exper) Goossen
110. **Practicum in Laboratory School Teaching (K-6).** Experience in teaching and/or research with a class of children in the University Elementary School. (Cr ar; prereq elementary student

- tchg or elementary school tchg, consent of adviser, director of elementary school, and coordinator of elementary student tchg)
118. **Education of Blind Children in the Elementary Grades.** Adaptation of broad curriculum areas for blind children in elementary grades; procedures in teaching specialized curriculum: Braille reading, typing, orientation, and mobility; utilization of family, school, and community resources. (3 cr; prereq 115, 116 and #) Kenmore
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 for elementary schools. (3 cr)
143. **Teaching and Supervision of Reading in the Elementary School.** Objectives, materials, and teaching procedures in lower and intermediate grades; 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) Bond
149. **Teaching and Supervision of Mathematics in the Elementary School.** Present practices and trends in methods, materials, and curriculum development; review of curriculum studies; evaluation and diagnosis; literature on current issues and problems. (3 cr; prereq 9 cr in education) Stochl
150. **Supervision and Improvement of Instruction.** Functions and duties of a supervisor in the improvement of instruction; specific supervisory technique, objective analysis of classroom activities; applications to present-day problems. (3 cr; prereq 9 cr in education) Goossen, Curtin
- 153x. **Teaching and Supervision of English in the Elementary Schools.** Improvement of instruction in language, spelling, and handwriting. (3 cr; prereq Ed 75B or equiv) Chase
- 165A,B. **Arithmetic for Gifted Children.** Psychology of giftedness in general and mathematics in particular. Social aspects. Development of creative thinking in children. Discovery, generalization, analogy, and abstraction. Laws of arithmetic. Elementary theory of numbers. Geometric intuition. Combinatorics and probability. Source materials for teachers. Illustration of procedures. (3 cr per qtr; prereq none for 165A, 165A for 165B) Stochl
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
- 170A. **Curriculum and Course of Study Construction.** Principles and methods for selection and organization of units, courses of study, and curriculums at the elementary school level. (3 cr; prereq 119 or #) Goossen
- 173A. **Organizing Units of Instruction in the Elementary School.** Principles and procedures involved in organizing units, utilizing natural science and social studies in development of skills in reading and study, oral and written composition, arithmetic, and the arts. (3 cr; prereq 119 or tchg exper) Goossen
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)
- 226x. **Seminar: Elementary School Problems.** (No cr) Bond, Clymer, Curtin, Goossen
257. **Research in Language Instruction in the Elementary Schools.** Recent research dealing with methods, materials, and program of instruction in listening, speaking, writing, spelling, and handwriting. (3 cr; prereq 153 or equiv)
- 261x.* **Problems: Improvement of Instruction.** Primarily for students qualified to make intensive studies of problems related to school supervision. (Cr ar; prereq #) Goossen, Curtin, Chase, Odland, Rogers, Stochl
263. **Research in Mathematics Instruction in the Elementary School.** Recent research in curriculum, gradation of subject matter, methods, materials, and supervision of arithmetic. (3 cr) Stochl
264. **Research in Educational Diagnosis.** Recent research in methods of diagnosis in education, and techniques of preventive and remedial teaching. (3 cr) Bond, Clymer

SECONDARY EDUCATION

101. **Driver Education.** Materials and methods of driver education, planned to meet requirements of State Department of Education for driver education in schools. (3 cr; prereq Δ) Gebhard
- 113x. **High School Curriculum.** Viewpoints and curriculum issues, reorganization trends, typical research findings by subjects, and analysis of state and local curriculums. (3 cr; prereq Ed 55B or equiv)

114. **Development of the Core Curriculum.** Planning and administering the core curriculum; its philosophical, psychological, and educational bases; preparation of the core teacher. (3 cr)
120. **Education of Blind Students in the Secondary Schools.** Adaptation of curriculum of junior-senior high school for blind students. Preparation of educational materials. Consideration of reader service, orientation and mobility, specialized equipment; utilization of guidance and counseling services, local, state, and national resources. (3 cr; prereq EdCI 115, 116, 118, and §) Kenmore
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
124. **Foundations of Career Development.** Evaluation of vocational theory and career development research; occupational analysis and industrial structure; critical examination of 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)
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 §) Dugan, Tennyson
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
134. **Materials and Methods in Economic and Consumer Education.** Development of teaching units; evaluation of printed and audio-visual materials; survey of teaching procedures. (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 §) Dugan, Tennyson
136. **Organization and Administration of Distributive Education.** Principles, practices, and legislation followed in developing co-operative part-time and adult programs under Smith-Hughes and George-Barden 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 of Reading in Secondary Schools.** Procedures, objectives, and materials for teaching reading in subject-matter fields. (3 cr; prereq 9 cr in education) Bond, Clymer, Chase, Kegler
147. **Materials and Methods in Teaching.** Practice in using equipment. (3 cr; prereq §) 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
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 90A-B-C or §) Meyer

161. **Curriculum Construction in Business Education.** Curriculum problems; organization and preparation of teaching units. (3 cr; prereq 113) Price
168. **Current Developments in the Social Studies.** Contemporary literature, curricular trends, and developments in methods. (3 cr) McCune, Gardner
169. **Extracurricular Activities.** Aims and values; practices in organizing, administering, and supervising; methods of evaluation. (3 cr; prereq Ed 55B or equiv) Popper
- 170B. **Curriculum and Course of Study Construction.** Principles and methods for selection and organization of units, courses of study, and curriculums. (3 cr; prereq 113 or 119 or #)
- 173B. **Organizing Units of Instruction in the Secondary School.** Development of principles and procedures for constructing units of instruction. (3 cr; prereq 113 or #)
191. **Advanced Teaching and Supervision of Secondary Mathematics.** Present practices in methods, materials, and curriculum development; principles of learning applied to mathematics; review of research; preparation and evaluation of units, tests, and materials of instruction. (3 cr) D 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) D Johnson
- 199E. **Internship.** (Cr ar; available for MEd students in recreation; ar) Mork
204. **Social Studies Curriculum.** History, techniques, and practices at all grade levels. (3 cr) West, Gardner
- 222x. **Seminar: Current Problems in Techniques of High School Instruction.** (Cr ar or no cr; prereq Ed 55B and sr methods) Keller, Popper, Gardner
- 225x.* **Problems: Secondary School Supervision.** An individual problems course on improvement of instruction. (Cr ar; prereq #) Keller
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
- 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
266. **Supervision of High School Instruction.** Present status, proper scope and function, principles, application to improvement of instruction. (3 cr; prereq EPsy 193 or 293 or #) Keller
280. **Supervision of Counseling.** Seminar for advanced graduate students majoring in counselor preparation. Lectures, seminar discussions, review and analysis of recorded interviews, critiques of counseling practicum and observation of practicum experiences in counseling included as basic activities. (3 cr; prereq #) Dugan, Blocher, Soldahl, Tennyson
- 287.* **Advanced Teaching of Science.** Recent developments; evaluation of investigations dealing with science teaching. (3 cr) Boeck
- 294x.* **Advanced Teaching of Materials and Methods in Secondary School English.** Evaluates present content and method in light of research and recent trends in teaching. (2 cr per qtr; prereq EdT 75C or equiv) 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 of 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 of higher education; 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, Wrenn, 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.** An individualized program under guidance of an instructor or department. Emphasizes 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, Wrenn, others
- 284x.* Problems: Student Teaching.** Research in supervision, organization, and administration of student teaching 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 neither 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

GENERAL COURSES

- 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)
- 117. Schools in Rural Areas.** Administrative and curricular problems peculiar to rural areas; sociological changes in small towns and farm life. Building a school program suited to the culture and needs of people in smaller towns and villages. (3 cr)
- 118. The Community School.** Philosophy, purposes, organization, and functioning of the community school, including study of its relationships with the area it serves. (3 cr)
- 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 course)
- 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) Domian, Hooker
- 211. School Business Management.** Administration of school business affairs. (3 cr; prereq 210 or #) Domian
- 224. Legal Aspects of Public School Administration.** Constitutional, statutory, and common law bases; principles growing out of fundamental legal procedures. (3 cr)
- 226. School Plant Planning and Management.** Plant program planning and financing, including operation and maintenance of public school buildings. (3 cr) Domian, Hooker
- 227. Teacher and Employee Administration.** Selection and placement of school employees, salary schedules, conditions of service, records and reports, and legal aspects. (3 cr)
- 228x.* Special Problems: Educational Administration.** For superintendents and principals qualified to make intensive studies of administration of a school system. (1-3 cr per qtr) Domian, Hooker, Keller, Popper
- 230. Public School Community Relations.** Theory and practice of educational interpretation. Principles involved; 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, and organizing material for press, radio, and television; planning, writing, and designing 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 within a specific school system. (1-4 cr; prereq course in school business management or #) Domian
- 235x. **Seminar: Educational Administration.** Administrative decision-making through case method. Cases and concepts covering human relations, curriculum, school-community relations, instructional problems. Students analyze decision-making processes involved and use the research and writings in fields covered. (1-3 cr; prereq MA in educational administration or #) Domian
- 236x. **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 #) Staff
237. **Seminar: Educational Law.** Legal theory as it applies to education. (1-3 cr; prereq 224 or #) Hooker
238. **Seminar: Research and Theory in Educational Administration.** For advanced graduate students. Problems of theory, models, and design in administration; developing and testing meaningful hypotheses. Consideration of theoretical designs used in behavioral sciences and of means used to test hypotheses. Students develop proposals and design models for empirical research. (1-3 cr)

ELEMENTARY EDUCATION

200. **Seminar: Elementary School Administration.** For elementary school principals. Problems of administration and organization of instruction. (3 cr) Curtin, Goossen
215. **The Elementary School Principalship.** Specific problems in elementary school administration and the principal's unique role of leadership in elementary education. (3 cr) Curtin
- 270A.* **Problems in Elementary Education.** (Cr ar; prereq #) Bond, Clymer, Curtin, Goossen

SECONDARY EDUCATION

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
- 218x. **Seminar: Secondary Education.** Current problems and literature. (Cr ar) Keller, Popper, others
- 233x. **Workshop: Junior High School.** Projects related to concerns of registrants, such as articulation with elementary and senior high school; organizing curriculum; development of curricular materials; producing an organization to meet needs of the preadolescent; activity programs; guidance functions. (1-4 cr) Popper
264. **The Secondary School Principalship.** Factors affecting administration, staff, and student relationships, intra-school relationships, school services. (3 cr)
265. **The High School Program.** Scheduling, administrative practices affecting learning, the academic program, community relationships, program evaluation. (3 cr)
- 270B.* **Problems in Secondary Education.** (Cr ar; prereq #) Domian, Hooker, Keller, Popper, Thompson

HIGHER EDUCATION

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; offered when feasible) Morse
274. **The Junior College.** Present status, development, functions, organization, curriculum, and trends. (3 cr) Keller
290. **Financing Higher Education.** (3 cr; prereq #; offered when feasible)
291. **Public Relations for Colleges and Universities.** (3 cr; prereq #; offered when feasible)

Educational Psychology

GENERAL COURSES

100. **Individual Appraisal for Counseling.** Analysis of appraisal techniques; use in guidance and counseling. (3 cr; prereq 9 cr in education; offered when feasible)
- 110x. **Educational Measurement in the Classroom.** Principles and methods for construction, evaluation, and improvement of educational measurements in classroom instruction. (3 cr) Stecklein, Corcoran, Kellogg, Merwin

- 116x. Introduction to Statistical Methods.** Basic statistical techniques in educational work. Comprehension of literature using elementary statistical concepts and methods. Not equivalent to EPsy 216, 216A. (3 cr; not open to Master's or PhD degree candidates who will take more than 1 qtr of statistics; prereq ¶116A or §) Collier, MacEachern
- 116Ax. Introduction to Statistical Methods—Laboratory.** (See EPsy 116) (2 cr)
- 117x. Basic Principles of Measurement.** Role of measurement in educational work; principles underlying construction of achievement examinations; developments in educational and psychological measurement; measurement theory and practice as related to appropriate statistical methods; types and uses of derived scores, and factors influencing reliability and validity of educational measurements. (3 cr; prereq 116 or 216 or Psy 70 or equiv) Stecklein, Corcoran, Merwin, Lathrop
- 133. Basic Procedures in Student Personnel Work.** Principles and current practices in development and operation of a student personnel program; guidance services and related techniques. (3 cr; prereq 9 cr in education) Dugan, Tennyson, Blocher, Soldahl
- 140. Instruments and Techniques of Measurement.** Measuring intelligence, achievement, interests, attitudes, and personality traits; using measurement in educational guidance, personnel work, administration, and supervision. (3 cr; prereq 110 or 117) Edson, Merwin
- 142x. Individual Mental Testing.** Revised Stanford-Binet and Wechsler Adult Intelligence Scale 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; prereq 110 or 117 or ¶117 with §) Duker
- 143. Advanced Individual Mental Testing.** Development of proficiency in administering and interpreting 3 or 4 selected individual mental tests. Limited practicum involved. (3 cr; prereq 142 and §) Balow
- 148x. Clinical Diagnosis of Reading Difficulties.** Psychology of reading difficulties; clinical diagnosis of reading problems, their relationship to psychological factors, and their clinical remedial correction. (3 cr; prereq EdCI 145) Bond, Clymer, Balow
- 150x. Clinical Practice in Remedial Teaching.** Remedial tutoring of individual children who have difficulty in school learning. (3 cr; prereq EdCI 145 or 151, §) Balow, others
- 151x. Clinical Practice in Educational Diagnosis.** Education, interview technique, preparation of case reports. Work with children referred to the Psycho-Educational Clinic. (3 cr per qtr; prereq 142 or EdCI 145, and §) Balow, others
- 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
- 159x. 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) Wrenn, Torrance
- 182. Education of Exceptional Children.** Overview of field of special education. Especially for classroom teachers, counselors, supervisors, and administrators; also the initial course for students working for special class certificates. Reports on individual work equivalent to 1 credit. (3 cr; prereq Ed 55B or 75B or equiv) Force, Reynolds, Karlson
- 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. Education of Mentally Retarded Children in the Elementary Schools.** Curriculum, materials, and methods of instruction in special classes for educable mentally retarded children in the elementary schools. Problems of administration, diagnosis, parent counseling. Field trips when possible. (3 cr; prereq 182 or §) Force
- 186. Seminar: Education of Emotionally Disturbed and Socially Maladjusted Children.** Discussion and critical evaluation of curriculum, materials, and methods for instruction of disturbed and delinquent children in hospital, training school, and public school settings. (1 cr per qtr; prereq §) Balow
- 187. Education of Crippled Children.** Characteristics and abilities of crippled children; methods and materials for their training; observation of teaching situations involving these groups. Personal consultation scheduled in addition to class hours. (3 cr; prereq 182 or §) Force
- 190. Educational Problems of Cerebral Palsy.** The unique problems in development, learning, and adjustment produced by cerebral palsy. Study and development of materials to meet the special educational needs. Observations of teaching the cerebral palsied and personal conferences will be included. (3 cr; prereq 182 or §) Force
- 191. Education of the Mentally Retarded in Secondary Schools.** Curriculum, materials, and methods of instruction for educable mentally retarded students in secondary schools. Philosophy,

administration, vocational and personal guidance, parent consultation, and work programs. Field trips when possible. (3 cr; prereq 182 or §) Karlsen

Note—Additional courses in special education (pertaining to the blind, deaf, mentally retarded, etc.) are offered in Summer Session. For specific offerings, check the *Bulletin of the Summer Session* or write to the Special Education Laboratory, 14 Pattee Hall.

193. **Psychology of Human Learning.** Application to school situations: motivation; rate of learning and forgetting; teaching of skills, meanings, attitudes; reasoning and problem solving; transfer of learning. (3 cr) Neale
- 200x. **Seminar Institute in Guidance.** Participants selected in advance. (1-3 cr per qtr; prereq §)
201. **Seminar: Counseling Needs of Able Students.** (3 cr; offered when feasible) Berdie, Dugan
- 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) Collier, Wilk
- 216-217-218. **Statistical Methods in Education.** Foundations of statistical theory; practice in applying theories to solution of educational and psychological problems. (3 cr per qtr) Collier
- 216A-217A-218A. **Statistical Methods in Education—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)
219. **Design and Analysis of Statistical Investigations.** Functional approach to principles of efficient design of experiments and other types of observational programs; improved sampling techniques and appropriate methods of analyzing observational results. (3 cr; prereq 218, §) Collier
- 219A. **Design and Analysis of Statistical Investigations—Laboratory.** Applicational extension of 219. (2 cr; recommended for all students taking 219; sections limited to 18; prereq 218, §)
- 220-221. **Advanced Theory of Measurements.** 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. (2 cr per qtr; prereq 117 and 217 or equiv or §) Hoyt
225. **Counseling Theory and Procedure I.** Influences bearing on 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 1 of the following: 133, 250, or Psy 130) Wrenn
- 226.* **Counseling Theory and Procedure II.** Dimensions of counseling relationship; dynamics of interviewing; distinction between psychotherapy and counseling; treatment of factors related to counseling—counselor attitude and personality; applications of counseling in different settings. (3 cr; prereq 225 or equiv) Wrenn
- 233x.* **Problems: Guidance and Personnel Work.** Independent study. No class meetings. (1-9 cr) Dugan, Edson, Hagenah, Wrenn, Glotzbach, Merwin, Tennyson, Wilk, Blocher
234. **Seminar: Counseling Theory and Research.** Examination of theoretical positions in learning and personality development as related to an emerging theory of counseling; review of recent research in counseling with special reference to evaluation. (3 cr) Dugan, Blocher, special lecturers
- 240x.* **Problems: Measurement.** Intensive study and individual research. (3 cr per qtr) Hoyt
- 243x.* **Problems: Statistics for Students in Education and Psychology.** Recent developments in statistical science; their application to educational and psychological problems. (3 cr per qtr)
244. **Research in Special Education.** Review of recent research in special education, consideration of needed research, and problems in research design. (1 cr per qtr; prereq 116, 117 or equiv, and §) Force, Reynolds, Karlsen, Orlando
- 253x.* **Research Problems.** (Cr ar; prereq §)
259. **Personality Theory in Mental Hygiene.** Major concepts of 5 or 6 selected personality theories examined for mental health implications. Understanding dynamics of personality development and implications for personality assessment for prophylaxis and creation of healthy conditions in groups, for identification of individuals needing special help and for psychotherapy. Theory, research, and modern practices. Preparation of counselors, classroom teachers, administrators, supervisors, curriculum specialists, social workers, and other mental hygiene workers. (3 cr) Torrance

- 260x. Educational Psychology Seminar.** For all Ph.D. majors in educational psychology. Purposes include: integrating course work in all areas of educational psychology and related fields, analyzing new developments, and presenting Ph.D. dissertation outlines. (No cr) Staff
- 261. Survey of Theory and Research in Education of the Mentally Retarded.** Critical review of research findings and relevant theoretical formulations. Study of important contributions in primary sources concerning principles of behavior and applied problems. (3 cr; prereq #) Orlando
- 262. Functional Analysis of Behavior in Mental Retardates.** An empirical theory of retarded development based on experimental research in perception, learning, motivation, and emotion; derived principles of behavior applied to a variety of specific problems in education of the retarded. (3 cr; prereq 261) Orlando
- 263. Education of the Retarded: Research Design and Interpretation.** Detailed treatment of objectives, selection of problems, design, methodology, interpretation, and reporting of experimental research in education and training of the mentally retarded. Origin and implementation of researchable questions, with training and practice through study of research reported in the literature. (3 cr; prereq 261, 262) Orlando
- 264. Assessment of the Handicapped.** Individual assessment of intelligence, achievement, personality, and vocational aptitudes and interests; limited practicum required. (3 cr; prereq 142) Karlsen
- 287. Practicum in School Psychological Services.** (1-3 cr; prereq #) Duker
- 288. Practicum in Special Education.** Individually arranged, supervised experience in special education. May include supervision, administration or co-ordination, teaching and related work in schools, agencies, institutions, and other facilities for exceptional children. (3-9 cr; prereq #) Reynolds, Force, Karlsen, Kenmore
- 289. Survey of Special Education Problems.** Advanced course for persons working in special education or in allied fields. (3 cr; prereq 182 or exper, and #) Reynolds
- 290. Advanced Counseling Practicum.** Open only to students selected in advanced institute provided under the National Defense Education Act. Emphasis on identification of talent and counseling of superior students. (3 cr; prereq #) Dugan
- 292. Recent Literature in Educational Psychology.** (3 cr; prereq #) Borow, Hoyt
- 293.* Psychology of Learning.** Principles and research in human learning and implications for curriculum and instruction. (3 cr; prereq 12 cr in psychology and educational psychology) Neale
- 294.* Recent Theory and Research in Human Learning.** (3 cr; prereq #)

SECONDARY EDUCATION

- 134. School Counseling Procedures.** Basic principles and practices related to the work of counselors in the public schools. Lectures, discussion, audio-visual aids, practice in case study analysis and interviewing. (3 cr; prereq 110 or 117, 133 and #) Dugan, Blocher
- 282A. Field Practice in Guidance.** Laboratory experiences in testing, occupational information and beginning counselor duties. (1-3 cr; prereq #) Dugan, Tennyson, Blocher, Soldahl
- 282B. Supervised Practicum in Counseling.** Individual assignments in counseling under supervision. (1-3 cr; prereq counselor in service only, #) Dugan, Tennyson, Blocher, Soldahl

HIGHER EDUCATION

- 250. College Student Personnel Work—Development and Administration.** For potential personnel workers, teachers, or administrators in college or university. Scope, administration, co-ordination, and evaluation of program. (3 cr; prereq 1 course in higher education or ¶ or #) Wrenn
- 251x. College Student Personnel Work.** Weekly seminar discussions of college student and non-educational 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) Wrenn, Snoke
- 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 in higher education. (3 cr) Hoyt
- 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 225-226, or #) Wrenn, Hagenah, Snoke

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
- 110x. Intercultural Education.** Racial, religious, and nationality problems; their importance for the schools. (3 cr; offered when feasible)
- 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 149B-150B-151B) 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)
- 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
- 180x. The School and Society.** Readings in social science and philosophy give student opportunity to integrate points of view in thinking about the role of the school in present-day society. (3 cr) Beck, Bagley
- 182. Comparative Philosophies of Education.** Examination of competing philosophies of education. (3 cr) Beck
- 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.** (See Hist 296A-297A-298A). Source materials; historical criticism and analysis applied to study of social and educational forces in history; individual research projects. (3 cr per qtr) T Smith

Home Economics Education

Prerequisites—For a major or a minor in home economics education, prerequisites that are satisfactory to the major advisers in this field must be presented.

- 190. Readings in Home Economics Education.** Independent study under tutorial guidance. (1-3 cr; prereq consent of adviser and instructor) Ford
- 192. Evaluation in Home Economics.** Measuring progress toward important goals; available tests and evaluation materials; construction and refinement of various evaluation instruments. Elementary statistical techniques useful to home economics teachers. (2 or 3 cr; prereq 91, 93, Ed 55B) Brown
- 193Ax. Home Economics Curriculum.** (Secondary level) Contributions of home economics at elementary and secondary levels; techniques employed in curriculum planning and reconstruction. (3 cr; prereq 94 or #) Holmblade
- 193B. Home Economics Curriculum.** (College level) Place and problems of home economics in higher education; curriculum offerings; teaching schedules and load. (3 cr; prereq #) Holmblade
- 194Ax. Adult Education in Home Economics.** Objectives; problems affecting community and family life; methods of helping adults and out-of-school youth solve problems in home living. (3 cr; prereq 91, 93 or equiv) Ford
- 194B. Adult Education in Home Economics.** Planning a community program; teaching procedures; special problems. For teachers, home economics extension workers, and supervisors of adult education. (3 cr; prereq 91, 93, 194A) Ford

195. **Space, Equipment, Furnishings, and Materials for Home Economics Departments.** Remodeling old and planning new departments; equipping and furnishing them. Review of research; investigation of problems. (3 cr; prereq 91, 93, HE 49; offered when demand warrants) Ford
196. **Home Experiences and the Extended Program.** Place of home experiences in the high school program; procedures in directing home experiences; effective use of the period of extended employment of homemaking teachers in the vocational program. (3 cr; offered when demand warrants) Brown
243. **Trends in Home Economics.** Place of home economics in the educational program today; modification of content and procedures to meet changing conditions. (3 cr; prereq §) Holmblade
- 292.° **Problems: Evaluation.** Continuation of 192, with emphasis upon individual problems. (3 cr; prereq §) Brown
- 293x.° **Problems: Home Economics Education.** Independent study of current educational problems. (1-9 cr; prereq 294 recommended, §) Ford, Holmblade, Brown
- 294x.° **Research Methods.** Collection, treatment, and interpretation of data in areas of home economics; writing of a technical report. (3-6 cr; prereq 192, §) Brown
- 295x.° **Seminar: Home Economics Education.** Discussion and reports. (1 cr per qtr) Ford, Holmblade, Brown

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, §)
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)
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 equiv) 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 §) Widdowson
109. **Conference Leading for Industry.** Purposes, advantages, and limitations of conference method. Techniques of conference procedure. Experience in planning, leading, and evaluating conferences and in writing summaries. (3 cr; prereq §) Widdowson
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) Widdowson
125. **Philosophy and Practice of Industrial Education.** History, objectives, development, and current practices of the field. (3 cr, §35) Widdowson
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)

- 200x.* Research Problems.** Independent work for the degrees, master of arts, Plan B, and master of education, Plan Y. Individual conferences. (3, 6, or 9 cr per qtr; prereq approval of candidacy) Nelson, Kavanaugh
- 205x. Seminar: Industrial Education.** (No cr; required of all candidates for advanced degrees) 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 researches; selection of problems; organization and presentation of research projects. (3 cr; prereq #) Nelson

Music Education

- 100. Principles.** Philosophy, objectives, trends, content, and evaluation of school music programs. (3 cr) Ivory
- 103. Psychological Foundations of Music Education.** 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 #) Ivory
- 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; offered when feasible) 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; offered when feasible) Ivory
- 150. Organization, Supervision of Vocal-Instrumental Music in Elementary Schools.** Trends reflected in teaching materials and syllabi. Implications of supervision practices in other educational fields. (3 cr; prereq 6 cr in music education, 9 cr in music, and 6 cr in education; offered when feasible) Ivory, Caswell
- 160. Organization, Supervision of Vocal-Instrumental Music in Secondary Schools.** Practical problems in school music; individual projects, group activities; classroom management, supervisory techniques, scheduling, unit construction, instruments, repertory. (3 cr; prereq 6 cr in music education, 9 cr in music, and 6 cr in education; offered when feasible) Caswell, Ivory
- 170. Recent Research and Literature.** Current research; evaluation of teaching materials; appraisal of research techniques. (3 cr; offered when feasible) Caswell, Ivory
- 194. Advanced Selection, Conducting of Choral Materials.** Criteria for selecting choral music for school groups; analysis of selections of varying 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) Caswell, Ivory

Physical Education

In this section are included courses in health education, physical education, and recreation. A student may emphasize any of these fields in selecting his courses. Additional offerings in health education are listed under Curriculum and Instruction.

- 101. Principles of Physical Education.** Aims and scope of physical education; its place in education. (3 cr; prereq 55)
- 102. The Physical Education Program for Elementary and Secondary School.** Philosophy, objectives, trends, content, and evaluation in relation to the physical education curriculum at both elementary and secondary levels. Provision made for study of curricular problems of special interest to the individual. (3 cr)
- 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 of school health education. (3 cr; prereq #) Slocum

104. **Teaching Physical Education for the Handicapped Child.** Essential content and practical guiding concepts for selection and organization of appropriate physical activities for students typically referred for the most prevalent types of disabilities. Planning of physical activity programs for the atypical child at the elementary, high school, and college levels. Observations, demonstrations, special lectures. (3 cr; prereq #) Wilson
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) Fitzgerald
111. **Recreation Areas and Facilities.** Orientation, design, planning, and standards for recreation buildings and areas. (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
113. **Physical Education in the Elementary School.** Curriculum, instructional procedures, classification, evaluation. (3 cr; prereq exper with elementary school age level or #)
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 the solution of individual professional problems. (3 cr; prereq 83, PubH 50 or equiv or #) Slocum
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 undergraduate course in kinesiology or #) Wilson
116. **Community Recreation Resources and Organizations.** Agencies and their interrelationship in the field of recreation. (3 cr; prereq 110, 111, 112) Chapman
- 117B. **Advanced Instruction for Secondary Schools in School Health.** Instructional problems. Individual problems discussed. (3 cr, §117A; prereq 83 or #) Slocum
121. **Principles of Recreation Methods.** Leadership methodology in all aspects of recreation. (3 cr; prereq EdT 84A-B-C) Chapman, Fitzgerald
123. **Advanced Course in Methods of Teaching Physical Education.** Teaching procedures and method problems at all levels; research results. (3 cr; prereq #)
124. **Supervision of Physical Education.** Functions; adaptations of accepted procedures for observation, guidance, and training of teachers; face-to-face techniques. (3 cr; prereq #)
125. **Curriculum Trends in the Professional Preparation of Teachers of Physical Education.** Current needs and issues, philosophy and objectives, present trends, characteristic curricular patterns and standards. (3 cr; prereq tchg exper or #)
130. **Contributions of Basic Sciences to Physical Education.** Recent pertinent research in basic sciences; applications in selected areas. (3 cr; prereq #) Wilson
131. **Industrial Recreation.** History, scope, place, and relationship of management-employee recreation. (3 cr; prereq #) Fitzgerald
- 135x. **Tests and Measurements in Physical Education.** Analysis of tests and testing methods at all levels. Emphasis in winter quarter on needs of women's physical education and elementary education. Use of tests in physical activity programs. Application of principles of test construction to specific problems. (3 cr; prereq EPsy 60 or equiv) Wilson (w), for women; Stish (s), for men
141. **Introduction to Hospital Recreation.** General field of recreation in hospitals 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
155. **Instructional Aids in Health, Physical Education, and Recreation.** Evaluation, construction, and use, stressing audio-visual aids. (3 cr) Piper
221. **Seminar: Physical Education.** Discussion of individual projects and current problems. (No cr; consult adviser) Graduate staff
- 224x.* **Research Problems in School Health Education, Physical Education, and Recreation.** Individual problems in areas of philosophy, methods, curriculum, evaluation and measurement; all levels. (Cr ar; prereq 236 and 135 or EPsy 116 or #) Fitzgerald, Jaeger, Piper, Slocum, Wilson, Chapman, Donnelly, Stish

- 233. **Administration of the Physical Education Program in Secondary Schools.** Special administrative procedures in promotion of physical education program. (3 cr; prereq 63) Donnelly, Stish
- 234. **The Curriculum in Physical Education.** Application of principles of curriculum construction to physical education. (3 cr; prereq 63, 101 or equiv) Donnelly
- 236. **Introduction to Research in Physical Education and Recreation.** Research methods applied to physical education and recreation; designs for research problems. (3 cr) Donnelly, Stish
- 238. **Administration of Physical Education in Colleges and Universities.** Administering programs and facilities in physical education and athletics; field trips and surveys of neighboring colleges. (3 cr; prereq 63 or #) Donnelly, Stish
- 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) Fitzgerald
- 241. **Administration of Public Recreation.** Basic principles in administration of recreation as a governmental service. (3 cr) Fitzgerald
- 242. **Community Organization for Recreation.** Nature, scope, pertinent principles and procedures. (3 cr; prereq #) Fitzgerald
- 261A. **Seminar: Contemporary Problems in Physical Education.** Individual presentation and class discussion of studies completed by the class members and contemporary problems selected by class members. (3 cr; prereq 236 and #) Donnelly, Stish
- 261Bx. **Seminar: Contemporary Problems in Recreation.** (Cr ar; prereq consent of adviser) Fitzgerald, Chapman

ELECTRICAL ENGINEERING

Professor

William G. Shepherd
 William F. Brown, Jr.
 Loyst C. Caverley
 Robert F. Lambert
 Allan H. Morrish
 Hendrik J. Oskam
 Aldert van der Ziel

Associate Professor

Donald E. Anderson
 LeRoy T. Anderson
 Paul A. Cartwright
 Keith S. Champlin
 Bernard V. Haxby
 Sidney C. Larson
 Roy H. Mattson
 William T. Peria
 Mahmoud Riaz
 Karel M. van Vliet

Assistant Professor

Eugene R. Chenette
 James E. Holte
 Edwin Kinnen
 Ralph W. Peterson

Special Lecturer

Richard E. Jones

Prerequisites—Graduate work leading to the M.S. (Electrical Engineering), the undesignated M.S. with major in electrical science, 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 including sufficient pertinent subject matter that would qualify the student to carry forward a graduate program in electrical science. In some instances additional preparatory studies may be stipulated.

For minor work, mathematics through differential equations and the course work necessary to satisfy the prerequisite requirements of a minor program.

Language Requirement—For the M.S. degree, none. For the Ph.D. degree, a reading knowledge of two foreign languages.

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 3 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.

Candidates for the M.S. degree must have completed, as graduate or undergraduate students, the following two special requirements:

- a. At least 9 quarter credits in courses comparable in level and content to EE 150-151-152 or Phys 123-124-125 as offered at the University of Minnesota.

- b. At least 9 quarter credits of mathematics at the level of courses ITM 151-152-153 or ITM 147-148-149 as offered at the University of Minnesota.

A student may receive graduate credit for either (a) or (b) but not both.

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

[Professional degrees in engineering—These degrees are administered by the Institute of Technology.]

Courses Acceptable Only in Satisfaction of the Minor Requirement

- 104-105-106. Electronics.** 104: Introduction to physical electronics; electronic properties of metals, insulators, semiconductors, junctions; electron emission and gaseous discharge phenomena. 105-106: Quasi-linear and nonlinear behavior of vacuum, gas, and semiconductor devices; principles of rectification, amplification, frequency-conversion, oscillation; generic 2- and 4-terminal active circuits. (4 cr per qtr; prereq 73 or equiv for 104...63 and 104 or equiv for 105-106)
- 111-112-113. Circuits and Fields.** Lumped linear circuits in the transient and steady state; application of transform techniques in transient analysis; general multi-port network analysis. Fields, energy, and forces with application to electromagnetic and electromechanical devices. (3 cr per qtr; prereq 63 and 73 or equiv)
- 114-115-116. Electrical Engineering Laboratory.** Experimental studies in electrical engineering for fourth-year students. (2 cr per qtr; prereq 83, ¶104-105-106, ¶111-112-113)
- 131-133-135. Applied Electronics.** Analysis and design of both linear and nonlinear electronic circuits. Laboratory study of design problems. (3 cr per qtr; prereq 106, 113, 116)
- 138-139-140. Electric Power Control.** Analysis of power circuits and machines using symmetrical component methods. Control of motors, generators, and metadynes; application of magnetic amplifiers. Control of power systems, power system stability. (3 cr per qtr; prereq 112, 116)
- 143-144-145. Engineering Acoustics.** Acoustic equations; dynamical equations with equivalent circuits and application to microphones, loudspeakers, and ultrasonic transducers; room acoustics and noise control; technological application of vibration and sound; power transducers for industrial purposes. (3 cr per qtr; prereq 38 or 63, ITM 26A, MM 29 or equiv)
- 157-158-159. Control Systems.** Analysis and applications of typical linear control elements. Analytical and graphical treatment of system stability. Application of Boolean algebra to control logic; analogue and digital computers in control systems. (3 cr per qtr; prereq 106, 112, 116)
- 164-165-166. Communication Circuits.** Theoretical and laboratory study of selected topics in electric communication. Spectral analysis; modulation theory, including amplitude, frequency, and pulse modulation; noise; elements of information theory; system analysis. (3 cr per qtr; prereq 106, 112, 116)

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; gyroscopic systems; dissipative forces; normal co-ordinates and small oscillations; Hamilton's equations; variational principles for discrete and continuous systems; energy theorems. (3 cr; prereq MM 29 or equiv, ITM 153 and §)
- 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 ITM 153, Phys 51 or ME 30, and §)
- 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. Fluctuations, stochastic processes, non-equilibrium problems. Relations to information theory. (3 cr; prereq 150, 151 and § [students not meeting these specific course requirements should consult instructor])
- 167-168-169. Electromagnetic Theory and Application.** Electromagnetic theory, Maxwell's equations, boundary-value problems. Propagation of waves in space, on lines, and in wave guides.

- Cavities, antennas, and radiation. Introduction to microwave tubes. (3 cr per qtr; prereq 113, 116, §)
- 170-171-172. **Intermediate Network Theory.** Network topology and linear graph theory, driving and response functions, matrix methods; driving point synthesis, transfer function synthesis, the approximation problem; realization properties of network functions, synthesis employing lattice structures, image parameter methods; application of synthesis methods to communication and control problems. (3 cr per qtr; prereq 113 or equiv, ITM 153, §)
- 173-174-175. **Physical Electronics.** Physical principles underlying devices used in electrical engineering; elementary quantum and statistical mechanics, semiconductor properties, electron emission from surfaces, magnetism, special topics of current interest. (3 cr per qtr; prereq 104 or equiv, §)
- 178-179-180. **Nonlinear Active Circuits.** Active device theory combined with appropriate synthesis techniques to design oscillator, multivibrator, switching, wave-shaping, and other nonlinear circuits. (3 cr per qtr; prereq 108, 112, 116, ITM 153 or equiv, §)
- 187-188-189. **Problems in Electrical Engineering.** Nonlinear network analysis applied to electrical problems involving signal and power amplification, modulation and demodulation, and oscillations. Approximate methods of solution and their interpretation. Problems in wave motion as applied to transmission of electrical signals and power. (3 cr per qtr; prereq 109, 125, 163)
- 190A-B-C. **Principles of Digital Computer Systems.** A treatment of digital computers including computer organization, logic and control circuitry, memory systems, input-output arrangements, and practical computer design limitations. (3 cr per qtr; prereq 180, §)
- 191-192-193. **Linear Active Circuits.** Active device theory combined with network analysis and synthesis to design amplifier circuits with and without feedback, active filter circuits, and other linear circuits. (3 cr per qtr; prereq 106, 112, 116, §)
- 194-195-196. **Control Theory.** Analysis of linear feedback control systems, Nyquist and Bode diagrams, root-locus, and gain-phase techniques. Compensation and minor loops. Load disturbances. Performance criteria. Multivariable controls. Introduction to statistical methods. Experimental laboratory on typical control systems, analogue computer simulation. (3 cr per qtr; prereq 106, 112, 116, §)
- 200A-B-C. **Introduction to the Properties of Solids.** Classical statistical theory of matter, thermal properties of solids, crystal structure, ionic crystals, dielectrics, the electron theory of metals, band theory of solids, imperfections in crystals, magnetism. (3 cr per qtr; prereq 152, Phys 109 or 110, §)
- 211-212-213. **Advanced Topics in Network Synthesis.** Applications of matrix methods and complex variable theory to circuit theory. Approximation in the frequency and time domains. Synthesis of lumped R-L-C networks. Synthesis of distributed-constant, time-varying, and nonlinear networks. Graph theory applied to circuit synthesis. Selected current papers. (3 cr per qtr; prereq 172, ITM 174, §)
- 221-222-223. **Electric Power Seminar.** Discussions of problems in power circuits and machinery. (1-3 cr per qtr; prereq §)
- 227-228-229. **Stability of A.C. Power Systems.** System design factors which affect stability, relation of steady-state and transient conditions to stable operation of power distribution systems. (3 cr per qtr; prereq 140 and §) Caverley
- 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 §) van der Ziel
- 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 collisions, basic collision processes, methods of measurement. Topics such as 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 §) Oskam
- 245-246-247. **Plasma Physics Seminar.** Discussion of current literature; individual assignments. (1-3 cr per qtr; prereq 244 or Phys 275, §) Oskam
- 251A-B-C. **Properties of Semiconductors.** Details of band structure and scattering mechanisms of common semiconductive materials, electron transport phenomena, conductivity, Hall effect and magnetoresistive effect, thermal and optical properties of semiconductors, generation-recombination kinetics, minority carrier injection, diffusion, applications of semiconductor properties, semiconductor devices. (3 cr per qtr; prereq 200C, §) Champlain
- 252A-B-C. **Magnetic, Dielectric, and Superconductive Phenomena in Solids.** Magnetic and electric properties of solids; diamagnetism, paramagnetism, electron and nuclear relaxation and

- resonance, masers, dielectrics. Strongly coupled dipole systems; ferromagnetism, ferroelectricity, antiferromagnetism and ferrimagnetism, hysteresis properties. Topics in superconductivity. (3 cr per qtr; prereq 200C, #) Morrish
- 255-256-257. Analysis of A.C. Power-System Circuits.** Network theorems and equivalent circuits, A.C. generators, motors, transformers, and transmission lines, behavior of A.C. equipment under unbalanced conditions, use of symmetrical components. Transients in machines and associated circuits. (3 cr per qtr; prereq 169 or equiv, #) Caverley
- 261-263-265. Problems in Electromagnetism.** Static electric and magnetic fields. Studies of antennas, free-space transmission, refraction and diffraction phenomena, wave guides, and circuits. (3 cr per qtr; prereq 169 or equiv, #) Shepherd
- 262-264-266. Communication Seminar.** Study and discussion of current literature, individual assignments. (1-3 cr per qtr; prereq #) Staff
- 267-268-269. Statistical Theory of Communication.** Basic concepts of probability theory and statistical inference. Random processes, time and statistical averages, correlation functions, spectral analysis, statistical properties of linear systems. Random physical processes; shot and thermal noise. Concepts and theorems of information theory. Selected special topics. (3 cr per qtr; prereq #) Brown
- 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 #) Lambert
- 281-282-283. Seminar on Energy Conversion.** Selected topics relating to physical processes involved in the conversion of energy in its several forms to electrical energy and to devices which exploit these processes. Thermoelectric and thermionic processes. (Cr ar; prereq 200C or equiv) Staff
- 287-288-289. Microwave Generation and Amplification.** The Llewellyn and generalized space-charge-wave equations, analysis of klystron and traveling-wave devices. Coupled-mode theory and parametric amplification. Noise in electron streams. Sources of millimeter wave power. The principle of stimulated emission. Two-level and three-level maser systems. Optical masers. Noise in maser devices. (3 cr per qtr; prereq 169, #)
- 291-292-293. Electronics Seminar.** Current literature, individual assignments. (1-3 cr per qtr; prereq #) Staff
- 294-295-296. Advanced Control Theory.** Theoretical study of multiloop control systems, linear and nonlinear; sampled data systems, adaptive control systems, and systems with time-varying parameters. Filtering of noise, and optimum design of systems with random inputs. (3 cr per qtr; prereq #)

ENGLISH

Professor

John W. Clark
Harold B. Allen
Bernard R. Bowron
Huntington Brown
Charles H. Foster
Jacob C. Levenson
Samuel H. Monk
Franz J. Montgomery
Robert E. Moore
Gordon W. O'Brien

G. Robert Stange

Martin Steinmann, Jr.
Allen Tate
Leonard H. Unger

Associate Professor

Frank Buckley
John D. Hurrell
Joseph J. Kwiat
Mary C. Turpie
Brom Weber

Assistant Professor

Morgan Blum
Richard J. Cody
Richard J. Foster
James A. Wright
Sarah H. Youngblood

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 3 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. Thereafter they need confer only with their own advisers.

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 for those degrees 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 both 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 Plan A who have not previously had an elementary course in Old English (Anglo-Saxon) must include this subject in the program of graduate study.

Candidates under Plan B have three requirements: Engl 100, Old English, as specified above; Engl 213, Bibliography and Methods of Research; a complete sequence of English courses numbered 200 or above. (Some of these sequences run for 2 quarters and some for 3.)

Candidates who are active schoolteachers or who hold the teaching certificate may, if they plan to take the M.A. as a terminal degree, make certain substitutions for the above requirements. Those who so elect should consult the director of graduate work.

Under both plans, the candidate will be given a 6-hour written examination (see Special Regulation above) which calls for some acquaintance with each of the following periods of English literature: Old and Middle English literature, Renaissance, 17th century, 18th century, and English and American literature of the 19th and 20th centuries. While the examination is designed primarily as a test of knowledge, it affords opportunity for the display of critical judgment. It is given in the fall and spring quarters and in the first term of Summer Session. A specimen examination may be consulted in 219 Folwell Hall.

All candidates under Plan A must also pass an oral examination. Candidates under Plan B may be required to do so at the discretion of the graduate faculty.

A candidate under Plan B must submit to the chairman of his examining committee, at least 1 week before his oral examination, 3 papers, each about 5,000 words long, and each certified as satisfactory by the member of the graduate staff under whose supervision it was written.

The candidate must pass his examination in a foreign language (see below) before taking the general 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:

*American Literature**Composition*

Linguistics and Comparative Philology, including 100 (Old English), 102 (Old English Prose and Verse), 103 (Beowulf), 165 (Introduction to Modern English), 166 (Historical Backgrounds of Modern English), 174 (American English), 204 (History of the English Language), 205 (The Structure of Modern English), 206 (Studies in the English Language), and certain related courses.

Foreign Literature in Translation, including 123-124-125 (Technique of the Novel), 147-148-149 (The Literature of England in the Middle Ages Exclusive of Chaucer), 184-185-186 (Form and Idea in Dramatic Literature), 234-235-236 (Studies in Medieval English Culture), 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—Unless special exception is made upon petition the candidate is required to have a reading knowledge of one of the following languages: 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 a member of the graduate faculty during the first or second term after he has completed his work for the M.A., or, if he does not propose to take an M.A., during his second or third term of graduate study.

In order to qualify for candidacy for the Ph.D. with a major in English, all students, including those who hold the M.A. from other institutions, must pass the 6-hour written comprehensive examination in English and American literature required of all candidates for the M.A. of the University of Minnesota (see above). It is given in the fall and spring quarters and in the first term of the Summer Session. A student holding an M.A. from another institution must take this qualifying examination no later than the fourth quarter of residence.

The Department divides the study of English and American language and literature into six subfields, as follows:

1. Old English and Middle English, including linguistics
2. The Renaissance
3. The 17th Century
4. The 18th Century
5. The 19th and 20th Centuries
6. American Literature

A candidate shall "write off" 2 of the 6 subfields by at least 12 credits of course work in each of the 2 (in subfield 1, at least 11 credits *in addition to* Engl 100). Six credits in each of the 2 subfields must be of A quality. The following courses are regarded as outside of all 6 subfields and therefore cannot be used in writing off any of them: Engl 120-121-122, 127, 129, 184-185-186, 268-269, and 290-291-292.

Examinations—The candidate for the Ph.D. is required to take the following examinations: (a) a preliminary written examination (3 hours) devoted to the subfield in which he will write his thesis, (b) a preliminary oral examination (2 hours) devoted to the remaining 3 subfields and the minor, and (c) a final oral examination, given after the candidate has successfully completed his thesis and had it approved by his committee. (Concerning all three examinations, see Special Regulation above.)

The preliminary written examination is given by his adviser and two others (chosen by the adviser and the director of graduate work in consultation) in fall and spring quarters and first term of Summer Session at the time announced for the written examination for the M.A., and at a time to be announced in winter quarter.

If the thesis lies in subfield 5, that subfield will be regarded as falling into 2 parts, viz., earlier (up to 1880) and later (1880 ff.), and the examination will emphasize that part in which the thesis lies, but will not exclude the other.

Not later than the first week of the term during which the candidate proposes to take either preliminary examination, he should notify the director of graduate work of his intention to do so. The Graduate School should be notified of the date, hour, and room for all oral examinations at least 1 week in advance.

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.

The Graduate Minor in English

The candidate for the Master's degree (Plan A) taking a minor in English is expected to present a minimum of 9 credits in 1 of the 6 subfields listed above or in 1 of the sequences of courses in critical analysis (120-121-122, 123-124-125, 184-185-186).

A minor sequence in English for the Doctor's degree must include either 9 credits in 1 of the sequences of courses numbered 100 or above devoted to a historical period or 9 credits in 1 of the sequences of courses in critical analysis listed above.

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 2 of the 6 subfields listed above, or on 1 of the 6 and on 1 specific literary kind such as the drama or the novel.

Comparative Literature—For information on this program, see page 88.

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) Brown
- 103. **Beowulf.** Introduction to the Old English poem, with reading of considerable portions of the text. (3 cr; prereq 100) Brown
- 104. **Emerson and Thoreau.** (3 cr; prereq §§) Turpie
- 105. **Hawthorne and Melville.** (3 cr; prereq §§) Weber
- 106. **Whitman and Mark Twain.** (3 cr; prereq §§) Kwiat

§§ Five credits in literature, English or American, exclusive of freshman English.

- 109-110.† **Romantic Poets of the Early Nineteenth Century.** 109: Wordsworth, Coleridge, Scott, etc. 110: Byron, Shelley, Keats, etc. (3 cr per qtr; prereq §§)
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
114. **The Midwest in Literature.** (3 cr; prereq §§; offered when feasible) Buckley
115. **The Development of English Prose Style, I.** Definition of six broad types of prose style on historical principles. (3 cr; prereq §§; offered when feasible) Brown
116. **The Development of English Prose Style, II.** Styles of selected writers since 1700. (3 cr; prereq §§; offered when feasible) Brown
- 120-121-122. **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. 122: Intensive study of six longer poems. (3 cr per qtr; prereq §§) Tate
- 123-124-125.† **The Technique of the Novel.** Special studies in novels of the late 19th and 20th centuries, with particular regard to structure. See also Comp 101-102-103 for the writing of fiction. (3 cr per qtr; prereq §) Unger
- 126-127.† **Drama, 1660-1900.** 126: Restoration and early 18th century. The heroic play, tragedy, comedy of manners, beginnings of sentimental comedy. 127: 18th- and 19th-century English drama. Beginnings of modern realism: Ibsen and Chekhov. (3 cr per qtr; prereq §§) Moore
129. **Modern Drama.** Survey of chief dramatists, English, American, and Continental, from 1900. (3 cr; prereq 55-56 or 126-127) Moore
130. **Victorian Poetry I.** Early and mid-Victorians: Tennyson, the Brownings, Clough, FitzGerald, Arnold, and others. (3 cr; prereq §§; offered when feasible) Montgomery
131. **Victorian Poetry II.** Pre-Raphaelites and after: the Rossettis, Swinburne, Morris, Wilde, and the poets of the 1890's. (3 cr; prereq §§; offered when feasible) Montgomery
134. **The Origins of American Naturalism.** (3 cr; prereq §§; offered when feasible) Bowron
136. **Advanced Shakespeare.** Work of the poet's maturity. Special attention to *Othello*, *King Lear*, *Antony and Cleopatra*, *Cymbeline*, *The Winter's Tale*. (4 cr; prereq 56) Brown
- 137-138-139.† **Nineteenth-Century Literature.** Prose, poetry, and selected fiction—particularly of the period 1830-1890. Emphasis on the critical study of particular works of major authors and their relation to the recurrent themes and literary interests of the period. (3 cr per qtr; prereq §§) Stange
- 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
- 142-143-144.† **Twentieth-Century British and American Literature.** Critical survey of major figures; basic trends and interrelations of the two literatures. (3 cr per qtr; prereq §§) R Foster
- 147-148-149. **The Literature of England in the Middle Ages Exclusive of Chaucer.** Reading includes Latin documents in translation. (3 cr per qtr; prereq 75 and 100; offered when feasible) 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 §§) Levenson
- 159-160.† **American Literature: Colonial and Early National Periods.** Critical survey with emphasis on principal writers such as Taylor, Edwards, Franklin, Poe; historical and cultural backgrounds such as puritanism, neoclassicism, early romanticism, the Revolution, and transition from early American literature to the "American Renaissance." (3 cr per qtr; prereq §§) Weber
- 162x. **Milton.** The minor poems, *Areopagitica*, *Paradise Lost*, and *Samson Agonistes*. (3 cr; prereq 21 or 56) Steinmann, Unger

§§ Five credits in literature, English or American, exclusive of freshman English.

- 165x. **Introduction to Modern English.** Scientific approach to sounds and grammar of present-day English, with some attention to syntax; implications for a reasonable attitude toward English usage in America. (3 cr; prereq §§) Allen
166. **Historical Backgrounds of Modern English.** Historical influences upon, and changes within, the language as both a popular and a literary medium. (3 cr; prereq §§; offered when feasible) Allen
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; offered when feasible) O'Brien
173. **Dr. Johnson and His Circle.** Boswell; Johnson's influence on his contemporaries. (3 cr; prereq §§ and Δ; offered alt yrs) 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) Allen
- 176-177.† **Study of Meter and Rhyme.** Sound and music of verse. Common lines and stanzas with their uses and variations. (3 cr per qtr; prereq §§; offered when feasible)
178. **The South in Literature.** (3 cr; prereq §§; offered when feasible) Tate
180. **The Influence of Poe.** The French "Symboliste" school; influence of this school on modern literature, chiefly poetry, in English. (3 cr; prereq §§; offered when feasible) 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 §§; offered when feasible)
182. **The Far West in Literature.** Expansion beyond the Mississippi as a force in American thought and letters: literature of exploration and travel; Pacific Coast regional movement; Mark Twain. (3 cr; prereq §§; offered when feasible)
183. **The Poetry of T. S. Eliot.** (3 cr; prereq §§; offered 1962-63 and alt yrs) 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 §§...55-56 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
193. **The Poetry of W. B. Yeats.** (3 cr; prereq §§; offered 1963-64 and alt yrs) Unger
- 194-195-196.† **Elizabethan Literature: Prose, Poetry, Drama.** 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 or two of the Queen's reign. (3 cr per qtr; prereq §§) Brown (194, 195), O'Brien (196)
- 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 (197, 198), Hurrell (199)
- 204w. **History of the English Language.** Development of basic patterns of sound, grammar, and syntax from Old English to present day; cultural background. (3 cr) Allen
- 205f. **The Structure of Modern English.** Analysis according to methods of linguistics, with consideration of relevance to teaching of composition and literature. (3 cr) Allen
- 206s. **Studies in the English Language.** Intensive investigation of some critical problem in linguistic research. (3 cr; prereq §; offered 1963-64 and alt yrs) Allen
- 210-211-212. **Studies in Seventeenth-Century Literature.** Selected authors to 1660 exclusive of Milton and the dramatists; style and ideological 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; offered when feasible)

§§ 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; offered when feasible) Brown
- 231-232-233. **Shakespeare's Tragic and Comic Art.** (3 cr per qtr; offered when feasible) Brown
- 234-235-236. **Studies in Medieval English Culture.** (3 cr per qtr; prereq 75; offered 1962-63 and alt yrs) Clark
- 240-241-242. **The Canterbury Tales.** (3 cr per qtr; prereq 75; offered 1963-64 and alt yrs) Clark
- 243-244-245. **Nondramatic Literature of the Sixteenth Century.** Renaissance prose and poetry; Spenser and his contemporaries. (3 cr per qtr; offered when feasible) Brown
- 246-247. **English Literary Criticism.** Basic historical texts; principles and issues which have relevance for modern criticism. (3 cr per qtr; offered when feasible)
- 250-251. **Studies in Modern Literature.** Problems and issues in 20th-century British and American literature. (3 cr per qtr; prereq §; offered when feasible)
- 253-254-255. **American Renaissance I: Emerson, Whitman, Melville.** (3 cr per qtr; offered 1963-64 and alt yrs) C Foster
- 256-257-258. **Spenser and Milton.** (3 cr per qtr; offered 1963-64 and alt yrs) Brown
- 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, Emily Dickinson. (3 cr per qtr; offered 1962-63 and alt yrs) 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 §; offered when feasible) 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; offered 1962-63 and alt yrs) 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)
- 284-285-286. **Dryden and His Age.** (3 cr per qtr; offered 1963-64 and alt yrs) 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

Attention is also called to the following courses, in which foreign languages or literatures are studied but for which no specific foreign-language courses are prerequisites: Clas 106-107, 180-181-182, 191-192-193; Ger 140-141-142; Ital 164; Russ 110-111-112; Scan 161, 162, 171, 172, 173.

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. Class meetings are devoted to analysis of examples drawn from standard sources; meetings in the first 2 quarters to fiction, those in the third to poetry; but the student's compositions may be in either form in any quarter. (3 cr per qtr; prereq none for students registered as English majors in the Graduate School, § for others) Blum
- 200-201-202. **Graduate Seminar in 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
 Huai C. Chiang
 Laurence K. Cutkomp
 Samuel Eddy
 Frederick G. Holdaway
 William H. Marshall
 A. Glenn Richards
 Lloyd L. Smith, Jr.

Associate Professor

James R. Beer
 Edwin F. Cook
 Mykola H. Haydak
 Allan G. Peterson
 Franklin G. Wallace
 Thomas F. Waters

Assistant Professor

Marion A. Brooks
 Roger D. Price
 John R. Tester
 James C. Underhill

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, either German or French. In special cases, where a different language is needed for development of the thesis, one acceptable to the Graduate School may be substituted with the consent of the adviser. For the Ph.D. degree, two foreign languages, usually German and French. Substitutions may be made for French under the conditions already specified.

Graduate Major Fields—Work leading to the Master's and Ph.D. degrees is offered in the fields of entomology and fishery and wildlife management.

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 throughout the period of resident studies.

Entomology

- 103-104-105x.† **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) Haydak
116. **Population Ecology.** General principles of population, covering population dynamics and trophic relationships. (3 cr; prereq Zool 65 or ‡; offered 1963-64 and alt yrs) Underhill
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 9 cr in general biology or equiv; offered Itasca Biology Session) Underhill
124. **Biology of Immature Insects.** Habits, habitat, life history, and identification of immature insects; aquatic forms. (6 cr; prereq 9 cr in general biology or equiv, 52 or equiv, or ‡; offered Itasca Biology Session)
125. **Insect Morphology.** Comparative studies of external and internal macrostructure of insects; phylogeny and function. (4 cr; prereq 52, ‡) Cook
126. **Microanatomy and Development of Insects.** Histochemistry and fine structure; reproductive behavior, embryology, and postembryonic development of insects. (4 cr; 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. (4 cr; prereq 126, ‡, ...AgBi 106 or PhCh 101 recommended) Richards
128. **Aquatic Entomology.** Identification and biology of aquatic and littoral insects in all stages. (2 cr; prereq 52 or equiv; offered 1963-64 and alt yrs) 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, #) Cook
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, and #; offered when demand warrants) Richards
141. **Insects in Relation to Plant Diseases.** (Same as PIPa 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, Wilcoxon
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 9 cr in general biology or equiv, 52 or equiv, #) Price
145. **Parasitic Protozoa.** Structure, life histories, and economic relations of protozoal parasites of man and animals. (3 cr; prereq 9 cr in general biology or equiv, #) Wallace
146. **Helminthology.** Worm parasites of man and animals, their structure, life histories, and biological relationships. (3 cr; prereq 9 cr in general biology or equiv, #) Wallace
- 175.* **Principles of Economic Entomology.** Methods and principles of insect control. (4 cr; prereq 15 cr incl 50 or equiv, or #; offered 1962-63 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 Δ)
196. **Advanced Work in Field Zoology.** Research, faunistic studies in terrestrial, aquatic, and forest entomology and economic zoology. (1 or more cr per qtr; prereq #; offered Itasca Biology Session) Marshall, Tester, Staff
- 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) Chiang
- 203.* **Insect Physiology, General and comparative physiology.** Organ systems and their functioning. Research methods and evaluation of data. (Cr ar; prereq #) Richards
- 204.* **Insect Microbiology.** Relationships between insects and microorganisms; physiological, anatomical, and pathological aspects. (4 cr; prereq 9 cr in general biology, 127 or #) 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 1963-64 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 1963-64 and alt yrs) Cutkomp
207. **Resistance of Plants to Insect Attack.** (Same as Agro 207) Genetic and physiologic resistance of crop plants to insect attack and the insect-plant relationships involved; breeding crop plants for resistance to insects. (2 or 3 cr; prereq Agro 30 or equiv, 3 cr plant or insect ecology, or #; offered 1962-63 and alt yrs) Holdaway, Rinke
208. **Biological Control.** Reduction of populations of insect, weed, and vertebrate pests by biotic agents. Ecological principles and practical problems involved. (3 cr; prereq 5 cr general entomology, 118 or #; offered 1963-64 and alt yrs) Holdaway
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 1962-63 and alt yrs) Underhill
- 240-241-242-243.* **Research in Entomology.** (Cr ar) Chiang, Cutkomp, Hodson, Holdaway, Richards, Cook, Haydak, Peterson, Brooks, Price

Fishery and Wildlife Management

- 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])
119. **Limnology.** Conditions for life in the water and distribution of aquatic animals. (6 cr; prereq 9 cr in general biology or equiv; offered Itasca Biology Session) Underhill
121. **Ichthyology.** Taxonomy and habits of North American fishes, especially those of upper Mississippi drainage. (3 cr; prereq 9 cr in general biology or equiv, §) Eddy
128. **Aquatic Entomology.** Identification and biology of aquatic and littoral insects in all stages. (2 cr; prereq 52 or equiv; offered 1963-64 and alt yrs) Cook
- 162.* **Ecology of Terrestrial Vertebrates.** Ecological relationships of northern Minnesota terrestrial vertebrates. (6 cr; prereq Ent 68 or Zool 57-58, Ent 63 or equiv, Bot 50; 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 63, 65, Zool 58, Bot 50, or §) Beer
179. **Special Lectures in Economic Zoology.** Lectures in special fields of economic zoological 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, Waters, Tester
196. **Advanced Work in Field Zoology.** Research; faunistic studies in terrestrial, aquatic, and forest entomology and economic zoology. (1 or more cr per qtr; prereq §; offered Itasca Biology Session) Marshall, Tester, and staff
- 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 §) 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 §) 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 §) 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 63, 65, Zool 116 and Bot 50 or §; offered 1963-64 and alt yrs) Beer
- 274.* **Wildlife Management: Upland Game.** Survey of upland game bird management problems in North America. (3 cr; prereq 65, Zool 58, 116 and Bot 50 or §; offered 1962-63 and alt yrs) Beer
- 275.* **Wildlife Management: Waterfowl.** Life histories, ecology, and management of North American waterfowl. (3 cr; prereq 65, Zool 58, 116 and Bot 50 or §; offered 1962-63 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 63, 65, Zool 116 and Bot 50 or §; offered 1962-63 and alt yrs) Marshall
- 277-278-279-280.* **Research in Wildlife Biology.** (Cr ar) Marshall, Beer, Tester

FLUID MECHANICS

Subcommittee:

Professor

Neal R. Amundson, *chairman* (Chemical Engineering)
 Ernst R. C. Eckert (Mechanical Engineering)
 William C. Meecham (Aeronautical Engineering)
 James B. Serrin, Jr. (Mathematics)
 Edward Silberman (Civil Engineering)
 Ephraim M. Sparrow (Mechanical Engineering)
 Hans F. Weinberger (Mathematics)

This group, together with the following, may serve as graduate advisers for this area:

Professor

Chieh Chien Chang (Aeronautical Engineering)
Edward L. Hill (Physics)
Paul C. Rosenbloom (Mathematics)
Lorenz G. Straub (Civil Engineering)

Doctor's Degree—The program in fluid mechanics leads to the Ph.D. degree.

Prerequisites—Candidates for the Ph.D. program 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 3 of the several departmental areas 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 two foreign languages. 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.

FOOD TECHNOLOGY

No graduate degree is offered in food technology. Students interested in this area will find courses in agricultural biochemistry, dairy industries, home economics, and genetics.

FORESTRY

Professor

Frank H. Kaufert
Randolph M. Brown
Donald P. Duncan
Henry L. Hansen
Ralph L. Hossfeld
Scott S. Pauley
Louis W. Rees

Associate Professor

Merle P. Meyer

Assistant Professor

Egolf V. Bakuzis
Bruce A. Brown
Frank D. Irving
Richard A. Skok
Edward I. Sucoff
Kenneth E. Winsness

Prerequisites—Students normally are expected to have an undergraduate degree in forestry, or its equivalent. The facilities of the Cloquet Forest Research Center

and the Forestry and Biological Station at Lake Itasca are available to students taking this work.

Language Requirement—For the M.S. degree, one foreign language selected in consultation with the student's adviser. For the M.F. degree, none. For the Ph.D. degree, either (a) 2 foreign languages selected in consultation with the student's adviser and the director of the School or (b) 1 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 Science Degree—Offered under Plan A and Plan B. This program is intended for graduates preparing for research or teaching in such branches of forestry as silviculture, management, measurements, and forest products engineering.

Master of Forestry Degree—Students registered for the master of forestry degree will fulfill the general requirements for the master of science degree under Plan B. Candidates for the degree must complete, with an average of B, a minimum of 51 quarter credits in graduate courses. This program is designed to meet the needs for added professional study by qualified forestry graduates primarily interested in administrative and technical work in forest resources management. Required courses for the M.F. degree are outlined in the School of Forestry Graduate Student Guide.

Doctor's Degree—Work leading to the Ph.D. degree is offered under the general requirements for that degree.

101. **Advanced Dendrology.** Classification and distribution of important timber species of the world. (3 cr; prereq 4) Rees
104. **Watershed and Range Management.** Climatic, vegetational, and historical factors affecting watershed and range management in the United States. Principles underlying management of the forested watershed; influences of woody vegetation upon soil moisture, stream flow, and erosion. Fundamentals of range land management for sustained production of livestock forage; its relation to other land uses. (4 cr; prereq 5 or §) Duncan, Meyer
111. **Application of Statistical Methods in Forestry.** Use of statistical methods in sampling in timber estimating and to compile, analyze, and interpret forestry data. (3 cr; prereq 8 or §) R M Brown
123. **Production and Marketing.** Considerations in the long- and short-run production and marketing of representative kinds of products; principles of decision making in micro forest economic situations. (4 cr; prereq 47 or §) Skok
124. **Forest Management.** Acquisition, organization, and administration of forest lands. Application of forest science in management planning. (3 cr; prereq 123) Irving
127. **Introduction to Silviculture.** Description and classification of forests of the United States. Silvicultural treatment of some important forest types. (3 cr; prereq 4 and 5) Hansen
128. **Silviculture.** Lectures and field laboratory to demonstrate cutting methods and cultural practices used in American forestry; nursery practices and principles, field planting, and plantation evaluations. (6 cr; prereq 127, given at Cloquet) B Brown
131. **Forest Policy.** Public and private forest policies in the United States. Analysis of current policy issues. (3 cr) Irving, Skok
133. **Forest Management and Utilization.** Observation and analysis of state, federal, and private forestry operations with field trips and assigned readings; trips through forest products processing plants. (2 cr; prereq 124, given at Cloquet) B Brown
134. **Forest Inventory and Photographic Interpretation.** Use of aerial photographs; delineation of forest cover types, acreage measurement, cruise designs, preparation of maps, and field cruising. (3 cr; prereq 59 and 111 or Biom 90; given at Cloquet) Meyer
136. **Forest Economics.** Economics of forest resource development and forest products industries. (3 cr; prereq 123 or §) Skok
137. **Forest Tree Seed.** Important tree seed problems encountered in natural regeneration and nursery work; origin, production, storage, and germination. (2 cr; prereq Biol 2 or a course in botany) Hansen, Duncan, Bakuzis

140. **Advanced Forest Management.** Economic, administrative, and biologic problems of forest land management. Current techniques. Problems of increasing intensity of management. Lectures and reports. (3 cr; prereq 124) Irving
141. **Principles of Silvics.** Principles underlying the silvicultural treatment of forest types. Review of silvical and ecological literature of special significance. (3 cr; prereq 127) Hansen
143. **Forest Recreation.** Recreational use of the forest from a technical point of view. Problems of land management arising from recreational demands. (3 cr) Duncan
145. **Advanced Silviculture.** A synthesis of silvicultural knowledge through review of classical and recent literature. Topical presentations and class discussion. (3 cr; prereq 128) Hansen
146. **Advanced Forest Aerial Photogrammetry.** Photogrammetric systems, flight planning, contracting, contract inspection; advanced photo interpretation, mapping, and measurement problems. (3 cr; prereq 59 or #) Meyer
149. **Advanced Forest Measurements.** Applications of statistical and advanced mensurational methods in the analysis and interpretation of forestry data and forest survey sampling methods. (3 cr; prereq 111 or #) R M Brown
150. **Forest Genetics.** Heredity and variation of important forest-tree species; applications of genetic principles in tree improvement. (3 cr; prereq Agro 30 or 131, or #) Pauley
152. **Forest Tree Physiology.** Examination in terms of physiology of tree and stand behavior in the forest, nursery, and growth chamber. (3 cr; prereq Bot 51 or AgBi 5, and MeAg 24, 25 or #) Sucoff
154. **Advanced Watershed Management.** Recent literature relating to management of the forested watershed. Methods of analyzing research data. (3 cr; prereq 104 or #; offered when feasible) Duncan
156. **Introduction to Research.** Research philosophy, objectives, problem development, analytical principles, and presentation, illustrated by situations in forestry. (3 cr; prereq #) Hossfeld, Duncan
175. **Wood Pulp and Paper.** Production of wood pulp and paper products. Lectures, reading, and reports. (3 cr; prereq 76 and organic chemistry) Hossfeld
176. **Timber Engineering.** Fabrication and use of the timber truss and laminated arches and beams in building construction. Timber connector, nailed, bolted, and nail-glued wood joints. (4 cr; prereq 79) Rees
177. **Wood Chemistry.** Chemical composition, reaction, and analyses of wood components and derivatives. Chemical technology of wood and wood products. (3 cr; prereq 76 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. (4 cr; prereq 76 or #) Hossfeld
181. **Moisture Relations in Wood.** Moisture movement in wood related to the micro-physical and chemical structure and its influence on the development of stress during drying and subsequent use. (3 cr; prereq 81, 177; offered when feasible)
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; offered when feasible) Kaufert
183. **Advanced Wood Finishing.** Laboratory. Industrial applications of wood finishes. (2 cr; prereq 83; offered when feasible) Hossfeld
184. **Advanced Wood Chemistry.** Laboratory problems in analysis of wood constituents and in the technique of their isolation and purification. (2 cr; prereq 177, AnCh 57 or equiv; offered when feasible) 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) Hossfeld
187. **Advanced Building Materials Merchandising.** Lecture and seminar presentations in the areas of retailing, wholesaling, market analysis, and research. (3 cr; prereq 87, Mktg 107) Staff
195. **Advanced Wood Pulp and Paper.** Laboratory problems in the properties of wood pulp and of paper products. (2 cr; prereq 175, AnCh 57 or equiv; offered when feasible) Hossfeld
- 200x.° **Research Problems: Silviculture.** (Cr ar) Hansen, Duncan, B Brown, Bakuzis
- 203x.° **Research Problems: Forest Management.** (Cr ar) Duncan, Irving, B Brown, Winsness
- 205x.° **Research Problems: Forest Economics.** (Cr ar) Kaufert, Skok

- 207x.* Research Problems: Forest Products Engineering. (Cr ar) Hossfeld, Rees, Kaufert
 213x.* Research Problems: Forest Utilization. (Cr ar) Hossfeld, Rees, Kaufert
 218x.* Research Problems: Forest Measurements and Photogrammetry. (Cr ar) R M Brown, Meyer
 220x.* Research Problems: Forest-Tree Genetics. (Cr ar) Pauley
 221x.* Research Problems: Forest Influences. (Cr ar) Duncan
 222x.* Research Problems: Forest Policy. (Cr ar) Kaufert, Irving, Skok, Winsness
 223x.* Seminar. Current forestry research problems and current forestry literature. (1 cr) Graduate staff
 224Ax.* Forest Biology Seminar. Topics in forest biology. (1 cr) Graduate staff
 224Bx.* Forest Management Seminar. Topics in forest management. (1 cr) Graduate staff
 224Cx.* Forest Products Seminar. 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
 226-227.* Statistical Methods in Forestry. (1 cr per qtr; prereq 6 cr in statistics or #)

GENETICS

Professor

Elmer R. Ausemus (Agronomy and Plant Genetics)
 Cyrus P. Barnum (Physiological Chemistry)
 Charles R. Burnham (Agronomy and Plant Genetics)
 Ralph E. Comstock (Animal Husbandry)
 Troy M. Currence (Horticulture)
 A. Orville Dahl (Botany)
 Jean W. Lambert (Agronomy and Plant Genetics)
 Will M. Myers (Agronomy and Plant Genetics)
 Scott S. Pauley (Forestry)
 Sheldon C. Reed (Zoology)
 Ernest H. Rinke (Agronomy and Plant Genetics)
 Robert N. Shoffner (Poultry Husbandry)
 Leon A. Snyder (Agronomy and Plant Genetics)
 John C. Spizzen (Microbiology)
 Arthur N. Wilcox (Horticulture)

Associate Professor

V. Elving Anderson (Zoology)
 S. Gaylen Bradley (Microbiology)

Richard S. Caldecott (Agronomy and Plant Genetics)
 Laddie J. Elling (Agronomy and Plant Genetics)
 Joseph G. Gall (Zoology)
 Charles E. Gates (Agriculture Experiment Station)
 David J. Merrell (Zoology)
 William E. Rempel (Animal Husbandry)
 James C. Sentz (Agronomy and Plant Genetics)
 Francis A. Spurrell (Veterinary Medicine)
 Horace L. Thomas (Agronomy and Plant Genetics)

Assistant Professor

William M. Clement (Agronomy and Plant Genetics)
 Verne E. Comstock (Agronomy and Plant Genetics)
 Frank D. Enfield (Animal Husbandry)
 Florian I. Lauer (Horticulture)
 Donald C. Rasmussen (Agronomy and Plant Genetics)
 Charles W. Young (Dairy Husbandry)

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 on 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 more than one 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, one foreign language, preferably German. For Plan B, the language requirement may be waived. For the Ph.D. degree, (a) 2 foreign languages, 1 being preferably German, or (b) 1 foreign language, preferably German, plus a special research technique or collateral field.

- Agro 131. Principles of Genetics.** (4 cr; prereq 30 or equiv) Lambert
- Agro 132. Farm Crops Plant Breeding.** (4 cr; prereq 30 or equiv) Rinke
- Agro 235. Radiation Biology.** (3 cr; prereq VSR 219 or equiv and §) Caldecott, Loken, Marvin, Spurrell
- Agro 240. Advanced Genetics.** (3 cr; prereq 131 or equiv) Snyder
- Agro 241. Research in Plant Genetics.** (Cr ar) Myers, Burnham, Rinke, Ausemus, Thomas, Lambert, Snyder, Caldecott, Sentz, Rasmussen, Comstock
- Agro 242. Plant Breeding Seminar.** (1 cr per qtr) Staff
- Agro 243. Methods in Plant Breeding.** (3 cr; prereq 132 and 240 or equiv) Myers
- Agro 244. Laboratory Methods in Plant Breeding.** (Cr ar; prereq 132 or equiv) Staff
- Agro 245. Topics: Plant Breeding.** (2 cr; prereq 240, 243, and 244 or equiv or §) Plant Genetics staff
- Agro 246. Genetics Seminar.** (1 cr per qtr) Staff
- Agro 252. Cytogenetics.** (4 cr; prereq 240, Bot 118) Burnham
- Agro 253. Methods in Plant Genetics.** (3 cr; prereq 252) Burnham
- Agro 255. Special Topics in Genetics.** (2 cr [can be taken for cr more than once]; prereq 252 or consent of staff) Plant Genetics staff
- Agro 256. Radiation Genetics.** (3 cr; prereq 240 and §) Caldecott, Snyder
- Agro 257. Special Topics in Radiation Plant Biology.** (3 cr; prereq 256, PiPa 214 and §) Caldecott and staff
- Agro 261. Quantitative Inheritance.** (3 cr; prereq 131 or equiv, 248 or equiv) Sentz
- AnHu 162. Animal Breeding.** (3 cr; prereq Agro 30 or equiv) Rempel
- AnHu 201. Advanced Animal Breeding I.** (3 cr; prereq 162, Biom 101, Zool 171) Rempel
- AnHu 204. Quantitative Inheritance II.** (3 cr; prereq Agro 261) R E Comstock
- AnHu 205. Quantitative Inheritance III.** (3 cr; prereq 204) Enfield
- Bot 118. General Cytology.** (5 cr; prereq 10 cr in biology, botany, or zoology, elementary genetics or §) Dahl
- Bot 119. Experimental Cytology.** (5 cr; prereq 118 or Zool 161; offered 1962-63 and alt yrs) Dahl
- Bot 120. Research Methods in Cytology.** (3-5 cr; prereq 3 or 5 or Biol 2 or old NSci 9, 118, or 119, and §; offered 1962-63 and alt yrs) Dahl, Hansen
- Bot 229, 230, 231, 232. Research Problems in Cytology.** (Cr ar) Dahl
- Bot 255, 256, 257. Seminar in Cytology.** (1 cr per qtr) Dahl
- DyHu 122. Dairy Production II.** (4 cr; prereq 49, Agro 30 or equiv) Young

- DyHu 217. Dairy Cattle Inheritance. (3 cr; prereq #) Young
 For 150. Forest Genetics. (3 cr; prereq Agro 30 or 131, or #) Pauley
 Hort 110. Horticultural Crop Breeding. (3 cr; prereq Agro 30) Wilcox
 Hort 248. Truck Crop Breeding. (3 cr; prereq 110 or Agro 132) Currence
 Hort 249. Research in Horticultural Crop Breeding. (Cr ar) Currence, Hutchins, Wilcox
 MicB 110. Microbial Genetics. (3 cr; prereq 53 or #; offered 1962-63 and alt yrs) Bradley
 MicB 111. Advanced Laboratory. (3 cr; prereq 53 or #) Bradley
 PhCh 211. Nucleic Acid and Protein Metabolism. (3 cr; minimum 8 students; prereq 100-101; offered 1962-63 and alt yrs) Barnum
 PIPa 215. Genetics of Plant Pathogens. (3 cr; prereq 1 or 51, 156 or equiv, and Agro 131)
 PoHu 102. Poultry Breeding. (4 cr; prereq 1, Agro 30; offered 1963-64 and alt yrs) Shoffner
 PoHu 216. Research in Poultry Breeding. (Cr ar; prereq 9 or in genetics or equiv) Shoffner
 VSR 131. Heredity in Animal Disease. (3 cr; prereq VMC 104, #) Spurrell
 Zool 160, 161. Cytology. (6 cr; prereq 15 cr incl Biol 2 or equiv with #) Gall
 Zool 170. Advanced Genetics. (3 cr; prereq 15 cr incl 83, and #) Reed, Merrell
 Zool 171. Genetics of Speciation. (3 cr; prereq 15 cr incl 83 or #) Merrell
 Zool 175. Human Genetics. (3 cr; prereq 83 and #) Reed
 Zool 176. Problems and Methods in Human Genetics. (3 cr; prereq 175 or #) Anderson
 Zool 251, 252, 253. Research in Genetics. Anderson, Reed, Merrell

GEOGRAPHY

Associate Professor
 Eugene C. Mather

Professor
 John R. Borchert
 Jan O. M. Broek

Assistant Professor
 Ward J. Barrett
 Ronald A. Helin
 Fred E. Lukermann
 Philip W. Porter
 John W. Webb

Prerequisites—Geography majors are expected to have taken introductory courses in physical, social, and economic geography, similar to courses 1, 4, and 41, and at least 7 Upper Division courses in systematic and regional geography and also to have a substantial minor in some related biological, physical, or social science. For *minor work*, 12 credits in geography.

Language Requirement—For the Master's degree, German, French, or Spanish. Exemptions may be made in individual cases by petition. For the Doctor's degree, good reading knowledge of German and French is generally indispensable. In special cases another language may be substituted for French. Adequate reading knowledge of 1 of the 2 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.

100s.* 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; prereq 10 cr or #) Webb

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, Norway, and Denmark. (3 cr; prereq 10 cr or #) Webb

102s.* 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 10 cr or #) Helin

- 105f.° **Mediterranean Region.** Physical and human geography of lands adjacent to the Mediterranean Sea: Greece, Italy, Spain, Portugal, and Southern France. (3 cr; prereq 10 cr or #) Webb
- 107w.° **Soviet Union.** Character of and bases for the regional diversity of physical resources, population, agriculture, manufacturing, and transportation in the U.S.S.R. (3 cr; prereq 10 cr or #) Helin
- 109s.° **Middle America.** Physical and human geography of the West Indies and the mainland from Mexico to Colombia. (3 cr; prereq 10 cr or #; offered 1963-64 and alt yrs) Barrett
- 110w.° **South America.** Regional survey of physical resources, population, agriculture, manufacturing, and transportation in South America. (3 cr; prereq 10 cr or #; offered 1962-63 and alt yrs) Mather
- 111f.° **Canada and Alaska.** Regional analysis of the physical and human geography, with an examination of both internal and external areal relationships. (3 cr; prereq 10 cr or #) Mather
- 112s.° **Western United States.** Regional analysis of physical and human resources of western United States. (3 cr; prereq 10 cr or #) Mather
- 113w.° **Eastern United States.** Regional analysis of physical and human resources east of the Great Plains. (3 cr; prereq 10 cr or #) Mather
- 114f.° **Historical Geography of North America.** Sequential analysis of settlement and economy in the changing environment and resource patterns of North America. (3 cr; prereq 10 cr or #) Lukermann
- 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; prereq 10 cr or #) Lukermann
- 118w.° **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 10 cr or #) Porter
120. **South Asia.** Physical and human geography of India, Pakistan, and Ceylon; geographic aspects of population pressure, development of resources, and international relations. (3 cr; prereq 10 cr or #; offered when feasible) Broek
- 121s.° **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
122. **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 10 cr or #; offered when feasible)
- 126s.° **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; prereq 10 cr or #; offered 1962-63 and alt yrs) Barrett
- 133f.° **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; prereq 1 or #) Barrett
- 134w.° **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. (3 cr; prereq 133 or #) Barrett
- 135s.° **Advanced Physical Geography.** Laboratory work and field observations in quantitative description and analysis of terrain and climate. Especially North Central United States. (3 cr; prereq 134 or #) Barrett
- 138w.° **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; prereq 70 or #) Porter
- 139s.° **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; prereq 70 or #) Porter
- 140f.° **Advanced Cartography.** Advanced statistical mapping techniques, with emphasis on the mapping of population and settlement. Measures of distribution. History of cartography. (3 cr; prereq 138) Porter
- 143w.° **Political Geography.** Scope and methods of political geography as exemplified by various writers; analysis of selected areas. (3 cr; prereq 4 or #) Broek, Helin

- 150f.° Rural Geography.** Geographic components and assemblages of rural settlement. World regional occupancy and production patterns and the geographic problems of rural settlement and agricultural production on the American scene. (3 cr; prereq 10 cr or #) Mather
- 152s.° Geography of Economic Localization.** An analysis of the localization of economic activity, circulation of resources, and the process of industrial regionalization in the economies of the world. (3 cr; prereq 41 or #) Lukermann
- 153f.° 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; prereq 4 or #) Webb
- 160f.° 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; prereq 15 cr) Broek
- 165. 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; prereq 15 cr; offered when feasible)
- 170s.° Field Course.** Concepts and techniques of field work. Saturdays devoted to field study in eastern Minnesota and neighboring areas. (3 cr; prereq 15 cr) Staff
- 190f,w,s.° Directed Readings.** (1-3 cr) Staff
- 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
- 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.** Methodology, Southeast Asia, cultural geography. (3 cr per qtr; prereq #) Broek
- 266-267-268.° Seminar.** Eastern Europe. (3 cr per qtr; prereq #) Helin
- 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.** Cartography, Africa. (3 cr per qtr; prereq #) Porter
- 286-287-288.° Seminar.** Settlement and population geography, western Europe. (3 cr per qtr; prereq #) Webb
- 291-292-293.° Seminar.** (3 cr per qtr; prereq #) Staff
- 296-297-298.° Seminar.** (3 cr per qtr; prereq #) Staff
- 301x.° Research Problems in Geography.** (Cr ar) Staff

GEOLOGY

Professor

Preston E. Cloud, Jr.
Harold L. James
Paul K. Sims
Frederick M. Swain
Herbert E. Wright, Jr.

Associate Professor

Campbell Craddock
Paul W. Gast
Tibor Zoltai

Assistant Professor

William C. Phinney
Robert E. Sloan

Prerequisites—For candidates for advanced degrees, a Bachelor's degree in geology or related earth science, with mathematics through integral calculus, at least 1 year of college chemistry, and 1 year of college physics. A Bachelor's degree in other fields, such as chemistry, physics, or biological sciences, is entirely acceptable, particularly for those who wish to pursue specialized studies in geochemistry, geophysics, crystallography, and paleontology.

Conditions for a minor in geology are established on an individual basis by consultation with a faculty member and approved by the chairman of the graduate faculty in geology.

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 6 credit hours will be in 1 research course in which a written report will be prepared and reviewed by at least 2 members of the faculty.

Doctor's Degree—Admission to candidacy for the Ph.D. degree is contingent upon completing the minor, passing a qualifying oral examination, and completion of both language requirements.

- 100. Field Geology.** Measurement of stratigraphic sections; study of fossils and igneous, sedimentary, and metamorphic rocks. Geologic surveying on aerial photographs and topographic maps and by plane table method. Preparation of geologic maps and cross-sections. Structural and geomorphic features and geologic setting of mineral deposits. (6 cr; prereq 125; 4-wk trip beginning in mid-June, Black Hills and Rocky Mountains) Craddock, Phinney
- 101.* Field Geology in Minnesota I.** Geologic field methods; study of selected areas of Precambrian rocks in northern Minnesota. (3 cr; prereq 100; comprehensive report for grad cr; 2-wk trip beginning in mid-July) Zoltai
- 102.* Field Geology in Minnesota II.** Stratigraphic methods and principles as illustrated by Cambrian and Ordovician rocks. (3 cr; prereq 63; comprehensive report for grad cr; 2-wk trip beginning in mid-July) Sloan
- 105f. Introduction to Paleontology.** Introduction to morphology and classification of major fossil groups. (5 cr; prereq 2H, B or #) Sloan
- 106w.* Invertebrate Paleontology.** Detailed studies of morphology, ecology, and classification of selected groups of invertebrate fossils. (3 cr; prereq 105) Sloan
- 107s.* Vertebrate Paleontology.** Stratigraphic and morphologic aspects of fossil vertebrates. (5 cr; prereq 105 or Zool 56 or #) Sloan
- 111w, 112s.* Mineral Deposits.** Nature and distribution of mineral deposits; analysis of processes by which elements are concentrated in magmatic, hydrothermal, sedimentary, and surface environments. (3 cr per qtr; prereq 123 or #, 125) James
- 121f.* Mineral Systems I.** Basic and compound symmetry elements. Derivation and study of point groups, co-ordinate systems, crystal forms, lattices, plain groups and space groups. Introduction to x-ray diffraction. Introduction to crystal chemistry and crystal structures. (4 cr; prereq 63, trigonometry, a yr of college physics and chemistry) Zoltai
- 122w.* Mineral Systems II.** 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: study of structure models, thin and polished sections; immersion techniques. (4 cr; prereq 121) Zoltai, Phinney
- 123s.* Mineral Systems III.** Application of basic physical sciences to geologic problems. Rocks as chemical systems. Laboratory: macroscopic and microscopic study of rocks and minerals. (4 cr; prereq 122, PCh 102, ITM 26) Phinney, Gast
- 125f. 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 63, 163, or #) Craddock
- 126w.* Advanced Structural Geology.** Fundamental problems and genesis of secondary structural features; detailed analysis of typical examples. (3 cr; prereq 125; comprehensive term paper required for grad cr) Craddock
- 130.* Geologic Problems.** Individual research in laboratory or field. (1-6 cr) Staff
- 131f.* Major Problems in Geology.** Central problems of modern and classical geology considered 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 reading facility in at least 1 language other than English and #; open to science majors in any field with supplemental reading by nongeologists; offered 1962-63 and alt yrs) Cloud, James, and staff
- 140s.* 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 B) Wright

- 141f.° **Glacial Geology.** Physics of modern glaciers. Glacial erosion and deposition. Stratigraphy and chronology of the Pleistocene in glaciated and nonglaciated areas. (3 cr; prereq B) Wright
- 142w.° **Pleistocene Geology.** Problems in Pleistocene history of glaciated and unglaciated areas, particularly North America, Europe, and the Mediterranean. Relation of Pleistocene climatic changes to soils, biogeography, and archaeology. Pollen analysis. (3 cr; prereq 141; offered 1963-64 and alt yrs) Wright
- 143w.° **Advanced Geomorphology.** Selected geomorphic processes, especially of arctic and desert regions. (3 cr; prereq 140; offered 1962-63 and alt yrs) Wright
- 151w.° **Stratigraphy I.** Sedimentary processes and products—modern sedimentary environments; principles of physical stratigraphy, correlation, facies, tectonic control, classification of stratigraphic units. (4 cr; prereq 63) Swain
- 152s.° **Stratigraphy II.** Stratigraphy of typical and unique sequences of (a) Precambrian and Paleozoic rocks or (b) Mesozoic and Cenozoic rocks; methods of presentation of stratigraphic data; term paper required. (3 cr; prereq 151) Swain
- 153f.° **Micropaleontology.** Biology and paleontology of microorganisms of geologic importance including Foraminifera, Radiolaria, flagellate Protista, Diatomaceae, Characea, Ostracoda, and conodonts. (3 cr; prereq 105) Swain
- 161w.° **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 121 or #) Zoltai
- 162s.° **Single Crystal X-ray Diffraction.** (2 cr; prereq 161 or #) Zoltai
- 163s.° **Soil Mineralogy.** Crystallography, crystal chemistry, and mineralogy. Descriptive and determinative mineralogy. Classification of rocks. Textural, structural, and mineralogical variations of rocks and some ores. (4 cr; not open to geology, mining, and metallurgy majors; prereq 1H, 2H, A, B, or #, a term of college chemistry; term paper) Zoltai, Phinney
- 171f.° **Phase Equilibrium in Mineral Systems.** Graphical and mathematical treatment of 1, 2, 3, and 4 component systems. Phase rule, open and closed systems and effects of disequilibrium. (3 cr; prereq 123 or #) Phinney
- 172w.° **Igneous Petrology.** Fractional crystallization, disequilibrium, nucleation, assimilation, volatiles, granites, serpentines, and other problems in light of modern experimental data and theory. (3 cr; prereq 171) Phinney
- 173s.° **Metamorphic Petrology.** Solid state phase equilibrium, reaction rates, partial fusion, metasomatism, methods of graphical projection for several component systems, geologic thermometers, and effect of nonhydrostatic stress. (3 cr; prereq 172) Phinney
- 181f.° **Principles of Geochemistry.** Application of principles of thermodynamics to systems of geologic interest; aqueous solutions. (3 cr; prereq PCh 102 or #) Gast
- 182w.° **Isotopic and Nuclear Processes in Geology.** Measurement of geologic time using isotopic methods. Variations in isotopic compositions due to radioactivity and to natural isotope fractionation processes. (3 cr; prereq 123, PCh 103 or #; offered 1963-64 and alt yrs) Gast
- 183w.° **Advanced Geochemistry.** Selected topics. (2 cr; prereq 182 or #; offered 1962-63 and alt yrs) Gast
- 200f.° **Seminar in Paleocology.** Major features of paleocology developed through evaluation of current and classical publications and special projects. (3 cr; prereq reading facility in at least 1 language other than English and #; offered 1963-64 and alt yrs) Cloud
- 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) Cloud
- 205.° **Research in Paleontology.** (Cr ar; prereq #) Sloan
- 206.° **Seminar in Paleontology.** (Cr ar; prereq #) Sloan
- 211w.° **Advanced Mineral Deposits I.** Metalliferous districts. Interpretation of paragenetic relationships of ore minerals, using mineralographic, petrographic, and x-ray methods. (3 cr; prereq 112 or #) Sims, James
- 212s.° **Advanced Mineral Deposits II.** 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 112; offered 1963-64 and alt yrs) James
- 213.° **Research in Mineral Deposits.** (Cr ar; prereq #) James
- 214.° **Seminar in Mineral Deposits.** (Cr ar; prereq #) James
- 227s.° **Geotectonics.** Basic problems of structure and evolution of the earth's crust. (3 cr; prereq 125 or #; offered 1963-64 and alt yrs) Craddock

- 228.* Research in Structural Geology. (Cr ar; prereq 126) Craddock
 229s.* Seminar in Structural Geology. (3 cr; prereq 125 or #; offered in 1962-63 and alt yrs) Craddock
 241.* Research in Geomorphology and Pleistocene Geology. (Cr ar; prereq 141, 142) Wright
 242.* Seminar in Geomorphology and Pleistocene Geology. (Cr ar; prereq 141, 142) Wright
 251.* Research in Stratigraphy. (3 cr; prereq 152) Swain
 252.* Seminar in Stratigraphy. (Cr ar; prereq #) Swain
 261w.* X-ray Crystallography. Introduction to geometrical and mathematical principles of crystal structure determination. Principles and techniques of various methods. (3 cr; prereq 162 or #; offered on demand) Zoltai
 262.* Research in Mineralogy and Crystallography. (Cr ar; prereq #) Zoltai
 263.* Seminar in Mineralogy and Crystallography. (Cr ar; prereq #) Zoltai
 271.* Research in Petrology. (Cr ar; prereq #) Phinney
 272.* Seminar in Petrology. (Cr ar; prereq 173; offered when feasible) Phinney
 281.* Research in Geochemistry. (Cr ar; prereq #) Gast
 282.* Seminar in Geochemistry. (Cr ar; prereq #) Gast

Credit in geology may be granted for the following courses given in other departments; other courses, such as those in hydromechanics, will be considered on application. For detailed descriptions see listings under respective departmental headings.

- Bot 128. Introduction to Paleobotany. (3 cr) Hall
 Bot 246, 247, 248. Seminar in Paleobotany. (1 cr per qtr) Hall
 GPhy 125. Principles of Gravity and Magnetic Exploration. (3 cr) Mooney
 GPhy 126. Principles of Seismic Exploration. (3 cr) Mooney
 GPhy 127. Principles of Electrical Exploration. (2 cr) Mooney
 GPhy 135-136-137-138. Special Problems in Geophysics. (Cr ar) Mooney
 GPhy 232-233. Theoretical Seismology. (3 cr per qtr) Mooney
 MinE 131, 132, 133. Rock Mechanics I, II, III. (3 cr per qtr) Fairhurst
 MinE 180. Geochemical Exploration. (3 cr) Yardley
 MinE 230. Advanced Geochemical Exploration. (Cr ar) Yardley
 MinE 251, 252. Advanced Rock Mechanics I, II. (3 cr per qtr) Fairhurst

GEOPHYSICS

Advisers:

Associate Professor

Harold M. Mooney (Geophysics)

Assistant Professor

William D. Munro (Mathematics)

Professor

J. William Buchta (Physics)
 Frederick M. Swain (Geology)

Prerequisites—Basic preparation in physics, mathematics, and geology with an undergraduate major in one of these subjects or geophysics is required.

Major and Minor—With the approval of the adviser, courses in physics or geology may be accepted as part of the major work in geophysics. Physics, mathematics, electrical engineering, and geology are acceptable minor fields.

Language Requirement—One foreign language, preferably German.

Master's Degree—Offered under Plan A or Plan B.

108. **Introduction to Earth Geophysics.** Physics of the earth; evidence and data on origin, age, size, and shape, internal constitution, thermal history, gravity, and magnetic fields. (3 cr; prereq Phys 9 or 14, Geol 2)
109. **Introduction to Earthquake Seismology.** Physics and geology of earthquakes; causes, effects, distribution, seismic waves. (3 cr; prereq Geol 125 or #) Mooney
110. **Introduction to Exploration Geophysics.** Principles of exploration by gravity, magnetic, seismic, and electrical measurements. (3 cr; prereq Phys 9 or 14, Geol 2) Mooney
125. **Principles of Gravity and Magnetic Exploration.** Instrumentation, surveying techniques, reduction of data, interpretation, case histories. (3 cr; prereq Phys 9 or 14, Geol 1, ITM 25A)
126. **Principles of Seismic Exploration.** Reflection and refraction seismology; theory, interpretation, instruments. (3 cr; prereq Phys 9 or 14, ITM 25A, Geol 2) Mooney
127. **Principles of Electrical Exploration.** Resistivity, electromagnetic, and other methods; theory, interpretation, instruments. (2 cr; prereq Phys 9 or 14, ITM 25A, Geol 2) Mooney
- 135-136-137.* **Research Problems in Geophysics.** (Cr ar; prereq #) Staff
175. **Gravity and Geodesy.** Gravity potential theory and measurements, reference ellipsoids and gravity formulas, gravity anomalies, earth tides, isostasy, geoid and deflections of the vertical, world geodetic system, satellite geodesy. (3 cr; prereq Phys 14, ITM 25A)
176. **Geomagnetism.** Main field and secular variation, dynamo theory, magnetic storms, aurora, ionospheric physics, rock magnetism, polar wandering. (3 cr; prereq Phys 14, ITM 25A)
- 232w-233s. **Theory of Elastic Wave Propagation.** Theoretical seismology, solutions of wave equations, normal mode propagation. (3 cr per qtr; prereq MM 180...ITM 174-175 recommended but not required) Mooney
- 251-252-253. **Geophysics Seminar.** (Cr ar; prereq #) Staff
- Geol 125.* **Structural Geology.**
- ITM 147. **Vector Analysis.**
- ITM 148. **Differential Equations.**
- ITM 149. **Determinants and Matrices.**
- MM 180. **Introduction to the Theory of Elasticity.**
- MM 193. **Introduction to the Theory of Mechanical Vibrations.**
- Phys 100-102-104. **Mechanics, Electricity, and Magnetism.**
- Phys 144. **Electrical Measurements.**
- Phys 146. **Physics of Vacuum Tubes and Associated Circuits.**
- Phys 148. **Application of Electronic Circuits.**

GERMAN

Professor

Herman Ramras
Edwin F. Menze
Frank H. Wood

Associate Professor

Cecil Wood

Assistant Professor

Frank D. Hirschbach
Gerhard Weiss

Prerequisites—For major work, 27 Upper Division quarter credits or equivalent. 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 1 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 1 of the following: classics, English literature, fine arts, foreign 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 88.

Composition and Bibliography

- 103-104-105.† **German Syntax and Composition.** Required of all graduate majors. (1 cr per qtr; prereq 66 or equiv; offered 1962-63 and alt yrs)
- 133-134-135.† **Bibliography and Research Methods.** Required of all graduate majors. (1 cr per qtr; prereq 11 cr above 69; offered 1963-64 and alt yrs)

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.† **The Middle High German Epic.** (3 cr per qtr; prereq 111 or ‡) C Wood
118. **The Minnesang.** (3 cr; prereq 111 or ‡) C Wood
- 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; offered 1962-63) Menze
149. **Directed Reading.** (2-3 cr)
- 150-151-152.*† **The Age of Luther.** (3 cr per qtr)
- 153-154.* **German Literature of the Seventeenth Century.** (3 cr per qtr) Weiss
- 160-161-162.*† **Klopstock, Wieland, Lessing, Herder.** (3 cr per qtr; offered 1963-64 and every 3rd yr) Ramras
- 163-164-165.*† **Goethe.** (3 cr per qtr; offered 1962-63 and every 3rd yr) Ramras
- 166-167-168.† **Schiller.** (3 cr per qtr; offered 1964-65 and every 3rd yr) Ramras
- 170-171-172.*† **Romanticism.** (3 cr per qtr; offered 1963-64) Menze
- 173-174-175.*† **The Nineteenth-Century Novel.** (3 cr per qtr) Menze
- 176-177-178.*† **The Nineteenth-Century Drama.** (3 cr per qtr) F Wood
- 179A-B. **German Drama from Naturalism to the Present.** 179A: 1880-1910. 179B: 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 und Drang*. 187: Goethe through Romanticism. 188: Heine to Rilke. (3 cr per qtr; offered 1962-63) F Wood
- 189.* **Expressionism in German Literature.** (3 cr) Hirschbach
- 190-191-192.*† **English-German Literary Relations.** (3 cr per qtr)
- 190A-191A-192A.*† **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) Ramras
- 254.* **Seminar: Nineteenth Century.** (3 cr; prereq 1 yr grad work in German) Ramras, F Wood
- 255.* **Seminar: Twentieth Century.** (3 cr; prereq 1 yr grad work in German) F Wood

Germanic Philology

- 110-111. **Middle High German Language.** (3 cr per qtr; prereq 94 and 11 cr in courses 70 and above or equiv; offered 1962-63) C Wood
112. **History of the German Language.** (3 cr; prereq 111; offered 1962-63) C Wood
- 157-158-159. **Old Norse Language and Literature.** (3 cr per qtr; prereq knowledge of 1 Germanic language other than modern English) C Wood

Germanic Linguistics

113. **Gothic.** (3 cr; prereq 80 and 11 cr in courses 70 and above or equiv; offered 1963-64) C Wood
- 114-115. **Methods of Comparative Germanic Linguistics.** (3 cr per qtr; prereq 113; offered 1963-64) C Wood
119. **Old High German.** (3 cr; prereq 112 or 115; offered 1962-63) C Wood
120. **Old Saxon.** (3 cr; prereq 119; offered 1962-63) C Wood
121. **The Hildebrandslied.** (3 cr; prereq 119 and 120; offered 1962-63) C Wood

HISTORY

Professor

Harold C. Deutsch, *chairman*
 Robert S. Hoyt
 Tom B. Jones
 Philip D. Jordan
 Otto P. Pflanze
 David H. Willson
 John B. Wolf

Associate Professor

Paul W. Bamford
 W. Donald Beatty,
assistant chairman
 Hyman Berman
 Clarke A. Chambers
 Ralph E. Giesey
 Rodney C. Loehr
 Paul L. Murphy
 David W. Noble
 Timothy L. Smith

Burton Stein

William E. Wright

Assistant Professor

Josef L. Altholz
 Robert F. Berkhofer, Jr.
 Karl F. Morrison
 Darrett B. Rutman
 Theofanis G. Stavrou
 Romeya Taylor

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 2 or 3 of the following areas or periods: Ancient, European, English, American, and Asian; (b) a minimum of 2 full-year advanced or Upper Division courses (or their equivalent) in 2 of these areas or periods, including (c) at least 1 course in which intensive work has been done.

A student who minors in history must have completed approximately the same amount of prerequisite 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 and research work.

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 a member of the graduate faculty for suggestions concerning an adviser.

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 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, including Hist 200-201-202 or its equivalent, and 9 credits in the minor are required. There shall be a final written examination covering the two subareas 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. Hist 200-201-202 or its equivalent is required.

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 take an examination covering 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 3 of these subareas will fall within the subfield of the student's concentration (in which he will also write his dissertation) and 2 subareas in 2 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 3 subareas of the Old Orient, Greece, and Rome, as well as the subfield of medieval history with 1 subarea.

All candidates shall take Hist 167-168-169 and Hist 200-201-202, or equivalents.

Preliminary Examination—The preliminary examination shall cover the subfield, the subareas in history, and the 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 1 subarea of history.

The candidate for the Ph.D. degree with a minor in history must be prepared for written and oral examinations in either (a) 1 subfield of history and an associated

subarea, or (b) 2 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 minor programs must be approved by a member of the graduate faculty of the department.

LECTURE COURSES

- 100f-101w-102s.† The Ancient Near East. (3 cr per qtr; offered 1963-64 and every 3rd yr) Jones
- 100Af-101Aw-102As.† Greece to 200 B.C. (3 cr per qtr; offered 1964-65 and every 3rd yr) Jones
- 100Bf-101Bw-102Bs.† History of Rome. (3 cr per qtr; offered 1962-63 and every 3rd yr) Jones
- 100Cf-101Cw-102Cs.† Byzantine History. 100C: Later Roman Empire from accession of Diocletian to death of Justinian in A.D. 565. 101C: Rise of Byzantium to its zenith at the accession of Basil II in 976. 102C: From reign of Basil II to fall of Constantinople in 1453. (3 cr per qtr; offered when feasible)
- 103f-104w-105s.† Europe in the Early Middle Ages. 103: Reforms of Diocletian to first sack of Rome (410). 104: Age of the Fathers to Carolingian Empire. 105: Germanic Empire to end of Investiture Controversy. (3 cr per qtr) Morrison
- 103Af-104Aw-105As.† Europe in the High Middle Ages. 103A: Twelfth century revival. 104A: Medieval civilization. 105A: Rise of western monarchies, decline of papacy and empire. (3 cr per qtr) Hoyt
- 103Bf-104Bw-105Bs.† Europe in the Late Middle Ages, Renaissance and Reformation. 103B: Later Middle Ages and early Italian Renaissance (1300-1450). 104B: High Renaissance (1450-1515). 105B: Reformation (1515-1560). (3 cr per qtr) Giesey
- 103Cf-104Cw-105Cs.† English Constitutional History to 1485. 103C: Anglo-Saxon and Anglo-Norman England. 104C: From Henry II to Edward I. 105C: England in the later Middle Ages. (3 cr per qtr) Hoyt
- 106f-107w-108s.† Early Modern Europe. 106: Reformation and religious wars. 107: 17th century. 108: 18th century. (3 cr per qtr) Wolf
- 106Af-107Aw-108As.† Europe in the Nineteenth Century. 106A: French Revolution and Napoleon. 107A: Liberalism and nationalism, revolutions of 1820, 1830, 1848. 108A: 1852-1900, unification of Italy and Germany, industrialism and imperialism. (3 cr per qtr)
- 106Bf, 107Bw, 108Bs. French Revolution and Napoleon. 106B: Background and emergence of Revolution, to Thermidor. 107B: Impact of Revolution and Revolutionary Wars on Britain and Europe (1789-1806), and emergence of Napoleonic Empire (1795-1806). 108B: Struggle to stabilize the Empire and its disintegration under nationalist assaults. (3 cr per qtr; offered when feasible) Bamford
- 109f-110w-111s.† Europe in the Twentieth Century. 109: 1890-1918. 110: 1918-1938. 111: 1938 to the 1950's. (3 cr per qtr) Deutsch
- 112f-113w-114s.† Economic History of Europe. 112: Economic life in medieval times. 113: Developments in the early modern world. 114: Developments in the modern world. (3 cr per qtr) Bamford
- 115f-116w-117s.† European Overseas Expansion. 115: Voyages of discovery and overseas expansion, 1400-1600. 116: Colonial development, 1600-1815. 117: Imperialism since 1850. (3 cr per qtr; offered when feasible) Stein
- 120f-121w.† Modern France. 120: Political, social, and economic history of France from Vienna settlement to establishment of Third Republic. 121: 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)
- 122f-123w-124s.† Modern History of Spain. Spain and Portugal in the modern period: politics, diplomacy, social, economic, and cultural problems. 122: 1400-1700. 123: 1700-1898. 124: The 20th century. (3 cr per qtr; offered when feasible)
- 125f-126w-127s.† Russia. 125: Origins of the Slavs, the eastward movement, and the rise of Russia through the death of Peter the Great. 126: The Empire after Peter the Great to the 19th century. 127: 19th century to the end of the Empire. (3 cr per qtr) Anderson
- 125Af-126Aw-127As.† Central Europe. Austria, Poland, Hungary, Czechoslovakia. 125A: Austria, Poland, and Hungary up to the 19th century. 126A: 19th century and World War I. 127A: After World War I to the present. (3 cr per qtr; prereq 3) Wright

- 125Bf-126Bw-127Bs.† **Modern Russia.** 125B: The 19th-century background, reign of Nicholas II to 1914. 126B: 1914-1929, World War I, revolutions, civil war, new economic policy. 127B: The Soviet regime from 1929 to the present. (3 cr per qtr) Stavrou
- 125Cf-126Cw-127Cs.† **The Modern Near East: The Balkans and the Arab World.** 125C: From the fall of Constantinople (1453) to the Treaty of Jassy (1792). 126C: From the Treaty of Jassy to the Congress of Berlin (1878). 127C: From the Congress of Berlin to the present. (3 cr per qtr) Stavrou
- 128f-129w-130s.† **Modern England: Tudor and Stuart Periods.** 128: 1485-1588, from Henry VII to defeat of Spanish Armada. 129: 1588-1642, from Spanish Armada to English civil wars. 130: 1642-1714, from civil wars to death of Queen Anne. (3 cr per qtr; offered 1962-63 and alt yrs) Willson
- 128Af-129Aw-130As.† **Modern England: 1783 to the Present.** 128A: 1783-1846, the triumph of the middle class. 129A: 1846-1901, the Victorian era. 130A: 1901-1951, war and social change. (3 cr per qtr; offered 1963-64 and alt yrs) Altholz
- 128Bf-129Bw-130Bs.† **Modern England: Social History.** 128B: The age of Queen Elizabeth I. 129B: The 18th century. 130B: The age of Queen Victoria. (3 cr per qtr; offered 1963-64 and alt yrs) Willson
- 131f-132w-133s.† **Intellectual and Cultural History of Modern Europe.** 131: The 18th century and its background. 132: The early 19th century, romanticism and liberalism. 133: The late 19th and early 20th centuries, the breakdown of the intellectual unity of Europe. (3 cr per qtr; offered 1962-63 and alt yrs) Altholz
- 134f-135w-136s.† **World War II.** 134: Origins and background. 135: War period, 1939-1942. 136: Period 1943-1945. (3 cr per qtr) Deutsch
- 137f-138w-139s.† **The Early National Period in United States History.** 137: 1783-1815. 138: 1815-1835. 139: 1835-1850. (3 cr per qtr) Jordan
- 137Af-138Aw-139As.† **American History, 1850-1900.** 137A: Compromise of 1850 to Appomattox. 138A: 1865 to 1880. 139A: 1880 to 1900. (3 cr per qtr) Loehr
- 140f-141w-142s.† **History of Germany.** 140: To 1648. 141: 1648-1871. 142: Since 1871. (3 cr per qtr; prereq 3 or major in German or #) Wright
- 143Af-144Aw-145As.† **Social History of American Religion.** Role of religion, both as a sanction to developments determined by other forces and as itself a factor in social change. 143A: Colonial period. 144A: The 19th century. 145A: The 20th century. (3 cr per qtr) T Smith
- 143Bf-144Bw-145Bs.† **History of American Labor.** Role in development of United States from colonial period to present. 143B: 1607-1873. 144B: 1873-1917. 145B: 1917 to present. (3 cr per qtr; offered when feasible) Berman
- 145s. **American Agricultural History.** Colonial times to present. (3 cr) Loehr
- 146f-147w-148s.† **American Economic History.** 146: Colonial life. 147: From American Revolution to 1860. 148: Developments since 1860. (3 cr per qtr) Loehr
- 146Af-147Aw-148As.† **History of the South.** 146A: 1607-1840. 147A: 1840-1890. 148A: Since 1890. (3 cr per qtr) Noble
- 149f-150w-151s.† **Intellectual History of the United States.** (3 cr per qtr) Noble
- 149Af-150Aw-151As.† **American Constitutional History.** 149A: English and colonial background through the Age of Jefferson. 150A: Slavery controversy, sectionalism, Civil War and Reconstruction. 151A: Constitutional developments in an industrial age. (3 cr per qtr) Murphy
- 149Bf-150Bw-151Bs.† **Social History of American Education.** Impact of education on social and institutional developments, colonial period to present. "Education" is defined to include not only work of schools but family, religious congregation, and popular press. (3 cr per qtr) T Smith
- 154Af-155Aw-156As.† **History of the British Empire and Commonwealth.** 154A: First empire to 1783. 155A: Second empire, 1783-1914. 156A: Development of the Commonwealth. (3 cr per qtr; offered when feasible) Stein
- 154Bf-155Bw-156Bs.† **History of South Asia, Especially India.** 154B: Ancient India to A.D. 1000. 155B: Muslim India, A.D. 1000-1757. 156B: Modern India, 1757-1947. (3 cr per qtr) Stein
- 157f-158w-159s.† **Survey of Latin-American History.** 157: Colonial period. 158: Latin-American republics. 159: Recent Latin-American history. (3 cr per qtr) Beatty
- 162f-163w.† **Cultural History of China.** 162: Prehistoric times to A.D. 600. 163: 600 A.D. to the present. (3 cr per qtr; prereq ¶Art 111 recommended; offered when feasible)
- 163Af-164Aw-165As.† **The Chinese Revolution, 1851-1949.** A survey of modern Chinese history focused on transition from imperial bureaucracy to communist bureaucracy in a context of

- broad cultural adjustment under Western influence. 163A: 1851-1911. 164A: 1911-1927. 165A: 1927-1949. (3 cr per qtr; offered when feasible) Taylor
- 164f-165w-166s.† History of China, Prehistoric Times to Present. 164: To 221 B.C. 165: 221 B.C. to A.D. 1279. 166: A.D. 1279-1949. (3 cr per qtr) Taylor
- 167f-168w-169s.† Readings in the Works of Great Historians. (2 cr per qtr; required of all Ph.D. candidates) Morrison, Giesey, Rutman

Courses numbered 170 to 199 are open to seniors and to graduate students upon recommendation of adviser and written consent of instructor.

PROSEMINARS IN EUROPEAN HISTORY

- 170f-171w-172s.† Ancient History. (3 cr per qtr) Jones
- 173f-174w-175s.† Medieval History. (3 cr per qtr) Hoyt, Morrison
- 173Af-174Aw-175As.† Medieval English History. (3 cr per qtr)
- 173Bf-174Bw-175Bs.† Renaissance History. (3 cr per qtr) Giesey
- 176f-177w-178s.† Seventeenth-Century France. (3 cr per qtr; prereq reading knowledge of French) Wolf
- 176Af-177Aw-178As.† Russian History. (3 cr per qtr; prereq 127 and reading knowledge of Russian, German, or French, or ‡)
- 176Cf-177Cw-178Cs.† Recent European History. (3 cr per qtr; prereq lect course in 20th-century Europe or World War II, or §) Deutsch
- 176Df-177Dw-178Ds.† Nineteenth-Century Germany. (3 cr per qtr; prereq reading knowledge of German, §) Pflanze
- 176Ef-177Ew-178Es.† Europe in the Eighteenth Century. (3 cr per qtr) Wright
- 179f-180w-181s.† European Economic History Since 1500. (3 cr per qtr) Bamford
- 179Af-180Aw-181As. History of European Commerce. (3 cr per qtr; offered 1963-64 and alt yrs) Bamford
- 182f-183w-184s.† English History: Tudor and Stuart Periods. (3 cr per qtr) Willson

PROSEMINARS IN AMERICAN HISTORY

- 185f-186w-187s.† American Political and Constitutional History. (3 cr per qtr) Murphy
- 185Af-186Aw-187As.† The West in American History. (3 cr per qtr; offered 1963-64 and alt yrs) Berkhofer
- 185Bf-186Bw-187Bs.† American Diplomatic History. (3 cr per qtr; offered 1963-64 and alt yrs) Beatty
- 185Cf-186Cw-187Cs.† Twentieth-Century American History. (3 cr per qtr) Chambers
- 185Df-186Dw-187Ds.† Nineteenth-Century American History. (3 cr per qtr) Jordan
- 185Ef-186Ew-187Es.† Seventeenth- and Eighteenth-Century American History. (3 cr per qtr) Rutman
- 188f-189w-190s.† American Economic History. (3 cr per qtr; offered 1962-63 and alt yrs) Loehr
- 188Af-189Aw-190As.† American History, 1850-1900. (3 cr per qtr; offered 1963-64 and alt yrs) Loehr
- 188Bf-189Bw-190Bs.† Intellectual History of United States in Nineteenth, Twentieth Centuries. (3 cr per qtr) Noble
- 191f-192w-193s.† Latin-American History. (3 cr per qtr; prereq reading knowledge of Spanish; offered when feasible) Beatty

PROSEMINARS IN ASIAN HISTORY

- 176Bf-177Bw-178Bs.† History of India. (3 cr per qtr) Stein
- 194Af-195Aw-196As.† Chinese History. (3 cr per qtr; prereq 2 yrs of literary Chinese or equiv preparation) 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

SEMINARS

Courses numbered 200 and above are for graduate students only.

- 200-201-202.*† **Historical Bibliography and Criticism.** (2 cr per qtr; required of candidates for advanced degrees in history who do not present evidence of similar training elsewhere) Jones, Jordan
- 210-211-212.† **Ancient History.** (3 cr per qtr) Jones
- 213-214-215.† **Medieval History.** (3 cr per qtr) Hoyt
- 216-217-218.† **Renaissance History.** (3 cr per qtr) Giesey
- 220-221-222.† **Medieval English History.** (3 cr per qtr)
- 223-224-225.† **English History, Tudor-Stuart Period.** (3 cr per qtr) Willson
- 233-234-235.† **Seventeenth-Century France.** (3 cr per qtr) Wolf
- 240-241-242.† **Nineteenth-Century Germany.** (3 cr per qtr) Pffanze
- 243-244-245.† **Recent European History.** (3 cr per qtr) Deutsch
- 250-251-252.† **European Economic History.** (3 cr per qtr) Bamford
- 253-254-255.† **Russian History.** (3 cr per qtr)
- 260-261-262.† **Latin-American History.** (3 cr per qtr) Beatty
- 263-264-265.† **History of India.** (3 cr per qtr) Stein
- 270-271-272.† **Seventeenth-Century American History.** (3 cr per qtr) Rutman
- 273-274-275.† **Nineteenth-Century American History.** (3 cr per qtr) Jordan
- 276-277-278.† **American History, 1850-1900.** (3 cr per qtr) Loehr
- 280-281-282.† **Twentieth-Century American History.** (3 cr per qtr) Chambers
- 283-284-285.† **American Economic History.** (3 cr per qtr) Loehr
- 286-287-288.† **American Political and Constitutional History.** (3 cr per qtr) Murphy
- 290-291-292.† **The West in American History.** (3 cr per qtr)
- 293-294-295.† **American Diplomatic History.** (3 cr per qtr) Beatty
- 296-297-298.† **Intellectual History of the United States in the Nineteenth and Twentieth Centuries.** (3 cr per qtr) Noble
- 296A-297A-298A.† **American Social and Educational History.** (See HED 296-297-298) (3 cr per qtr) T Smith

HOME ECONOMICS

Professor

Louise A. Stedman
 Marjorie M. Brown
 Suzanne Davison
 Florence A. Ehrenkranz
 Gertrude Esteros
 Roxana R. Ford

Isabel T. Noble
 Robert J. Sirmy
 Murray A. Straus

Associate Professor
 Lura M. Morse

Assistant Professor

Margaret D. Doyle

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 each of the following—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 school for the Doctor's degree must include a seminar in the area of the major or minor or one in a closely related area.

Language Requirement—Candidates for the Master's degree under Plan B are exempted from the foreign language requirement. Candidates for the Ph.D. degree may submit (a) 2 foreign languages or (b) 1 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.

- 102. Advanced Textiles.** Nature of textile raw materials; economic, chemical, and physical problems involved in their manufacture and use; measurement and significance of physical characteristics of yarns and fabrics. (3 cr; prereq 50, AgBi 1A or OrCh 42, AgEc 2 or ¶AgEc 2) Davison
- 107. Textile Analysis.** Application of quantitative methods in analysis of textile materials, fiber composition, and finishes. (3 cr; prereq 50, AgBi 1A or OrCh 42, InCh 11, AnCh 57) Davison
- 115. Economic and Social Aspects of Clothing.** Trends in clothing consumption; factors influencing consumer demand for clothing; clothing expenditure patterns; psychological, sociological, and economic aspects of fashion in dress; clothing industry. (3 cr; prereq 50, AgEc 2 or Econ 2, Soc 1A or 1, Psy 2, or ¶) Davison
- 116. Family Clothing Problem.** Influence of family composition, income, and occupation on family clothing; clothing in relation to family goals and values; theories of consumer behavior, decision making, and management in the solution of family clothing problems. (3 cr; prereq 50, AgEc 2 or Econ 2, Soc 1A or 1, Psy 2, or ¶) Davison
- 119su. Cultural Resources of the Twin Cities.** Study of the broad range of arts represented: architecture, including interior design (homes and public buildings), gardens, painting, sculpture, ceramics, music, theater, costume, and food. Lectures by instructor and practicing professional artists, field trips, readings. (2-3 cr) Esteros
- 120x.° Art History.** Egyptian period to the present. Painting, sculpture, and architecture of the past studied for influences on contemporary period. (3 cr) Esteros
- 121. Textile Design.** Historic and modern textile designs and designers. Original designs applied to textiles by means of silk screen, batik, and block print techniques. (3 cr; prereq 23, 50, or ¶) 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 Art 20 or 23, HE 24) Forsyth
- 122B. Interior Design Problems.** Interiors designed and rendered in a variety of mediums; 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 home furnishings field, other topics of practical and historic interest. Field trips to shops, buildings, and homes. (3 cr; prereq 120, 122A, 123, or ¶...180 recommended) Ludwig
- 123. History of Home Furnishings.** Historic styles in home furnishings with corresponding styles in exteriors. Effect on contemporary design in home furnishings. (2 cr; prereq 120 recommended) Ludwig
- 125. Advanced Costume Design.** Problems in draping and sketching clothing designs. Pencil, crayon, and watercolor techniques, studies and reports on selected topics. (3 cr; prereq 3, 22, or ¶) Esteros
- 126.° Special Problems in Crafts.** Advanced study of area of crafts; weaving, enameling, leatherwork, metalwork, or other. One area may be studied or a combination of two or more. (1-3 cr; prereq 20, 25 or ¶) Abell
- 127.° Purchasing Home Furnishings.** Use, cost, and appearance: furniture, dinnerware, floor and wall coverings, fabrics and accessories. Actual materials, slides, and references will be used. Field trips. (3 cr; prereq 24, 50) Ludwig, Myren
- 128. History of Costume.** Primitive to contemporary styles. Reports. (2 cr; prereq 22, 120 or ¶) Esteros

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 discussion. (1-2 cr; prereq 49, total of 15 cr in physics, foods, textiles and clothing, or §) Ehrenkranz
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) Trammell
- 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) Trammell
140. **New Developments in Food Preparation.** (3 cr; prereq 40...70 recommended) Lund
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 problem. (3 cr; prereq 40, AgBi 1A) Noble
144. **Topics in Experimental Foods.** Assigned readings, reports, and discussions. (2-3 cr; prereq OrCh 42 or equiv, 15 cr in food and nutrition) Noble
146. **Special Food Problems.** (3 cr; prereq 142) Trammell
- 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
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
- 170x. **Nutritional Principles.** Application in promotion of optimal health. (3 cr; prereq 31, 40, AgBi 1A, Phsl 4) Doyle, Morse
- 171x.* **Maternal and Child Nutrition.** Principles; formation of desirable food habits; observation of children at mealtime. (3 cr; prereq 170, HEEd 90) Doyle, Morse
172. **Current Developments in Nutrition.** Fundamental facts and techniques for solving current nutrition problems. (3 cr; prereq 31, 40, AgBi 1A, Phsl 4 or §) Sirmy
173. **Diet Therapy.** (4 cr; prereq 170...35 recommended) North
174. **Nutrition Topics.** (1 cr; prereq 170) North
- 174Asu. **Workshop in Applied Nutrition.** Recent advances; application to problems of schools and public welfare agencies; use of new materials and techniques; recent publications and audio-visual materials. (3 cr; prereq 8 cr in normal nutrition and §) North
175. **Nutrition.** Tissues and tissue metabolism as well as work on blood, milk, and urine. (4 cr; prereq 33, InCh 11, AnCh 57) Morse
176. **Advanced Nutrition.** Quantitative methods applicable to investigations relating to digestion and metabolism. (4 cr; prereq 35 or §35, InCh11, AnCh 57) Morse
177. **Digestion and Metabolism.** (3 cr; prereq 35) Morse
- 178x.* **Clinical Problems in Nutrition.** Application of nutrition information to health and disease. Experience in a diabetic clinic. (2 cr; prereq 170, 35 or §35) North

- 179x.° Readings in Nutrition. (2 cr; prereq 170) Sirny
- 180x.° Advanced Home Planning and Furnishings. Problems. Aesthetic, economic, social, and managerial aspects. Each student plans a house and its furnishings based on family living. Field trips. (3 cr; prereq 24, 49...120 recommended, §) Myren, Ludwig
181. Housing Problems of the Family. Plans for urban and rural homes; evaluation of economic, art, and social aspects. Discussions, field trips, and classroom analyses. (3 cr; prereq 24)
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 17, HEEd 90, or §) Straus
- 184su. Home-Management Principles. Problems in use of time, energy, and money. (3 cr; prereq 40...41 recommended) Jeary
- 185x.° Family Relationships. Functioning of family in contemporary America. Family relationships as an empirical science; in laboratory work each student demonstrates for herself some basic principles of family organization and functioning. (3 cr; prereq 17, HEEd 90 or §) Straus
186. Problems in Income Management. Individual and family. Readings, discussions, field work. (3 cr; prereq 76, 85, or §) Jeary
187. Readings in Family Relationships. Independent study in selected areas with faculty conferences. (1-3 cr; prereq §)
188. Evaluation of Food Quality. Subjective and objective methods used in measuring quality of food products. (3 cr; prereq AgBi 1A, InCh 11, AnCh 57, HE 142, Biom 90 or 100) Noble
- 189A, B, C. Construction and Use Characteristics of Household Appliances. Thermal and electrical characteristics of A: Ranges, refrigerators, and freezers. B: Selected electric and nonelectric appliances such as air conditioners, dehumidifiers, humidifiers, electric housewares, and others. C: Washers, dryers, combination washer-dryers, water heaters, water softeners, irons, and ironers. (3 cr per qtr; prereq 131) Ehrenkranz
190. Family Relationships Colloquium. Review of research, and discussions; designed for graduate students, but available to high scholarship seniors with consent of instructor. (2 cr per qtr with 4 cr total; prereq 185, or 15 cr in child development, psychology, and/or sociology) Straus
195. Development of Home Economics. Current problems. (2 cr) Stedman
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 in 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. Silk screen, block printing, and 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 in 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, AgBi 1, §) Noble

- 249x.* **Seminar in 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, #) Sirny
272. **Human Metabolic Studies in Health and Disease.** (4 cr; prereq 173 or equiv, #; offered at St. Marys, Rochester)
273. **Advanced Diet Therapy.** (4 cr; prereq 173 or equiv, #; offered at St. Marys, Rochester)
- 279x.* **Seminar in Nutrition.** Review and interpretation of the literature. Recent advances. Individual oral and written reports. (1 cr; prereq #) Morse
289. **Seminar in Household Equipment.** Reference sources and research reports on recent and current work in home lighting, kitchen and laundry planning, and selected electric and non-electric 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
- 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

HORTICULTURE

Professor

Leon C. Snyder
Troy M. Currence
Arthur E. Hutchins
Robert E. Nylund
Arthur N. Wilcox

Associate Professor

Richard E. Widmer

Assistant Professor

Florian I. Lauer
John C. Weiser
Donald B. White

Prerequisites—For a major in horticulture 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. 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) 2 foreign languages or (b) 1 foreign language and either a special research technique or a collateral field of knowledge.

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.** (Same as Food 104) Technology of food preservation by freezing. Changes occurring during handling, freezing, and storage. Application to processing, packaging, distribution, and storage. (3 cr; prereq AgBi 5 or 6 or 10, MicB 53, or #)
105. **Frozen Food Problems.** (Same as Food 105) Special problems based on work in 104. (2-4 cr per qtr with 9 cr total; prereq 104 or #)
107. **Orchard Management.** Cultural operations in orchards and berry fields. (3 cr; prereq 6, horticulture majors or minors, or #; offered 1962-63 and alt yrs) Andersen
110. **Horticultural Crop Breeding.** Principles of plant improvement; breeding methods used with vegetables, fruits, and ornamentals. (3 cr; prereq Agro 30) Wilcox
111. **Systematic Pomology.** Fruit varieties. Classification, description, identification, and elements of judging. (3 cr; prereq 6, horticulture majors or minors or #; offered 1963-64 and alt yrs) Andersen
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 1963-64 and alt yrs) Andersen

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 1963-64 and alt yrs) Currence
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 Bot 51 or AgBi 105, 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 1962-63 and alt yrs)
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 1963-64 and alt yrs)
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, parthenocarp, growth rate, growth habit, plant size, apical dominance, organ initiation, dormancy, germination, flowering, callusing, and others. Optional 1- or 2-credit laboratory. (3-5 cr; prereq 15 cr in plant science incl 3 cr in plant physiology) Weiser
142. Turf Management. Species and varieties of grasses and cultural practices for growing turf for home lawns, golf courses, athletic fields, and other landscape purposes. Lecture and laboratory. (5 cr; prereq Biol 2 plus 12 cr in plant science)
152. Commercial Floriculture, Fall Crops. Culture of principal florist crops and tropical plants of economic importance. Major emphasis on foliage plants, 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 1963-64 and alt yrs) Widmer
154. Commercial Floriculture, Spring Crops. Principal florist crops and tropical plants of economic importance. Major emphasis on orchids, roses, bulbous plants, and material adapted to spring sales. Lectures, reference reading, and field trips to greenhouses, wholesalers, and retail flower stores. (3 cr; prereq 16; offered 1963-64 and alt yrs) Widmer
- 190-191-192.† Special Problems. Problems based upon work given in preceding courses. (2-4 cr per qtr; prereq §)
241. Organization of Horticultural Research. Organization and administration in agricultural experiment stations; project development and research outlines. (2 cr) Snyder, Nylund, and others
- 242x.* Horticultural Seminar. Reports and discussions of problems and investigational work. (1 cr per qtr; prereq 9 cr in horticulture) Snyder and graduate staff
- 243*-244. Advanced Topics in Horticulture. Recent advances in horticultural research. (2 cr per qtr) Snyder and graduate staff
- 247x.* Written Report on Special Horticultural Topics. (Not to exceed 9 cr; prereq final approval by grad committee in horticulture)
248. Truck Crop Breeding. Variety improvement, selection methods, pollination control, inheritance of characters, and suitable improvement programs for different crop species. (3 cr; prereq 110 or Agro 132) Currence
- 249x.* Research in Horticultural Crop Breeding. (Cr ar) Currence, Hutchins, Wilcox, Lauer
- Agro 242x.* Plant Breeding Seminar. (1 cr per qtr) Horticulture and Agronomy staffs
- Agro 246.* Genetics Seminar. (2 cr) Horticulture, Agronomy, and Animal Husbandry staffs

HOSPITAL ADMINISTRATION

Professor

James A. Hamilton, M.C.S.
James W. Stephan, M.B.S.

Associate Professor

Edith M. Lentz, Ph.D.

The American hospital has become an important focal point of health care. It is part of a complex of institutions and ideas—medical, religious, charitable, and civic. Full understanding of this complex requires intensive and broad education.

Prerequisites—Ordinarily the professional degree master of hospital administration (administered by the School of Public Health) will serve as a first step in acquiring the Ph.D.

Ph.D. Degree—The Ph.D. program in hospital administration is interdepartmental and is designed to produce scholars, teachers, and research workers who possess thorough knowledge not only of the problems of the hospital but also of the hospital's role within the wider community. Work toward the Ph.D. will be done under a dual advisership. The second adviser shall be in one of the relevant departments such as anthropology, business administration, economics, political science, psychology, or sociology. Use of a double major rather than a major and minor is permitted for students who choose this alternative. Programs will be submitted to the Social Science Graduate Group Committee.

For a more complete statement concerning requirements, fellowships, and recommended courses of study, see the special bulletin published by the Program in Hospital Administration at the School of Public Health.

Thesis—The dissertation shall deal with a significant problem concerning health care services as they relate to the role and function of the hospital.

Language Requirement—Either (a) 2 foreign languages, or (b) 1 foreign language and the option of a special research technique or a collateral field of knowledge.

PubH 261f-262w-263s. Alternative Patterns for Meeting Health Care Needs. Future role of hospitals in light of patient needs and community services. (3 cr per qtr; prereq #) Hamilton, Stephan, Lentz

PubH 264f. Seminar: Medical Care Patterns Abroad. Readings, discussion, guest lectures on relations between health services and other social institutions. (3 cr; prereq #) Stephan, Lentz

PubH 265w. Seminar: Research Studies on Health Services. Appraisal of design, instruments, field work procedures, and findings of existing studies. (3 cr; prereq #) Lentz

PubH 266w,s. Hospital Administration Topics. Independent study under tutorial guidance on selected problems, current issues. (Cr ar; prereq #) Hamilton

HYDROMECHANICS

(Staff listed under Civil Engineering Department)

101f. Fluid Mechanics. Fluid statics and dynamics for liquids and gases. Viscous effects, dimensional analysis and similitude, potential flow. (3 cr; prereq MM 27; 103 may be substituted for 101) Straub and staff

103f,w,s. Fluid Mechanics. Fluid properties, hydro- and aerostatics, fluid dynamics for viscous and nonviscous liquids and gases, dimensional analysis and similitude, pipe flow, open channel flow, principles of lift and drag, and introduction to boundary layers. (5 cr; prereq MM 27; 103 may be substituted for 101) Straub and staff

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 103 or ChEn 101...or ¶101 or 103 or ChEn 101) Straub and staff

183f.* Open Channel Flow. Theory of uniform and varied flow with practical applications to design of hydraulic structures, computations of drawdown curves, backwater curves, hydraulic jump, measuring flumes, submerged weirs, etc. (3 cr; prereq 101 or 103 and 104) Anderson or Straub

184f-185w-186s.* Advanced Hydraulic Problems. (2 cr per qtr; prereq 183 or ¶183 or #; offered when demand warrants) Straub and staff

187f. 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 or 103 and 104) Ripken, Silberman, Wetzel

190w.* Mechanics of Similitude and Dimensional Analysis. Theory of use of models in design; conditions for similarity of hydraulic structures, elastic structures, aircraft, ships, waves, etc. (3 cr; prereq 101 or 103 or #) Anderson or Straub

191w. Hydraulic Motors and Pumps. Introductory theory of hydraulic pumps, turbines, motors, transmissions. (3 cr; prereq 187 or #) Ripken

- 192s.* **Natural and Artificial Waterways.** Wave motion, tides, ship resistance, transportation of sediment. Control and regulation of rivers, design of ship canals, locks, dry docks, movable dams, harbors. (3 cr; prereq 183 or #) Anderson or Straub
- 193s. **Hydraulic Measurements.** Laboratory and field methods and instruments for measurement of hydraulic pressure, velocity, and discharge. (3 cr; prereq 187 or #) Ripken
- 194f-195w-196s.* **Advanced Hydraulics Laboratory.** Experimental studies of characteristics of turbines, pumps, etc. Hydraulic models. (2 cr per qtr; prereq 101 or 103 and 104; offered when demand warrants) Straub and staff
287. **Fluid Turbulence.** Theory of turbulence with applications. (3 cr; prereq 187 or #; offered when demand warrants) Silberman or Straub
- 290f-291w-292s. **Advanced Fluid Mechanics.** (3 cr per qtr; prereq 190 or #; offered when demand warrants) Straub
- 293f. **Hydrodynamics.** Survey of theory. (3 cr; prereq 187 and Math 151 or #) Silberman
- 294w. **Hydrodynamics.** Viscous flow, laminar boundary layer, and stability. (3 cr; prereq 293 or #) Silberman
- 295s. **Hydrodynamics.** Turbulent boundary layer. (3 cr; prereq 294 or #) Silberman
- 296f-297w-298s. **Hydrodynamics.** Theory of fluid motion. (3 cr per qtr; prereq 295; offered when demand warrants) Silberman

INDUSTRIAL RELATIONS

| | | |
|-------------------------|----------------------------|---------------------------|
| Professor | George Seltzer | Research Associate |
| Herbert G. Heneman, Jr. | John G. Turnbull | Rene Dawis |
| George W. England | | |
| Edward Cross | Assistant Professor | |
| Lloyd Lofquist | Cyrus Smythe | |
| Thomas A. Mahoney | | |

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. For Plan B, the major field of industrial relations is coupled with at least two related fields. Commonly selected related fields include psychology, business administration, sociology, and economics; other fields are appropriate and may be selected to meet individual objectives.

Language Requirement—There is no language requirement.

Ph.D. Minor—Industrial relations may be selected as a minor 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.

Specialization—The following subfields of specialization within the general field of industrial relations are identified: (a) scope and systems of industrial relations, (b)

research methodology, (c) compensation theory and administration, (d) manpower resources and allocation, (e) staffing, training, and development, (f) collective bargaining, and (g) organization theory and administration. Consult the department for further information.

- 142. Conflict and Collective Bargaining.** Nature of industrial conflict in employment relations, stresses contributing to conflict situations; collective bargaining as an approach to conflict resolution; public and private approaches to regulation of collective bargaining and resolution of conflict. (3 cr; prereq 152, 172 or equiv) Seltzer, Smythe
- 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; related social and economic problems. Labor marketing, collective bargaining, unions and employer associations, industrial unrest and conflict, employment and unemployment, wage problems. (3 cr; prereq Econ 2 or equiv) 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) Uphoff, 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) England, Smythe, Heneman, Mahoney
- 182A.* Intermediate Labor Marketing.** Advanced 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) Mahoney, Seltzer
- 182B.* Intermediate Manpower Management.** Manpower policy development, application, and evaluation within union and company managements; manpower research and auditing. (3 cr; prereq 72 or 172) Heneman, Mahoney, England
- 192A, B.* Industrial Relations Practices and Techniques.** Role of quantitative measurement and analysis in formulation, administration, and evaluation of industrial relations practices and programs. (3 cr per qtr; prereq 3 cr statistics, 172 or equiv) England, Mahoney
- 202.* Organization and Staffing.** Translation of organization goals and objectives to specific manpower goals and objectives, and staffing to meet the organization's manpower needs. Techniques for recruitment, selection, and assignment of manpower resources for optimal utilization. (3 cr; prereq 52 or 152) England, Dawis
- 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) Uphoff
- 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) Mahoney, England
- 222.* Compensation Theory.** Analysis and evaluation of traditional economic wage theories; research findings in wage and salary determination, and compensation levels and relationships; development of modifications of wage theory appropriate to application in industrial relations. (3 cr; prereq 152, 172 or equiv) Mahoney, Seltzer
- 232.* Collective Bargaining Policies and Practices.** Analysis of functions and procedures. Problems of collective bargaining and techniques for preparation and conduct of negotiations. (3 cr; prereq 52 or 152) Seltzer, Smythe, Heneman
- 242.* Management Development.** Today's management development movement; 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) Mahoney
- 262.* Graduate Topics—Wage and Salary Administration.** Concepts and procedures for administration of compensation programs in plant and office, for managerial and nonmanagerial staffs. Methods of job evaluation, wage surveys, incentives, fringes, and administration of wage and salary programs. (3 cr; prereq 152, 172 or equiv) Mahoney, Seltzer, Smythe
- 272.* Graduate Topics—Supplementary Compensation.** Role of supplementary compensation and its nature: insurance, pensions, unemployment benefits, profit-sharing, bonuses. Problems

- attacked by supplementary compensation, public and private attempts to meet these problems, and their implications. (3 cr; prereq 152, 172 or equiv) Seltzer, Smythe
- 282.* **Graduate Topics—Collective Bargaining.** Advanced analysis of role and nature of collective bargaining. Impact and implications of collective bargaining, alternative approaches to conflict resolution, and evaluation of proposals for improvement. (3 cr; prereq 232 or equiv) Seltzer, Smythe, Heneman
- 292A.* **Readings in Manpower Economics and Industrial Relations.** Readings useful to student's individual program, but not available in regular course offerings. (3 cr; prereq consent of adviser and instructor in field covered)
- 292B.* **Graduate Research in Manpower Economics and Industrial Relations.** Research studies useful to student's individual program but not available in regular course offerings. (3 cr; prereq consent of adviser and instructor in field covered)
- 352.* **Seminar in Labor Marketing.** Advanced analysis of wage and employment theories, demand for labor, supply of labor, labor mobility, wage determination, and labor market institutions. (3 cr; prereq 182A or equiv) Mahoney, Seltzer, Heneman
- 362.* **Seminar in Manpower Management.** Advanced analysis of approaches to organization, development, administration, and evaluation of manpower management programs within firms and agencies. (3 cr; prereq 182B or equiv) Heneman, Mahoney, England
- 372.* **Seminar in Industrial Relations Research Methods.** Research methodology appropriate to problems and setting of industrial relations research: measurement, surveys, experimental design, hypothesis testing, etc. (3 cr; prereq 192A, B or equiv) England, Heneman, Mahoney, Gross
- 382.* **Seminar in Systems of Industrial Relations.** Alternative systems or approaches to industrial relations (labor marketing and manpower management) viewed in terms of historical development and cultural variations. (3 cr; prereq 152 and 172 or equiv) Heneman, England, Mahoney, Seltzer

Graduate courses in the Departments of Business Functions and Management, Quantitative Analysis, Economics, Statistics, Sociology, History, Psychology, Political Science, and the Schools of Journalism, Law, and Social Work may be included in graduate programs and carry graduate credit in industrial relations where appropriate. Consult your adviser concerning these courses.

INTERDISCIPLINARY PROGRAMS

Courses Carrying Graduate Credit

- FS 161. **Seminar for 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) Charnley
- FS 162. **Seminar for Foreign Study II.** Continuation of 161. (6 cr [grad students pay for 6 cr but receive 3 cr on their grad records]) Charnley
- 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

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

Charles H. McLaughlin (Political Science)
 Jan O. M. Broek (Geography)
 Harold C. Deutsch (History)
 Werner Levi (Political Science)
 Lennox A. Mills (Political Science)
 Raymond B. Nixon (Journalism)
 John E. Turner (Political Science)

Associate Professor

Edward Coen (Economics)
 Robert T. Holt (Political Science)

Prerequisites—Ordinarily an undergraduate major in international relations, in 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 1 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 1 of the social sciences, the remaining credits to be distributed among related courses in at least 2 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 6 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 6 subfields should be distributed among not less than 3 social science departments and may include 1 or 2 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:

Northwest Europe

Prof. John B. Wolf (History)
 Prof. John R. Borchert (Geography)
 Prof. Jan O. M. Broek (Geography)
 Prof. Harold C. Deutsch (History)
 Prof. Alrik Gustafson (Scandinavian)
 Prof. Werner Levi (Political Science)
 Prof. Don A. Martindale (Sociology)
 Prof. Arnold M. Rose (Sociology)

East and South Asia

Prof. John E. Turner (Political Science)
 Prof. Jan O. M. Broek (Geography)
 Prof. Werner Levi (Political Science)
 Prof. Lennox A. Mills (Political Science)
 Prof. Robert F. Spencer (Anthropology)
 Assoc. Prof. Richard B. Mather (Slavic and Oriental Languages)
 Assoc. Prof. Burton Stein (History)

Russia

Prof. Francis M. Boddy (Economics)
 Prof. John R. Borchert (Geography)
 Prof. Robert J. Holloway (Business Administration)
 Prof. Raymond B. Nixon (Journalism)
 Asst. Prof. Theofanis G. Stavrou (History)
 Prof. John E. Turner (Political Science)

Latin America

Prof. Raymond L. Grismer (Romance Languages)
 Assoc. Prof. W. Donald Beatty (History)

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: Northwest Europe, Russia, East and South Asia, Latin America. In the Northwest 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 Northwest 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 2 or 3 sub-fields, 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)
George A. Warp (Political Science)

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)

The University inaugurated in 1951 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 statistics 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

Professor

Robert L. Jones
Roy E. Carter
Mitchell V. Charnley
Edwin Emery
J. Edward Gerald
Raymond B. Nixon

Associate Professor

George S. Hage
William A. Mindak

Prerequisites—Courses in journalism are open to regularly enrolled graduate students who can meet prerequisites stated in course descriptions. A minimum of 15 credits in basic journalism, including writing and editing, must be completed before admission to candidacy. (See index for page number of definition of "candidacy.") Prerequisites for the minor are noted below. 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 1 additional seminar in journalism at the 200 level are required; for Plan B, at least 2 seminars numbered above 200 are required. Special courses are available to persons preparing for professional communications research.

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 an adviser from among the following: 103, 106, 109, 110, 113, 115, 120, 121, 124, 125, 126, 130, 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 plan 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 journalism leading to the Ph.D. degree is intended for students who plan careers in mass communications research, teaching, or journalistic practice. On this level, the program integrates professional practice and research, and a candidate is expected to demonstrate ability in both. Programs also can be arranged for those who wish to prepare for specialized practice of journalism in particular subject matter fields.

The candidate, with the approval of his adviser, shall select 3 subfields, 1 of which shall be designated as the thesis subfield. Individual needs and goals will be considered. 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, (e) specialized research methodology. The director of the School of Journalism will provide subfield descriptions upon request. At the time of the preliminary examination the candidate will be held responsible for the subject matter in Jour 200 and in one core course in each of the subfields not offered.

A mass communications subfield for the Ph.D. is conceived as a specialized extension of the social sciences. For that reason, supporting courses may be chosen from such disciplines as political science, history, sociology, psychology, economics, geography, and also from philosophy, English, and speech. Decision as to what constitutes adequate preparation will be made in terms both of the communications subfield and/or the social science areas related to it.

Minor—A candidate for the Ph.D. in other fields may elect a minor in journalism by obtaining the approval of his adviser, the director of the School of Journalism, and the dean of the Graduate School. 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) 2 foreign languages or (b) 1 foreign language and the option of a special research technique or a collateral field of knowledge.

- 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
- 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
- 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; comparative study of leading present-day newspapers; examination of major periods of change and of developing trends. Individual projects and readings. (3 cr; prereq 109) Emery
- 113f.s.* **Mass Communication Theory.** Nature of the communication process; contributions of other disciplines to knowledge about this process; similarities and differences between interpersonal and mediated communication; use of research concepts and findings in determining policy; comparative functions of printed and electronic media. (3 cr; prereq journalism major or #) Nixon
- 115f.s.* **Communications Analysis: Content, Audiences, Effects.** Research procedures and methods for analyzing content and audiences of newspapers, periodicals, radio, television, and motion pictures. Field and experimental approaches to studies of mass media effects. (3 cr; prereq QA 5 or Soc 45, or Psy 70 or equiv or #...Psy 167 recommended) Jones, Carter

- 120f.* Development of Radio and Television Communications.** Historical and economic development of the American broadcasting system; government regulation; broadcasting and the press; radio and television as social factors. Broadcasting in other countries. (3 cr; prereq 15 or 18 for journalism majors, 13 or # for others) Charney
- 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 15 or 18 for journalism majors, # for others) Gerald
- 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
- 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 Free World.** Communications in foreign democracies as compared with the United States and with totalitarian systems. Special emphasis upon Great Britain, the Netherlands, the Scandinavian countries, France, and Latin America; 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.** Traditional 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 Communist, Fascist, and neo-Fascist states. (3 cr; prereq 15 cr in social sciences with an Upper Division course in international relations or comparative government recommended) Nixon
- 130f-131w.* Public Opinion and Propaganda.** Functions of the press and other communication agencies in the formation of public opinion. Studies of persuasion and attitude change. Problems in interpretation of opinion and attitude research in the mass media field. Pressure-group activities and political and international propaganda. (3 cr per qtr; prereq 15 cr in social sciences for 130, 130 for 131) Carter
- 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 for 140, 140 for 141) Gerald, Emery, Nixon
- 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, 140) Lindsay
- 149w. Public Relations Theory.** 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, 113 or 130, or 15 cr in social sciences and #) Emery
- 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 #) Emery, Lindsay
- 161f,w. Advertising: Print Media.** Role of newspapers, consumer magazines, business papers, and supplementary media in the media mix; relations with national and local advertisers; media representatives; advertising agencies. Rate structures and economics. (3 cr; prereq 18, 54 and 79 or #...or 41, 57, and #) Mindak
- 162f,w. Advertising: Broadcast Media.** Role in media mix; characteristics; interaction of sponsor, agency, station, network, and station representative; program and market selection; rate structure; audience analysis; creating and measuring impact of commercials; future developments. (3 cr; prereq 18, 79, or #) Mindak
- 163f,s. Advertising Media Analysis.** Relation of advertising media to advertising task; media characteristics; evaluation and use of media and market measurements and data; comparison of rates and relative economy of media; mechanics of media purchasing, scheduling, and appro-

- priations; cases and campaigns. (3 cr; prereq 18, 161, 162 and §, or 161, 162, Mktg 77 or §) Mindak
- 164w,s.* **Current Advertising Developments and Problems.** Creative, management, research, media, and technical developments in advertising; implications for advertising specialists. Discussion and analysis of specific problems and case studies to aid in the advertising-marketing process. Contributions of related fields of behavioral sciences and communications. (3 cr; prereq 57, 79, 163 or §) Mindak
- 177s.* **Freedom of the Press and Communications Law.** Anglo-American concept of freedom of speech and press, its development under the Constitution of the United States, and present areas of tension. Statutes and administrative regulations affecting freedom of information, publishing, and broadcasting. (3 cr; prereq 15 cr in social sciences) Gerald
- 190s. **Advanced Problems in Journalistic Writing.** Investigation and analysis of problems of advanced professional accomplishment in the fields of journalistic writing. Uses of literary and journalistic forms. Development of individual effectiveness in journalistic presentation. (3 cr; prereq demonstration of acceptable writing achievement and §) Charnley
- 200f. **Scope and Methods of Communications Research.** Research areas, methods, and techniques. Basic seminar for M.A. and Ph.D. candidates in journalism. (3 cr; prereq consent of adviser) Jones and others
- 209s.* **Seminar in History of Communications.** Research in history and development of mass media. (3 cr; prereq 110 or §) Emery
- 213w.* **Seminar in 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 in 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 113 or 115, 200, and a course in statistics, or §) Jones
- 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
- 224f-225s.* **Seminar in 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 in Public Opinion and Propaganda.** Theoretical bases of public opinion and propaganda. Developing literature in this field of specialization. Opinion-making processes of governments, political parties, pressure groups, and other organized groups. (3 cr; prereq 131 and consent of adviser) Carter
- 264s.* **Seminar in 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 §) Mindak
- 277f-278w-279s.* **Government and Mass Communications.** Reconciliation of social and individual interest through government actions affecting mass media. (3 cr per qtr; prereq 12 cr incl 177, and §) 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 Auerbach
 John J. Cound
 James F. Hogg
 Yale Kamisar
 Stanley V. Kinyon
 William B. Lockhart
 Robert C. McClure
 Allan H. McCoid
 Maynard E. Pirsig
 Thomas L. Waterbury

Associate Professor

Robert J. Levy
 Terrance Sandalow

Assistant Professor

Jesse H. Choper
 Stephen B. Scallen

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.

- 101. **Contracts.** (8 cr) Kinyon
- 102. **Criminal Law.** (6 cr) Kamisar, Pirsig
- 108. **Torts.** (8 cr) McCoid, Miller
- 109. **Introduction to Procedure.** (3 cr) Cound, Christie
- 110. **Constitutional Law.** (6 cr) Auerbach, Kamisar, Lockhart
- 120. **Banking and Negotiable Instruments.** (4½ cr) Kinyon
- 123. **Private Corporations.** (6 cr) Choper
- 126. **Sales.** (4½ cr) McClure
- 127. **Trusts and Estates.** (6 cr) Waterbury
- 128. **Taxation I.** (6 cr) Scallen
- 140. **Administrative Law.** (4½ cr) Auerbach
- 142. **Conflicts.** (4½ cr) Cound
- 144. **Criminal Law Seminar.** (3 cr) Pirsig
- 150. **Insurance.** (4½ cr) Hogg
- 152. **Judicial Administration.** (3 cr) Pirsig
- 155. **Labor Law Practice.** (1½ cr) McCoid
- 156. **Law of Labor Relations.** (4½ cr) McCoid
- 158. **Legislation.** (3 cr) McClure
- 159. **Local Government Law.** (4½ cr) Sandalow
- 161. **Modern Social Legislation.** (4½ cr) McCoid
- 165. **Trade Regulation.** (4½ cr) Levy
- 170. **Judicial Administration Seminar.** (3 cr) Pirsig
- 173. **Taxation II.** (3 cr) Waterbury
- 175. **International Law.** (4½ cr) Christie
- 180. **Federal Jurisdiction.** (4½ cr) Sandalow
- 185. **Jurisprudence.** (4½ cr) Christie
- 186. **Family Law.** (3 cr) Levy
- 189. **Taxation Seminar.** (3 cr) Waterbury
- 197. **International Business Problems.** (4½ cr) Hogg

LIBRARY SCIENCE

Professor

David K. Berninghausen
Errett W. McDiarmid
Edward B. Stanford

Associate Professor

Ralph H. Hopp
Raymond H. Shove
Wesley Simonton
Frederick Wezeman

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 and satisfactory undergraduate training or the equivalent in the basic elements of library science, including reference, administration, history of libraries, cataloguing, and selection of library materials.

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: 154, 155, 156, or 157.

Papers to meet the Plan B requirement may be prepared in any course numbered above 100.

Doctor's Degree—A minor in library science may be presented for the Ph.D. with an appropriate major field.

131. **Public Library Extension and Development.** Larger units of service, laws, finance, promotion; state library agency. (3 cr; prereq 55) Wezeman
153. **History of Books and Printing.** The alphabet; manuscript books; the printed book from earliest times to present. (3 cr; prereq #) Shove
154. **The Public Library.** Theories and principles of administration. (3 cr; prereq 55) Wezeman
155. **The College and University Library.** Educational functions of the college and university library and administrative organization to perform these functions. (3 cr; prereq 55) Shove
156. **Special Libraries.** Procedures of newspaper, insurance, medical, technical, and other special libraries. (3 cr; prereq 55) Simonton
157. **School Library Problems.** Service in large units, relationships with public libraries, planning library quarters, budgets, training for school librarianship. (3 cr; prereq 55)
160. **Literature of the Social Sciences.** (3 cr; prereq 62) Shove
161. **Literature of the Humanities.** (3 cr; prereq 62) Shove
162. **Literature of the Natural Sciences.** (3 cr; prereq 62) Shove
165. **Advanced Bibliography.** National and trade bibliographies, domestic and foreign; use of sellers' catalogues in book buying. (3 cr) Shove
166. **Reference Work.** Special reference tools and government publications. (3 cr; prereq 62) Wezeman
168. **Research Methods in Librarianship.** (3 cr) Simonton
171. **Reading Guidance for Children.** (3 cr; prereq 70)
172. **Reading Guidance for Adolescents.** (3 cr; prereq 70)
173. **Reading Guidance for Adults.** (3 cr; prereq 70) Wezeman
175. **Publishers and Publishing.** The book trade; methods of distribution. (3 cr) Shove
176. **Communication Media and the Library.** (3 cr) Berninghausen
177. **History of Children's Literature.** (3 cr)
181. **Advanced Subject Cataloguing.** History, theory, and practice of classification and subject heading; the Library of Congress Classification. (3 cr; prereq 83) Simonton
182. **Advanced Descriptive Cataloguing.** Rules of entry, foreign cataloguing codes, handling of non-book materials, administrative problems in cataloguing. (3 cr; prereq 83) Simonton
- 185x. **Special Problems.** Individual study for advanced students in library science. (1-3 cr; prereq consent of Library School director)
258. **Problems in College and University Librarianship.** (3 cr; prereq 55 and 155) Berninghausen, Stanford
259. **Problems in Public Librarianship.** (3 cr; prereq 55 and 154) Wezeman
272. **Children's and Young People's Work.** (3 cr; prereq 154 or 157)
281. **Theories of Bibliographical Organization.** (3 cr; prereq 83 and 181) Simonton

LINGUISTICS AND COMPARATIVE PHILOLOGY

Professor

Donald C. Swanson
Harold B. Allen
Emmert M. Brackney
John W. Clark
Raymond L. Grismer
Walter T. Pattison
Robert F. Spencer

Associate Professor

Thomas B. Irving
Richard B. Mather
Cecil Wood

Assistant Professor

Richard Narvaez

Prerequisites—For major work, not less than 6 quarter credits above 50 in each of 2 foreign languages, 1 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 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 required of all candidates.

Doctor's Degree—A doctorate is not offered as a major field, but programs for candidates who wish to minor in linguistics will be planned in accordance with their backgrounds or needs.

Program—Candidates will work toward competence in several of the following subfields:

1. General linguistics
2. A modern language (such as French or Russian)
3. Ancient languages; Sanskrit especially recommended
4. A non-Indo-European language, such as Arabic, Chinese, Hebrew, Japanese; 1 year minimum of serious study
5. English linguistics: both the modern and earlier stages of English

General

Anth 180. Phonetics and Phonemics

Anth 181. Descriptive Linguistics

Anth 182. Language and Culture

For details, see Index for Anthropology

Clas 106-107. Introduction to the Study of Language

For details, see Index for Classics

Ling 151-152-153. Readings Course. (1-3 cr per qtr; open only to majors) Swanson and staff

Classics

Grk 101. Structure of Greek

Lat 133. Vulgar Latin

Skt 128-129-130. Readings in Sanskrit

For details, see Index for Classics

English

Engl 100. Old English

Engl 102. Readings in Old English Prose and Verse

Engl 103. Beowulf

Engl 165. Introduction to Modern English

Engl 166. Historical Backgrounds of Modern English

Engl 174. American English

Engl 204. History of the English Language

Engl 205. Structure of Modern English

Engl 206. Studies in the English Language

For details, see Index for English

Germanic Languages

- Ger 110-111. The Middle High German Language
 Ger 112. History of the German Language
 Ger 113. Gothic
 Ger 114-115. Methods of Comparative German Linguistics
 Ger 119-120-121. Old High German; Old Saxon
 Ger 157-158-159. Old Norse Language and Literature
For details, see Index for German

Romance Languages

- Fren 171-172-173. History of French Language
 Fren 204-205-206. Readings in Old French Literature
 Fren 207-208-209. Old Provençal
 Span 107-108-109. Structure of Modern Spanish
 Span 161-162-163. Hispano-Arabic Culture
 Span 171-172-173. History of Spanish Language
 Span 241-242-243. Old Spanish Philology
 Span 244-245-246. Readings in Old Spanish Literature
For details, see Index for Romance Languages

Slavic and Oriental Languages

ARABIC

- Arab 151-152-153. Honors Course

SLAVIC

- Slav 113-114-115. Old Church Slavic (Old Bulgarian)
 Russ 125-126-127. History of the Russian Language

CHINESE

- Chin 151-152-153. Directed Readings
 Chin 191-192-193. Honors Course

JAPANESE

- Jap 151-152-153. Directed Readings
 Jap 191-192-193. Honors Course
For details, see Index for Slavic and Oriental Languages

MARRIAGE AND FAMILY STUDY

Several departments of the Graduate School converge to offer training relevant for marriage and family educators 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 development, 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) teach-

ing methods relevant for functional marriage education. The individual student's program takes into account the assets and deficiencies peculiar to the discipline in which he is majoring and enables the student to enrich his program by supplementation in minor and collateral fields to complete his graduate study better equipped to serve in the family field.

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

- Glen E. Baxter
- Robert H. Cameron
- Eugenio Calabi
- Bernard R. Gelbaum
- Heinrich Guggenheimer
- Edward L. Hill
- Bjarni Jonsson
- Gerhard K. Kalisch
- Fulton Koehler
- Warren S. Loud
- Lawrence Markus
- Johannes C. Nitsche
- Steven Orey
- Edgar Reich
- Helmut Röhl
- Paul C. Rosenbloom
- James B. Serrin
- Marvin L. Stein
- Hugh L. Turriffin
- Stefan E. Warschawski
- Hans F. Weinberger

Visiting Professor

- Max Koecher

Associate Professor

- Alfred Aeppli
- Donald G. Aronson
- Elizabeth Carlson
- Steven A. Gál
- Leon W. Green
- Bernard W. Lindgren
- William D. Munro
- David A. Storvick

Assistant Professor

- George U. Brauer
- Peter L. Crawley
- Erwin Engeler
- Robert L. Evans
- Harry Furstenberg
- Jesus Gil de Lamadrid
- Laurence R. Harper, Jr.
- William A. Harris, Jr.
- Jack Indritz
- Howard B. Jenkins
- James T. Joichi
- Richard K. Juberg
- Frank B. Knight
- Walter Littman
- Charles A. McCarthy
- Norman G. Meyers
- Chester L. Miracle
- William E. Pruitt
- Eugene R. Rodemich
- John M. Slye
- Warren B. Stenberg
- James E. Thompson
- Lincoln H. Turner

Students majoring in mathematics should consult either Mr. Gelbaum, chairman, or Mr. Green, secretary of the group, or should confer with Mr. Cameron, chairman of the Department of Mathematics of the College of Science, Literature, and the Arts (119 Folwell Hall) or Mr. Warschawski, head of the Department of Mathematics of the Institute of Technology (114 Engineering Building).

Prerequisites—For students majoring in mathematics, 10 credits in calculus and 14 other credits in non-Lower Division courses. Exceptions may be made in unusual circumstances. For students minoring in mathematics 10 credits in calculus.

Language Requirement—For the Master's degree, one foreign language from the following list: German, French, Russian, Italian. In exceptional cases the department may waive this requirement. 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 3-course sequence of 200-level mathematics or its equivalent. Students for whom it is impossible to register for such a sequence should consult with either Professor Cameron or Professor Warschawski in planning their programs.

Courses other than those marked with an asterisk (*) may be so marked for individual students with the consent of their advisers and the instructors who give the courses.

Doctor's Degree—A student's program of work for the Ph.D. degree is to be made in consultation with an adviser, and will include the fundamentals in at least 3 of the 4 following subfields: (a) algebra, (b) analysis, (c) applied mathematics and/or statistics, (d) geometry and/or topology. Preliminary written examination in mathematics required of minors, unless exempted because of high scholastic standing. It is recommended that, whenever possible, the mathematics minor contain a 3-course sequence of 200-level mathematics courses or its equivalent.

For more detailed information about the following courses and for the courses offered in 1963-64, students should consult the program of the Department of Mathematics in the *Bulletin of the College of Science, Literature, and the Arts* and the program of the Department of Mathematics in the *Bulletin of the Institute of Technology*.

Note—For information on work in statistics, see index.

Courses identified by the §§ symbol are offered in the Department of Mathematics of the Institute of Technology.

Courses identified by the ¶¶ symbol are offered in the Department of Mathematics of the College of Science, Literature, and the Arts.

Any one of the courses Math 54 or ITM 25 or 25A may be offered as prerequisite where any one of them is listed.

104. §§ **Variational Problems in Engineering.** Euler-Lagrange equations, isoperimetric problems, geodesics, Fermat's and Hamilton's principle, 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 150A or §) Nitsche
- 106x. ¶¶ **Differential Equations.** Problem course, methods for solving ordinary differential equations of various types with necessary theory for developing these methods. (3 cr; prereq 55)
- 107x-108x. *¶¶ **Advanced Calculus.** (3 cr per qtr; prereq 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 54) Carlson, Knight
- 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. (2 cr per qtr; prereq 54)
- 111A-B. *¶¶ **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; operations with numbers and laws governing the operations. (3 cr per qtr; prereq 54)
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 54) Orey
- 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 55 or Phil 155 or §; offered 1963-64) Orey
- 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 the theory of continuous transformation groups. Differential geometry of n -dimensions: parallelism, affine connection, curvature. (3 cr per qtr; prereq 55; offered 1963-64) Guggenheimer

- 116A-B-C.¶¶ **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) Guggenheimer
- 121-122-123.*¶¶ **Mathematical Theory of Statistics.** Mathematical probability, distribution and sampling problems, theory of estimation including the method of maximum likelihood, tests of hypotheses including likelihood ratio tests, introduction to factorial design. (3 cr per qtr; prereq 55) Jamison
- 125.¶¶ **Theory of Geometrical Constructions.** Constructions with and without classical restrictions to rulers and compasses; famous geometrical problems of antiquity, with ancient and modern solutions; constructions by graded rulers, parallel rulers, squares, compasses alone, etc. (3 cr; prereq 40) Carlson
- 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 54) Cameron, Joichi
- 127-128-129.¶¶ **Applied Mathematics for Social and Biological Sciences.** (3 cr per qtr; prereq 55) Kalisch
- 131A-B.*¶¶ **Advanced Algebraic Theory.** Linear dependence of vectors: dimension; matrices; systems of linear equations; special matrices and canonical forms; characteristic values and vectors; diagonalization of quadratic and hermitian forms. Introduction to more abstract concepts of algebra by means of examples drawn from matrix calculus and polynomials; vector spaces and linear transformations; examples and elementary properties of groups, rings, and fields. (3 cr per qtr; prereq 54)
- 132.§§ **Introduction to Statistics and Probability.** Probability models, univariate and multivariate distributions, independence, basic limit theorems. (3 cr; prereq 25 or 25A) Lindgren, Reich
- 133-134.*§§ **Statistical Theory with Applications.** Statistical decision theory, sampling, estimation, testing hypotheses, parametric and nonparametric procedures for 1-sample and 2-sample problems, regression, analysis of variance. (3 cr per qtr; prereq 132) Lindgren, Reich
- 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 90 or 132 or ¶) Lindgren
- 133B-134B.*§§ **Probability with Technological Applications.** Spectral analysis of stationary processes, linear and nonlinear transformations, prediction and smoothing, recurrent events, random walk and diffusion, Markoff chains, Poisson processes. (3 cr per qtr; prereq 132, 153, or 132, 148, 149 or ¶) Lindgren
- 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 53 or ¶53)
- 137.¶¶ **Advanced Theory of Equations.** (3 cr; prereq 54, 62; offered when feasible)
- 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 54; offered 1963-64) Carlson
- 142-143.*§§ **Vector and Matrix Theory with Applications.** 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; prereq 25 or 25A) Stenberg
- 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 54; offered when feasible)
- 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 coordinates, dyadics, applications. (3 cr, §152; prereq 25 or 25A)
- 148.*§§ **Differential Equations.** Linear differential and difference equations with constant coefficients, isoclines, phase plane, reduction in order, numerical solutions, series solutions, Bessel functions, Legendre polynomials, introduction to boundary value problems. (3 cr, §150 or 150A; prereq 80 or 26 or 26A)

- 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, §148; prereq 26 or 26A or 80)
- 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 26 or 26A or 80) Harris
- 151.§§ **Calculus V: Advanced Calculus.** Functions of one and several variables: continuity, Riemann integral, partial derivatives, Taylor's theorem, implicit function theorem, transformations and mappings. (3 cr; prereq 26 or 26A or 80)
- 152.§§ **Calculus VI: Advanced Calculus.** Maxima and minima in several variables, vector algebra and calculus, Green's and Stokes's theorems, integrals depending upon a parameter. (3 cr, §147; prereq 151)
- 153.*§§ **Calculus VII: Advanced Calculus.** Infinite series, computation with series, series with variable terms, uniform convergence, power series. Improper integrals. Fourier series and orthogonal functions, special functions. (3 cr, §147-148-149; prereq 151)
- 155-156.*§§ **Tensor Analysis with Applications.** (3 cr per qtr; prereq 147, 149 or 142, 152 or #) Calabi
- 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 152 or #) Loud, Miracle
- 160.§§ **Operational Methods for Linear Systems.** Review of Fourier series and their applications* to linear ordinary differential equations. The Fourier transform, mathematical properties, amplitude and phase spectra, energy. The Laplace transform, mathematical properties and elementary inversion techniques, applications to systems of ordinary differential equations, transfer function, time and frequency domain relations. (3 cr; prereq 26A)
- 161-162-163.*§§ **Analytical Dynamics.** Newton's laws, energy, momentum, and angular momentum principles for inertial reference frames, modifications for noninertial reference frames. Lagrange's equations. Motion of particles, rigid bodies, e.g., planets, tops, gyroscopes. Stability, small oscillations. Hamilton's principle, motion of elastic bodies. Hamilton's equations, transformation theory. (3 cr per qtr; prereq 152, 153 or 147, 148, 149 or #) Koehler
- 165A.§§ **Introduction to Programming Modern Digital Calculators.** Organization of a modern digital calculator. Number systems. Elementary coding, flow charts, code checking techniques, scaling, subroutines, assembly techniques, interpretive programs. Informal laboratory. (3 cr; prereq 25 or 25A) Stein, Munro
- 165B-C.*§§ **Theory and Programming of Modern Digital Calculators.** Analysis of arithmetic operations, logical organization of arithmetic unit. Storage, control, and input-output units. Libraries, advanced assembly programs, interpretive systems, compilers. Applications to mathematical and physical problems. Informal laboratory. (3 cr per qtr; prereq 165A, 26 or 26A or 80) Stein, Munro
- 168B.*§§ **Applications of Complex Variables.** Conformal mapping, Poisson integral, potential flow, applications to electrostatics, Schwarz-Christoffel transformations, reflection principle, roots of polynomials, Nyquist and Hurwitz criteria, other applications. (3 cr; prereq 174 or #) Reich
- 169.*§§ **Mathematical Theory of Fluid Flow.** The general equations of fluid mechanics. Concepts from thermodynamics. The 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 152, 168A, or 152, 174 or 147, 168A or 147, 174 or #) Serrin
- 173.*§§ **Elementary Partial Differential Equations.** Partial differential equations of theoretical physics, Fourier series, proof of convergence, orthogonal systems, Sturm-Liouville systems, solutions of boundary value problems by separation of variables, applications. (3 cr; prereq 147, 148 or 152, 153 or #) Littman, Weinberger
- 174.*§§ **Elementary Theory of 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. (3 cr; prereq 26 or 26A) Littman, Weinberger
- 175.*§§ **Integral Transforms.** Laplace transforms, inversion formulas and methods of residues, applications to systems of ordinary and partial differential equations, problems in heat conduction and mechanical vibrations, Fourier transforms, three-dimensional wave equation. (3 cr; prereq 174) Littman, Weinberger
- 176.¶¶ **Intermediate Differential Equations.** Topics in differential equations not contained in a first course but not requiring a broad background of analysis. Emphasis on linear equations

- of second order of interest in physics. Normal form, adjoint equations, series solutions, equations of Fuchsian type. Hypergeometric, Bessel, and Legendre equations. (3 cr; prereq 106; offered when feasible)
- 178A-B-C.*¶¶ Introduction to Probability. Largely based on W. Feller, *An Introduction to Probability and Its Applications*, with emphasis on logical development and varied applications. Random walks, Markoff chains, and discrete stochastic processes. (3 cr per qtr; prereq 108 or 123 or #) Pruitt
- 180.*§§ Finite Groups. 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 #) Green or Stenberg
- 181-182-183.*§§ Selected Topics in the Theory of Numbers. (3 cr per qtr; prereq 152, 153 or #) Gál
- 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 55) Slye, Crawley
- 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 26 or 26A or 80) Munro or Stein
- 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 147, 148, 149, 184 or 152, 153, 184 or #) Munro or Stein
- 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 54) Carlson
- 190A-B-C.*§§ Combinatorial Topology. General topological and metric spaces. Function spaces. Fundamental group and covering spaces. Singular and simplicial homology theory. Betti and torsion groups. Fix point theorems and applications to analysis. Classification of surfaces. (3 cr per qtr; prereq 142 or ¶142 or #) Gál
- 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 185, 174, or #) Nitsche or Aronson
- 193A.*§§ Axiomatic Geometry. Axiomatic presentations of Euclidean and non-Euclidean geometries. Vector spaces and metric spaces. (3 cr; prereq 152, 153 or #) Markus, Aepli
- 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 152, 153, or #) Aepli
- 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 152, 153 or #) Aepli
- 196-197-198.*§§ Special Functions in Mathematical Analysis. Asymptotic expansions. Gamma and Beta functions. Hypergeometric functions as solutions of differential equations. Bessel functions using Sommerfeld's contour integrals. Legendre functions. (3 cr per qtr; prereq 174 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 #) Rosenbloom
- 200A-B-C. Matrix Theory. Self-contained development of matrix theory for the mature student. Linear transformations, canonical forms, special matrices, convexity properties and inequalities, integrals with matrix arguments, matrix equations. (3 cr per qtr; prereq 108) Olkin, Kalisch
- 201A-B-C.¶¶ Introduction to Modern Algebra. Definitions and elementary theory of groups, rings, fields, and vector spaces; properties of linear transformations and matrices in vector spaces over arbitrary fields; factorization in integral domains; polynomial domains; finite and infinite field extensions; real fields. (3 cr per qtr; prereq 131A) Jonsson or Kalisch or Harper
- 202A-B-C.¶¶ Advanced Mathematical Logic. Systems of axiomatic set theory. Consistency of the axiom of choice, axiom of foundation, continuum hypothesis. Theory of models of axiom systems. Interconnections between logic and algebra. (3 cr per qtr; prereq 112A-B-C or #) Engeler

- 203-204-205.*¶¶ Advanced Mathematical Statistics. General theories of estimation, testing hypotheses, etc. Mathematics of factorial designs, asymptotic distributions of estimators, etc. (3 cr per qtr; prereq 121-122-123 and either 108 or #)
- 206-207-208.*¶¶ Theory of Functions of Real and Complex Variables. (3 cr per qtr; prereq 108 or 159 or 125B or #)
- 209A-B-C. Introduction to the Theory of Finite Riemann Surfaces. Elements of algebraic theory. Abstract concept of Riemann surface with a brief introduction to topology of two-dimensional manifolds. Function theory on a Riemann surface. Existence theorems: Weyl's lemma, Schwarz's alternating method, Riemann-Roch theorem and some of its applications. Theorem uniformization, Schottky uniformization. Some geometrical applications. (3 cr per qtr; prereq 208 or 174 or #)
- 210A-B-C.*¶¶ Foundations of Algebra. Lattices and structure of algebraic systems, universal algebra, and interconnections between logic and algebra. (3 cr per qtr; prereq 172 or #) Jonsson
- 211A-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 #) Loud
- 212A-B-C.*¶¶ Point Set Topology. Abstract spaces based on notions of neighborhoods, open sets, closure. Subspaces. Properties invariant under homeomorphisms; compactness; connectedness. Separation axioms. Lattice of topologies. Metric spaces; Urysohn's metrization theorem. Transfinite numbers, Moore-Smith convergence. Uniform topology. (3 cr per qtr; prereq 206) Slye
- 213A-B-C.*¶¶ Topics in Point Set Topology. Dimension theory, upper semicontinuous collections, partitions, homotopy theory. (2 cr per qtr; prereq 212A or #) Slye
- 214.¶¶ Topological Algebra. (3 cr; prereq #) Gil de Lamadrid
- 215A-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 #) Cuggenheimer
- 217-218-219.*§§ Riemannian Geometry. Review of elementary differential geometry and tensor analysis. Introduction to exterior differential calculus and algebraic topology. Local properties of Riemannian manifolds. Connection with global properties. Generalization of the differential equations of mathematical physics. (3 cr per qtr; prereq #) Markus or Calabi
- 224A-B-C.§§ Lie Groups and Lie Algebras. Groups of matrices, topological groups, local groups. Lie algebras and Lie groups. Structure theorems, classification of semi-simple Lie algebras. Topics in homogeneous spaces and representations. (3 cr per qtr; prereq 280A-B-C or 201A-B-C or #) Green
- 227-228-229.*§§ Mathematics of Computers and Control Devices. (3 cr per qtr; prereq 186 or #) Munro
- 232-233-234.*§§ Mathematical Theory of Fluid Dynamics. (3 cr per qtr; prereq 152, 153, MM 127 or 152, 153, MM 28, 29 or #) Serrin
- 235A-B-C.*§§ Homotopy Theory. Review of singular homology and co-homology, homotopy of mappings extension and retraction, classification of maps of the circle into the circle, fundamental groups, Hurewicz's theorem, fiber spaces (Hopf fibering, covering spaces, space of loops), cross sections, homotopy groups (exactness, fibering property, uniqueness theorems), homotopy groups of special spaces (join, fiber spaces, product spaces, covering spaces, suspension theorems), obstruction theory, homotopy groups of spheres, fundamental theorems of Morse Theory. (3 cr per qtr; prereq 190A-B-C or #) Aepli
- 239A-B-C.*¶¶ Fourier Transforms, Harmonic Analysis. Commutative and noncommutative Banach algebras, group algebras of locally compact groups, group representations, spectral theory of operators in Hilbert space, positive definite functions, duality, Plancherel and Tauberian theorems. (3 cr per qtr; prereq 245B) Gelbaum, Furstenberg
- 240A-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; prereq 263, or #) Reich
- 241.§§ 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; prereq 132, 152, 153 or #) Reich

242. §§ **Mathematical Aspects of Boundary Layer Theory.** Introduction to mathematical theory of boundary layers, especially in fluid dynamics. 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. Westphal-Nagumo theorem. Qualitative theory, asymptotic behavior, and uniqueness. Remarks on compressible boundary layers, Stewartson-illingworth theorem. Shock layers. Mathematical models illustrating boundary layer phenomena. (3 cr; prereq 150, 173 or #) Serrin
244. ¶¶ **Introduction to Wiener's Integral in Function Space.** (3 cr; prereq course in function theory) Cameron
- 245A-B. ¶¶ **Introduction to Lebesgue Integrals.** (3 cr per qtr; prereq 206) Cameron
- 246-247. ¶¶ **Integration in Function Space.** (3 cr per qtr; prereq 245A or B and #) Cameron
- 248-249-250. ¶¶ **Reading and Research.** Competent students will be assisted in independent reading and reports by members of the department. (1-3 cr per qtr; prereq #)
- 252A-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 170 and 245B or #) Kalisch
- 254A. §§ **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 the solutions of steady-state problems in elasticity, potential theory, and hydrodynamics. (3 cr; prereq 152, 153 or #) Weinberger
- 254B. §§ **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; prereq 152, 153 or #) Weinberger
- 258-259-260. ¶¶ **Theory of Probability.** Topics in modern probability theory, including recent advances in limit theorems and introduction to stochastic processes. (3 cr per qtr; prereq 245B or #) Orey
- 261-262-263. ¶¶ **Functions of a Complex Variable.** (3 cr per qtr; prereq 152, 153 or #) Warschawski or Reich
- 264-265-266. ¶¶ **Conformal Mapping.** (3 cr per qtr; prereq 263 or #) Warschawski
- 267-268-269. ¶¶ **Selected Topics in the Theory of Analytic Functions.** (3 cr per qtr; prereq 263 or equiv) Warschawski or Reich
- 270A. ¶¶ **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; prereq 173, 186 or #) Nitsche
- 270B. §§ **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; prereq 186, 142, or 186, 149, or #) Nitsche
- 271-272-273. ¶¶ **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. (3 cr per qtr; prereq 208 or #) Loud
- 274A-B-C. §§ **Partial Differential and Integral Equations of Applied Mathematics.** Linear integral equations; Fredholm's theorems, symmetric kernels and the expansion theorem, Volterra equations, applications. Calculus of variations; Euler equation, isoperimetric problems, physical examples. Vibration and eigenvalue problems; Green's formulas, adjoints, method of separation of variables, Sturm-Liouville problems. Extremal properties of eigenvalues, expansion theorems, Rayleigh-Ritz method. Partial differential equations, introduction and classification. Initial value problem for heat equation and wave equation; energy method. Boundary value problems for Laplace and Poisson equations; second order elliptic equations, biharmonic equation, nonlinear problems. (3 cr per qtr; prereq 152, 153 or #) Aronson, Weinberger
- 275A-B-C. §§ **Theory of Partial Differential Equations.** Derivation of special equations. Special methods. First order of equations. Classification. Boundary and initial value problems; wave equation, heat equation, Laplace equation, biharmonic equation. 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, eigenvalue problems. Parabolic equations; maximum principle and applications, mixed initial boundary value problems, initial value problems for higher order equations. (3 cr per qtr; prereq 151, 152, 153, 174 and #) Nitsche, Serrin, Weinberger

- 277-278-279.*§§ Calculus of Variations and Minimal Surfaces.** The formalism of the calculus of variations: Euler equations, boundary conditions, isoperimetric problems, Legendre's condition, Hamilton-Jacobi theory. Weierstrass-Hilbert theory. Minimal surfaces: local and global properties. Plateau's problem. General two-dimensional variational problems. Haar's results. Rayleigh-Ritz method. Direct methods of Hilbert, Morrey, Shiffman. (3 cr per qtr; prereq 150, 152, 153, 174 [or 168A], 175) Nitsche, Serrin
- 280A.*§§ Galois Theory.** Fields of characteristic p , algebraic extensions, automorphisms and the Galois group of an equation, fundamental theorems of Galois theory and the Jordan-Hölder theorem, trisections of angles, applications to solvability by radicals. (3 cr; prereq 142, 143, 180 or §) Röhrli
- 280B.§§ Rings and Ideals.** Rings with minimum conditions. Vector spaces over rings, representation spaces, endomorphisms, simple and semi-simple rings, structure theorem for semi-simple rings, Wedderburn theorem. (3 cr; prereq 142, 143, 180 or §) Röhrli
- 280C.*§§ Algebraic Numbers.** Archimedean and non-Archimedean valuation of fields, p -adic numbers, the different and the discriminant, Ostrowski's theorem on extension valuations from the complex numbers. (3 cr; prereq 142, 143, 180 or §) Röhrli
- 280D.§§ Representations of Groups.** The group ring, irreducible representations, Schur's lemma and representation of abelian groups, theorem of Maschke, group characters, Young operators, crystal groups, applications to physics. (3 cr; prereq 280B or §) Röhrli
- 281-282-283.§§ 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 152, 153 or §) Serrin
- 284-285-286.*§§ Nonlinear Ordinary Differential Equations.** Existence and uniqueness, résumé of linear theory, equations with periodic coefficients, phase-plane and the Poincaré-Bendixson theory, behavior of solutions near singular points, stability, boundedness, periodic solutions, perturbation problems, relaxation oscillations. Equations of Duffing, Van der Pol, Emden-Fowler, etc. (3 cr per qtr; prereq 150, 152, 153 or §; offered 1963-64) Turrittin, Markus
- 284A-B-C.*¶¶ Stochastic Processes.** General theory of continuous parameter stochastic processes. Gaussian processes, processes with independent increments, Markoff processes and their connections with functional equations. (3 cr per qtr; prereq 245 or §; offered when feasible) Baxter
- 287-288-289.*§§ Hilbert Space and Functional Analysis.** Metric spaces; Hilbert space; bounded operators and topics in spectral theory; Lebesgue integration, measure theory, and function spaces; applications to ordinary and partial differential equations. (3 cr per qtr; prereq ITM 143, 152, 153, 261 or §) Green
- 290-291-292.*¶¶ Banach Spaces.** Basic notions of locally convex linear topological vector spaces with emphasis on Banach spaces. Special topics: bases, tensor products, integration of vector-valued functions. (3 cr per qtr; prereq 245B or §) Gelbaum
- 293A-B-C.*¶¶ Seminar in Stochastic Processes.** Varying topics depending on who gives the seminar. Recent research results of the participants and appropriate background thereto. (3 cr per qtr; prereq 208 or 263, §)
- 294A-B-C.*§§ Theory of Local Rings.** Rings, ideals, primary decomposition, rings of quotients, rank and dimension, integral elements, affine rings, local rings, semi-local rings, ring extension, regular local rings, structure theorem, Hilbert function, system of parameters, multiplicity, unmixedness theorem. (3 cr per qtr; prereq 143 and §) Röhrli
- 295A-B-C.§§ Homological Algebra.** Elementary theory of categories and their lattice structure, abelian categories, functors and satellites, spectral sequences, universal mappings, semi-simplicial complexes, local categories, applications. (3 cr per qtr; prereq 180 and §) Röhrli
- 296A-B-C.§§ Jordan Algebras and Their Application to Analysis.** Absolute analysis in vector spaces. Domains of positivity, Norm, invariant line, elements and geodetics. Jordan algebras, decomposition theorem, quadratic representation, eigenvalues and eigenvectors, derivations, mutations. Relation between domains of positivity and Jordan algebras. Uniqueness theorem for geodetics, Riemannian curvature. Half spaces, Bergman metric, holomorphic automorphisms, classification of half spaces, isotropy group. (3 cr per qtr; prereq ITM 143 and 152, 153 or §) Koecher
- 297.§§ 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 263 or §) Lehto

- 298.§§ Modern Theory of Differentiation. Vitali's covering theorem; differentiation of set functions, Radon-Nikodym theorem and Radon-Nikodym derivative; Lebesgue set; Hölder, Young and Jensen inequalities; integral averaging. Calculus of generalized derivatives. Relation to classical differentiation process. Sobolev-Morrey inequalities, existence and nonexistence of differential. Theory of trace. (3 cr; prereq 289) Serrin
- 299A-B.§§ Topics in Number Theory and Algebraic Geometry. Topics will include Riemann Zeta function, its functional equation and distribution of its zeros. Explicit formulae 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, 280B or §) Cál
- 301-302-303.*§§ Topics in Advanced Differential Geometry. (3 cr per qtr; prereq §) Markus
- 304-305-306.*§§ Advanced Topics in Differential and Difference Equations. (3 cr per qtr; prereq §) Markus, Turrittin
- 307-308-309.§§ Mathematical Problems in Theoretical Physics. Topic for 1962-63: *Foundations of quantum mechanics*. Mathematical problems arising in quantum mechanics and their relation to the physical basis of the theory. Von Nuemann's formulation of nonrelativistic quantum mechanics. Fourier and function space methods in wave packet theory. Representation theory of the rotation and Lorentz groups. Relativistic wave equations. (3 cr per qtr; prereq §) E L Hill

The following courses have been offered recently, and these or other courses of equivalent level will be given from time to time.

- | | |
|--|--|
| 100. Foundations of Geometry | 141. Mathematics of Transient Analysis |
| 102-103. Advanced Analytic Geometry | 176-177. Intermediate Differential Equations |
| 111. Development of the Number System | 179. Special Functions |
| 114. Mathematics of Small Vibrations | 187. Non-Euclidean Geometry |
| 115-116. Differential Geometry | 187A. Finite Planes and Orthogonal Latin Squares |
| 119. Topics in Finite Groups | 199. Calculus of Variations |
| 120. Group Representations | 220. Algebraic Topology |
| 124. Foundations of Calculus | 230. Advanced Tensor Analysis |
| 125. Theory of Geometrical Constructions | 238. Joint Seminar with Aeronautical Engineering |
| 126. Calculus of Finite Differences | 253A-B-C. Statistical Decision Functions |
| 130. Elementary Theory of Summability | |
| 135. Integral Equations | |
| 137. Advanced Theory of Equations | |

MECHANICAL ENGINEERING

| | | |
|---------------------|----------------------------|----------------------------|
| Professor | Robert E. Summers | Assistant Professor |
| Richard C. Jordan | James L. Threlkeld | Adolph O. Lee |
| Perry L. Blackshear | | Benjamin H. Liu |
| Ernst R. G. Eckert | Associate Professor | Omar E. Tewfik |
| Edward A. Fletcher | Richard J. Goldstein | Kenneth T. Whitby |
| Warren E. Ibele | Fulton Holtby | |
| Clarence E. Lund | Eugene A. Johnson | Research Associate |
| Gayle W. McElrath | Millard H. LaJoy | Edgar R. F. Winter |
| Katsuhiko Ogata | Homer T. Mantis | |
| James J. Ryan | Thomas E. Murphy | |
| Ephraim M. Sparrow | | |

Prerequisites—For major work, adequate preparation in undergraduate subjects and in the sciences fundamental to mechanical 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 French and German. (Substitution of other languages, such as Russian, 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. 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 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.

[Professional degrees in engineering—These degrees are administered by the Institute of Technology.]

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 31 and Hydr 101 or Hydr 103 or AE 100 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 32, Hydr 103)
- 143x. 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 134 or ¶134)
- 146x. An introduction to Combustion.** Flame propagation, quenching and ignition in a homogeneous gaseous mixture; combustion of solid and liquid particles, packed beds, and gaseous jets. (3 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)
- 160. Psychrometrics and Air Conditioning.** Thermodynamic properties of moist air; psychrometric charts; psychrometry and humidity measurement; psychrometric processes; mechanical vapor compression refrigeration; effects of thermal environment upon people, processes, and materials; psychrometric systems. (3 cr; prereq 32, 133)
- 162. Thermal Environmental Engineering.** Solar radiation; weather and climate; steady state and periodic heat transmission in structures; thermal loads for enclosed spaces; mechanical systems for year-around control of thermal environment; convection drying of materials. (3 cr; prereq 160)
- 169. Psychrometrics and Air Conditioning Laboratory.** Psychrometry and humidity measurement; experimental studies on refrigeration systems and on the processing of moist air; project study on complete air conditioning system. (2 cr; prereq 34, 160)
- 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)
- 198x. 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 38 or ¶ LaJoy)

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 15, 16) 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 15, 16 or #) Holtby
113. **Advanced Metal Cutting.** Advanced machine tool operation. Selection, tooling, and set-up of machine tools for production. (3 cr; prereq 15, 16) Holtby
114. **Advanced Welding.** Theory and applications of welding processes; factors affecting weldability; considerations in the design of weldments. (3 cr; prereq 15, 16) Holtby
115. **Control of Manufacturing Standards.** Precision measuring instruments and gauges for dimensional control in interchangeable manufacture. (3 cr; prereq 15, 16) McElrath
119. **Design for Casting, Forming, and Welding.** Basic factors in design of parts and structures for most efficient processing and fabrications and maximum performance. (3 cr; prereq 15, 16) Holtby
170. **Tool Design.** Design of jigs, fixtures, and dies for machining, forming, welding, and assembly operations. (3 cr; prereq 15, 16) Crowder

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 41) Ryan
127. **Lubrication.** Hydrodynamic theory of lubrication. Bearing design and construction, laboratory tests on 8-inch journal bearings. (3 cr; prereq 24) Ryan
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 41) Ryan
129. **Vibration Engineering.** Advanced vibration theory with application to vibration absorption and isolation. (3 cr; prereq MM 193)
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 37 or equiv, ITM 26A) Ogata
- 224-225-226. **Advanced Applied Dynamics.** Application of principles of dynamics to selected mechanical engineering problems. (3 cr per qtr; prereq 129) Ryan
228. **Photoelasticity.** Stress analysis by photoelasticity. Stress patterns. Frozen stresses. Solution of individual problems. (3 cr; prereq 128) Ryan
229. **Advanced Vibration Engineering.** Advanced dynamics of vibration, vibration in mechanical, electrical, and equivalent systems. (3 cr; prereq 129) Ryan
- 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, ITM 174 or ¶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)
137. **Thermodynamics of High Temperature Gases.** Determination of composition and properties of high temperature gases. Experimental and analytical methods useful in calculating thermodynamic and heat transfer data of plasmas. (3 cr; prereq 148 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, analog, 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) Sparrow

POWER AND PROPULSION

141. **Heat Power Engineering.** Application and control of fuels and combustion and applications of thermodynamics and heat transmission to steam power and process engineering. (3 cr; prereq 32) Lee
142. **Advanced Heat Power Engineering.** Exploration of potentially fruitful areas of power plant progress; performance limiting elements in a power system that control its competitive position in present and future power plants. (3 cr; prereq 141) Lee
- 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 148, GeCh 15) 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 32) Murphy
151. **Advanced Internal Combustion Engines.** Principles of supercharging, turbocharging and compounding, heat transfer in air and liquid cooled cylinders, chemistry of fuels, knock sensitivity, deposits and preignition, engine lubrication, wear, and contaminant control. (3 cr; prereq 150) Murphy
152. **Diesel and Free Piston Engines.** Principles of Diesel engine and free piston gasifier, combustion of stratified charge, theory of fuel spray formation and vaporization, hydraulic phenomena in fuel injection systems, air flow, scavenging processes, and performance. (3 cr; prereq 150) Murphy
154. **Design of Internal Combustion Engines.** Design of principle components, piston, rod, crankshaft, and valve mechanism, or compressor and turbine for compounded engine. (3 cr; prereq 24 and 150) Murphy
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 134 and 146 or 146 and Aero 102A) Fletcher
157. **Gas Turbine and Jet Propulsion Power Plants.** Gas turbine and ramjet cycles and principles; characteristics of compressors and turbines; power and efficiency calculations. (3 cr; prereq 143) Murphy
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 146)

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 146)
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 32) 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 157) 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

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 160) Lund
180. **Refrigeration and Cryogenics.** Single stage, multistage, and cascade mechanical vapor compression systems; thermoelectric cooling; gaseous air cycle; steam jet-water vapor system; 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 160) Threlkeld
- 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 32 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 162 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 180) Jordan
282. **Reverse Applications of Refrigeration—the Heat Pump.** Industrial, commercial, and residential applications. Lectures, assigned reading, and reports. (3 cr; prereq 162) Jordan

GENERAL

- 290-291-292. **Mechanical Engineering Research.** (Cr ar; prereq Δ)
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

Advanced degrees with a specialization in industrial engineering are available to students with the Bachelor's degree in this field and to graduates of other engineering curriculums who meet specific requirements. Industrial engineering may also be used as a minor subject by students in other departments who satisfy the prerequisites for specific courses.

Related courses in mechanical engineering, business administration, psychology, and public health are recommended in conjunction with a specialization in industrial engineering.

Students contemplating graduate study in this field should consult the chairman of graduate education 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 #)
- 153x. **Methods Engineering and Work Measurement.** Development of methods and processes for economical production; motion study, time study. (3 cr; prereq 50 or 100)
- 170x. **Production Planning and Control.** Planning of production requirements; routing, scheduling, and co-ordination of production; inventory policies and control. (3 cr; prereq 50 or 100)
- 171x. **Quality Control.** Quality standards, application of statistical methods and sampling theory; interpretation of results and corrective action. (3 cr; prereq ITM 90 or 132 or #)
- 172. **Manufacturing Cost Analysis.** Financial accounting concepts, standard cost systems, manufacturing cost accounting, cost information for management decision making. (3 cr; prereq 100)
- 190x. **Industrial Engineering Seminar.** Current developments in industrial engineering and management; assigned articles and classroom discussion. (1 cr; prereq 12 cr in industrial engineering)
- 194x. **Applied Industrial Engineering.** Industrial engineering surveys and programs; case problems; studies in local plants. (3 cr; prereq 15 cr in industrial engineering)

Advanced Courses in Industrial Engineering

- 154. **Advanced Methods Engineering and Work Measurement.** Multiple operation analysis, advanced work measurement techniques, incentives. (3 cr; prereq 153)
- 155. **Industrial Wage Administration.** Job evaluation, wage surveys, wage policies, establishment and administration of incentive wage plans. (3 cr; prereq 153)
- 165. **Industrial Plants.** Analysis of materials flow; layout of production and service departments; plant buildings, service facilities, and handling equipment. (3 cr; prereq 153)
- 167. **Materials Handling.** Development of materials handling systems and selection of equipment; industrial packaging techniques. (3 cr; prereq 153)
- 173x. **Engineering Economic Analysis.** Analysis of capital expenditures and annual operating costs as the basis for management policies and decisions. (3 cr; prereq 50 or 100)
- 174. **Introduction to Operations Research.** Industrial applications of operations research techniques using linear programming, decision models and Monte Carlo methods; industrial problems in allocation, sequencing, competitive strategies, and waiting lines. (3 cr; prereq ITM 90 or #) McElrath
- 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 ITM 90 or #)
- 180. **Management for Engineers.** Management functions and relations with employees, other supervisors, and staff departments. (3 cr; prereq 50 or 100)
- 182. **Industrial Safety.** Safety requirements for production processes, equipment, and plants; organization and administration of safety programs. (3 cr; prereq 50 or 100)
- 195-196. **Applied Industrial Engineering.** Industrial engineering surveys and programs; case problems; studies in local plants. (3 cr; prereq 15 cr in industrial engineering)
- 197. **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 or ITM 132 or #) McElrath
- 198. **Sequential Analysis.** Sequential vs. "classical" methods; operating characteristic functions for attributes and variables sequential plans; average sample number function; economic considerations; applications in research and production. (3 cr; prereq ITM 133 or #) McElrath

- 199. **Design of Industrial Experiments.** Designs involving crossed, nested, and mixed classifications; mathematical models for analysis of variance; estimation and comparison of effects; factorial experiments; confounding; balanced incomplete block designs; applications in research and production. (3 cr; prereq ITM 133 or #) McElrath
- 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.** (3 cr; prereq 26, ITM 25A or #) Barich
- 120. **Advanced Descriptive Geometry.** (3 cr; prereq 27, ITM 24A or #) Barich
- 130. **Nomography.** (3 cr; prereq 26, ITM 24A or #) Barich
- 131. **Graphical Mathematics.** (3 cr; prereq 26, ITM 25A or #)
- 194. **Graphics in Engineering Problems.** (2-4 cr; prereq 130 or 131 or #)

MECHANICS AND MATERIALS

Professor

Benjamin J. Lazan
 Lawrence E. Goodman
 William C. Meecham
 Robert Plunkett

Associate Professor

Allan A. Blatherwick
 Carl N. De Silva
 Chih-Chun Hsiao
 Theodore J. Mentel
 Patarasp R. Sethna
 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, 2 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.

- 142. **Experimental Mechanics I.** Strain gages. Photoelasticity. Experimental stress analysis. Deformation of beams and columns. Torsion, tension, and shear tests. (2 cr; prereq 40)
- 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 41 and Met 56)
- 151. **Fatigue of Materials and Structures.** Submicro- and micro-mechanisms of fatigue. Crack initiation and propagation. Statistical aspects. Random loading. Fatigue environment of aero-

- space structures, its analysis and simulation. Elevated temperature problems. Thermal fatigue. Resonance and acoustic fatigue. (3 cr; prereq 150)
- 164-165-166.1 **Problems in Mechanics and Materials.** Short duration research problems, literature studies, and reports. (0-3 cr per qtr; prereq $\frac{1}{2}$, faculty sponsor required before registration) Graduate staff
180. **Applied Elasticity I.** Stress and strain at a point in three dimensions. Equilibrium and compatibility equations. Generalized Hooke's Law. Formulation of the boundary value problem of elasticity. Strain energy and introduction to energy principles. (3 cr; prereq 40 or equiv)
181. **Applied Elasticity II.** Plane-stress and plane-strain problems of the thick pipe, rotating disc and cylinder and plate with circular hole. Introduction to torsion of various shaped bars. Energy principles and variational methods with application to the deformation analysis of trusses, arches, rings, and machine elements. (3 cr; prereq 180 or equiv)
182. **Applied Elasticity III.** Flexure of beams on elastic subgrades. Lagrange theory of thin plates. Stress concentrations and concentrated loads. Elastic instability of frames, narrow beams, and thin plates. (3 cr; prereq 180 or equiv)
183. **Applied Plasticity.** Plastic analysis of structures. Load carrying capacity. Limit analysis theorems. Shakedown and plastic collapse. Applications to trusses, beams, and frames. (3 cr; prereq 28, 41)
184. **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 40 and ITM 147 or equiv)
187. **Theory of Linear Viscoelasticity.** Linear viscoelastic behavior; linear viscoelastic laws; method of viscoelastic stress analysis; and applications to simple quasi-static viscoelastic problems. (3 cr; prereq 41 and ITM 148 or 150A)
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 29)
194. **Theory of Vibrations of Linear Discrete Systems.** 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 193)
196. **Problems in 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 193 or 194 or ITM 162 or EE 150 or Phys 102 or equiv)
199. **Thermal Stresses.** 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 or 184 and ME 133)
202. **Gyroscopic Instruments and Other Applications of Advanced Dynamics.** Classification of gyroscopes, accelerometers, the Schuler pendulum. Theory of inertial guidance; vehicle instrumentation. Some problems of the motion of a rocket *in vacuo*. Introduction to the problem of stability of motion; temporal stability, secular stability, stability in the sense of Liapounoff. Spin and gyroscopic stabilization. Effects of slight deformability on rigid body motions. (3 cr; prereq 196) Goodman, Warner
211. **Theory of Vibrations I.** 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 194 and ITM 148 or 150A) Sethna, Goodman, Plunkett
212. **Theory of Vibrations II.** Nonlinear systems. Methods in the phase plane, singular points. Response of 1 and 2 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 194, ITM 148 or 150A) Sethna, Goodman, Plunkett
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 ITM 148, 149, MM 211, 212 or $\frac{1}{2}$) Sethna
- 222-223. **Theory of Plasticity.** General stress-strain laws. Axiomatic construction of laws. Plane strain. Theory of slipline field. Rolling, drawing, extrusion. Pseudosteady and nonsteady plastic flow. Extremum principles. (3 cr per qtr; prereq 184 and ITM 173) Warner

227. **Introduction to Structural Instability.** Instability in mechanical systems. Reduction of structural instability to an eigenvalue problem. Use of variational techniques and matrices. Rayleigh-Ritz, Timoshenko, Galerkin, and general iteration methods of analysis. Creep buckling and irreversible inelastic buckling. Buckling of trusses, rings, arches, thin plates and introduction to buckling of shells. (3 cr; prereq 180 or 184 or ITM 173) Mentel
- 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, 142, and #) Lazan
- 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, non-homogeneous viscoelastic analysis. (3 cr; prereq 180 or 184 or #) Hsiao
- 264-265-266.† **Selected Topics on Mechanics and Materials.** Topics of current interest. (0-3 cr per qtr; prereq #) Graduate staff
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 184 and #) Goodman, De Silva
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 184 or #) De Silva, Goodman
- 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 184, ITM 147 or 152, ¶ITM 173) Goodman, Warner, Mentel, De Silva
- 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.
 Gerald T. Evans, M.D.C.M., Ph.D.
 R. Dorothy Sundberg, M.D., Ph.D.

Associate Professor

Ruth F. Hovde, M.S.
 Newell K. Ziegler, M.D., Ph.D.

Assistant Professor

Robert A. Bridges, M.D.
 Esther F. Freier, M.S.
 Lorraine M. Gonyea, M.S.
 Verna L. Rausch, M.S.

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 in 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) Hovde
- 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) Bridges
- 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) Bridges

MEDICINE

(Including Divisions of Internal Medicine and Dermatology)

Graduate work in medicine is designed to offer opportunities for gifted men and women to prepare themselves for the practice of internal medicine or any of its subdivisions as a specialty, and aims to guide its fellows in research in these subfields and to give them a start in university teaching. Prospective fellows who have had no special orientation in addition to that of the ordinary undergraduate courses will profit greatly from some special work. While any of the preclinical subjects might be of value, physiology, biochemistry, microbiology, and hematology at the present are of the greatest importance. Work in any of these subjects might be further continued during the major studies in medicine to meet the requirements for a minor subject. In dermatology, first-year fellows are residents at the Minneapolis General Hospital; the last 2 years are outlined by arrangement.

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

METALLURGICAL ENGINEERING

Professor

Strathmore R. B. Cooke
Gust Bitsianes
Thomas L. Joseph
James E. Lawver

Prerequisites—For major work, adequate preparation in the physical sciences and general engineering subjects fundamental to metallurgy.

Language Requirement—For the Master's degree, none. For the Ph.D. degree, either (a) 2 foreign languages (German, French, or Russian), or (b) 1 of these languages and the option of a special research technique.

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

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

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
108. **Principles of Process Metallurgy.** Converting, metal refining, retorting, hydrometallurgical processes, electrolytic methods. (3-4 cr depending on lab; 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. (4 cr) Cooke
111. **Mineral Dressing.** Principles of ore beneficiation by gravity, magnetic, and electrostatic processes. Material balances. Laboratory examination and concentration of ores. (4 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. (4 cr; prereq 111) Cooke
- 118, 119, 120. **Metallurgical Engineering Practice.** Report writing on current problems in mineral dressing and in ferrous and nonferrous metallurgical practice. (Cr ar; prereq #) Joseph, Bitsianes, Cooke
122. **Hydrometallurgy.** Application of physico-chemical 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
- 124-125-126.*† **Special Problems in Mineral Dressing.** (Cr and hrs ar; prereq 112) Cooke
134. **Metallurgical Unit Processes.** Physico-chemical principles. Slag-metal equilibria, 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) Joseph
- 136.* **Metallurgical Unit Processes.** Integration of operations and processes on a plant basis. Applications in nonferrous metallurgy. (3 cr; prereq 108) Joseph
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 Process Metallurgy.** Laboratory investigation of problems involved in metallurgical unit processes. (Cr and hrs ar; prereq 108) Joseph, Bitsianes
- 201-202-203.*† **Research in Process Metallurgy.** (Cr ar) Bitsianes, Joseph
- 204-205-206.† **Research in Mineral Dressing.** (Cr ar) Cooke
- 210-211-212.*† **Seminar in Metallurgical Engineering.** (Cr ar)
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

METALLURGY

Professor

Morris E. Nicholson
Richard A. Swalin

Associate Professor

Henry S. Jerabek
John M. Sivertsen

Prerequisites—For major work, course 153 or equivalent, PhCh 103 or equivalent, differential and integral calculus, Phys 14 or equivalent.

Language Requirement—For the Master's degree, none. For the Ph.D. degree, 2 foreign languages, 1 of which must be German. Either Russian or French is recommended as the second.

Master's Degree—Offered only under Plan A.

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, ¶PCh 101-102-103) Swalin, Sivertsen
153. **Principles of Physical Metallurgy I.** Atomic structure, crystal structure of metals, Hume-Rothery rules, elements of phase diagrams. (3 cr) Nicholson
- 153A. **Laboratory in Physical Metallurgy.** (2 cr; prereq ¶153) Nicholson
154. **Principles of Physical Metallurgy II.** Plastic deformation, dislocation theory, structure of cold worked metal, recovery, recrystallization, preferred orientation, X-ray metallography. (3 cr; prereq 153 or ¶) Sivertsen
- 154A. **Laboratory in Physical Metallurgy.** (2 cr; prereq ¶154) Sivertsen
155. **Principles of Physical Metallurgy III.** Transformations in solids, precipitation hardening, order-disorder, the iron-carbon diagram, heat treatment. (3 cr; prereq 154 or ¶) Jerabek
- 155A. **Laboratory in Physical Metallurgy.** (2 cr; prereq 154 or ¶155) Jerabek
159. **Dental Physical Metallurgy.** Basic course for dental students, involving theory of metals and alloys, constitution diagrams, heat treatment, properties and applications of metals and alloys used in dentistry. (2 cr; 20 hrs) Jerabek
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 PCh 101 or 101H) Nicholson
162. **Nuclear Metallurgy.** Nature of radiation damage and effects of neutron irradiation on the properties of crystalline materials. (2 cr; prereq 56 or equiv or ¶; 1 lect hr per wk) Swalin
- 162A. **Irradiation Effects Laboratory.** (2 cr; prereq 162) Sivertsen
167. **Control of Mechanical Properties in Metals and Alloys.** Mechanical properties of metals and alloys are 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, fatigue in metals. Seminar procedure. (3 cr; prereq 155, 182 or ¶) Jerabek
- 170-171-172.1 **Special Problems in Physical Metallurgy.** Laboratory investigation. (1, 2, or 3 cr per qtr) Nicholson, Jerabek, Swalin
173. **Crystalline Properties of Metals.** An introduction to the geometry and properties of metal crystals. Topics to be discussed are X-ray diffraction, electrical and thermal conductivity, Hall effect, optical properties, and elastic and plastic behavior of metals. (3 cr; prereq 155) Sivertsen
174. **Modern Theory of Metals and Alloys.** Free electron theory of metals and application. Imperfection in crystals. (3 cr; prereq Phys 51 or ¶) Sivertsen
175. **Imperfections in Metals.** Theory of imperfections and their effects on properties of metals. (3 cr; prereq 174 or ¶) Sivertsen
- 180-181-182.* **The 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 PCh 103H or ¶) Swalin
- 207-208-209. **Research in Physical Metallurgy.** (Cr ar) Staff
- 213, 214, 215. **Seminar: Physical Metallurgy.** (Cr ar) Staff

250. **Thermodynamics of Alloys.** Classical and statistical thermodynamics applied to study of alloys. (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 155 or #)
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

MICROBIOLOGY

Professor

John Spizizen, Ph.D.
James J. Jezeski, Ph.D.
Joseph C. Olson, Ph.D.
Dennis W. Watson, Ph.D.

Associate Professor

S. Gaylen Bradley, Ph.D.
K. Gerhard Brand, M.D.
Martin Dworkin, Ph.D.
Leroy C. McLaren, Ph.D.
Edwin L. Schmidt, Ph.D.

Assistant Professor

Dwight Anderson, Ph.D.
Robert W. Bernlohr, Ph.D.
Brooks Church, Ph.D.
Palmer Rogers, Ph.D.
John E. Verna, Ph.D.

Instructor

Joseph W. St. Geme, Jr.

Language Requirement—For the Master's degree, one foreign language. For the Ph.D. degree, either (a) 2 foreign languages or (b) 1 foreign language and the option of a collateral field of knowledge.

Master's Degree—Offered under Plan A.

Doctor's Degree—Work toward 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) Brand
- 103s. **Soil Microbiology.** Methods for enumeration and study of microflora and microfauna. Biochemical activities of soil population. (4 cr; prereq 53, 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, PhCh 100 or 101, or AgBi 120) McLaren and staff
- 110w. **Microbial Genetics.** Genetic mechanisms in the bacteria, bacteriophages, fungi, protozoa, and algae. Mutagenesis; selection; adaptation; cytoplasmic inheritance; patterns of genic

** Microscope required. Students may obtain use of microscope by purchasing \$3 microscope cards from the bursar.

- recombination; fine structure of genetic material. (3 cr; prereq 53 or #; offered 1962-63 and alt yrs) Bradley
- 111s. **Advanced Laboratory.** Techniques employed in study of fundamental techniques in microbiology. Laboratory exercises illustrate isolation, cultivation, and identification of microorganisms. (3 cr; prereq 53 or #) Bradley
- 112w. **General Mycology.** Physiology; genetics; development; ecology; evolution; taxonomy; economic importance of the yeasts, molds, actinomycetes, and other fungi. (3 cr; prereq 53 or #; offered 1963-64 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. (4 cr; prereq 53) Watson
- 121f. **Physiology of Bacteria.** Chemical and physical structure; staining; growth; influence of environment on growth; nutrition; enzymes; metabolism. (3 cr; required of all microbiology majors; prereq 53, 8 cr in organic chemistry or biochemistry) Rogers
- 122w. **Physiology of Bacteria Laboratory.** Techniques employed in study of bacterial physiology and metabolism. (3 cr; required of all grad students in microbiology, open to others by consent; prereq 121) Rogers
- 123s. **Bacterial Metabolism.** Advanced treatment of metabolism; enzymes; biological energy; fermentation; respiration; nitrogen metabolism. (3 cr; required of all grad students in microbiology, open to others by consent; prereq 122 or equiv, introductory biochemistry; offered 1963-64 and alt yrs) Bernlohr
- 124f. **Principles of Virology and Animal Cell Culture.** Lectures on biology of animal cell cultures; nature of viruses and rickettsia; etiology, epidemiology, and laboratory diagnosis of viral and rickettsial infections. (3 cr; prereq 102 or 105 and 116) Verna
- 152f,w,s. **Special Problems.** (Cr ar; prereq #)
- 153f,w,s. **General Microbiology.** Lectures, demonstrations, and laboratory exercises in morphology, physiology, taxonomy, and ecology of bacteria. Practical application of these fundamental principles in other phases of science and industry. (3 cr; prereq 10 cr in chemistry, 4 cr in biological sciences, #) Schmidt
- 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, #) McLaren, St. Geme
- 203f,w,s. **Seminar.** (1 cr) McLaren
- 206f.** **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 1962-63 and alt yrs) McLaren, Verna

MINERAL ENGINEERING

Professor

Eugene P. Pfeider
Strathmore R. B. Cooke

Associate Professor

Adrian C. Dorenfeld
Charles Fairhurst
Washington D. Lacabanne
Harold M. Mooney
Donald H. Yardley

Prerequisites—For major work, the Bachelor's degree in mining or geological or petroleum engineering, or its equivalent. If the student cannot meet this requirement, he may become eligible by taking courses prescribed by his adviser.

Major and Minor—The candidate may emphasize any of the several subfields of the minerals area. These include rock mechanics, mineral economics, mine plant

** Microscope required. Students may obtain use of microscope by purchasing \$3 microscope cards from the bursar.

engineering, mineral exploration, mineral beneficiation extractive metallurgy, or the industrial engineering aspects. It is recommended that courses in allied branches of engineering, mechanics, geology, economics, and business administration be included in the major in order to develop a sound program. Work in the above subfields, as well as other of the related sciences, may be elected as the minor upon consultation with the adviser and the department concerned.

Language Requirement—For the Master's degree, none. For the Ph.D. degree, either 2 foreign languages or 1 foreign language with the option of a special research technique.

Master's Degree—Offered under Plan A; in special cases Plan B may be followed when approved by the student's adviser.

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

Mining Engineering

- 111-112. **Exploration, Development, and Exploitation of Mineral Deposits.** Principles and techniques of exploration, factors, and concepts involved. Sampling design, combining theory. Drilling, explosives, development openings, haulage systems. Shafts, drainage, underground mining systems. (3 cr per qtr) Yardley
121. **Mine and Petroleum 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 Hydr 103, ME 30 or #, EE 37) 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 28 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, Hydr 103) Dorenfeld
- 124-125. **Mill-Plant Engineering I-II.** Basic methods used in selection of mill-plant equipment; problems of scale-up from pilot-plant and laboratory data; integration of equipment into a working plant and its economics, construction, and operation. (3 cr per qtr; prereq MetE 112) 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 142 or #) Fairhurst
133. **Rock Mechanics III.** Theories of blasting. Hydrodynamic theory of detonation. Calculation of explosion pressure. Design of blasting patterns. (3 cr; prereq 132) Fairhurst
139. **Inspection Trip.** Study of mining operations, mine plant, and metallurgical plants in several mining camps. Engineering report. (3 cr; prereq #; 2 wks beginning about September 10)
141. **Mineral Economics.** Forecasted demands, resources, and conservation of minerals. Mine and oil field examinations and valuation. Cost, taxation, depletion, Organization and administration. (3 cr; prereq 112 or PetE 112 or #) Pfeider
- 142.* **Surface Mining Engineering.** Development, engineering, planning, and operation of open-cut properties. Drilling, blasting, excavation, and transportation. Quarries: methods, equipment, field for product. Placers; dredging, hydrauliclicking. (3 cr; prereq 112 or #) Pfeider
143. **Coal Mining Engineering.** Coal measure rocks. Method of working and mechanized coal mining. Methane and coal dust explosions. Flame-proofing and intrinsic safety of equipment. Methane drainage. Subsidence and strata control. (3 cr; prereq 112) Fairhurst
- 144-145.* **Advanced Mining Engineering.** Preparation of a report on a mining property or some phase of the mineral industry. (2 cr for 144, 4 cr for 145; prereq 141) Pfeider and staff
- 151-152-153.* † **Special Mining Engineering Problems.** Literature survey or research work on mining problems. (Cr and hrs ar; prereq 112) Staff
- 160.* **Mining and Processing Industrial Minerals.** Survey of minerals and rocks industrially important but primarily not mined for recovery of metals. Origin, geographic distribution, mining methods, processing, uses, etc. (Cr ar; prereq 112 or #) Yardley

- 180.* Geochemical Exploration.** Application of geochemical techniques and principles to the search for orebodies. 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. Search theory in exploration. (3 cr; offered 1962-63 and alt yrs) Yardley
- 201-202-203.*† Mineral Engineering Seminar.** (Cr ar) Pfeider and staff
- 210.* Engineering Report.** Detailed study and report of the actual operations of a mine. (Cr and term ar) Pfeider
- 212-213-214.*‡ Mining Research Problems.** (Cr ar) Staff
- 220. Advanced Mine Air Conditioning.** Theory of dust control and exhaust ventilation systems, calculation of pressure drops and leakage in complicated mine ventilation circuits, theory of heat flow from wall rock into mine openings, and design of refrigeration and air conditioning systems. (3 cr; prereq 123, ME 31 or #)
- 230.* Advanced Geochemical Exploration.** Development of geochemical techniques, both field and laboratory phases. Specific project assignment. (Cr ar; prereq #) Yardley
- 240.* Advanced Concepts in Drilling of Rocks.** Disintegration 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
- 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

Petroleum Engineering

- 111. Oil Field Development.** Drilling and completion of oil wells, methods and equipment involved. Problems and protection of completed well; directional drilling, well surveying; electrical and mechanical logging and other methods of securing underground information; well records. (3 cr; prereq Geol 25 or #) Lacabanne
- 112. Oil Field Production.** Principles and methods. Petrophysics of oil reservoirs, oil and gas; phase relations under reservoir conditions; condensate fields; sand drainage; oil reservoir performance; lifting oil; secondary methods of recovery; gas wells. (3 cr; prereq 111) Lacabanne
- 131. Reservoir Mechanics.** Reservoir rocks, fluids, forces, and classification of energies. Rock-fluid systems and equations of flow for principal reservoir drives. (3 cr; prereq 134, Hydr 103 or #) Lacabanne
- 134. Natural Gas Engineering.** Properties of natural gas, gravities, etc. Critical condition of gases, deviations, compressibility factor, reduced and pseudo states; retrograde condensation. Estimation of gas reserves. Orifice meters, measuring of gas flow. Gas well capacities by back pressure. Gas hydrates. (2 cr; prereq 112 or #) Lacabanne
- 135. Engineering Study Through Field Trip of Several Oil Fields.** Oil well drilling, production methods, refining practices, reservoir features, etc. (3 cr; prereq #; 2-wk field trip ar) Lacabanne
- 144-145. Advanced Petroleum Engineering.** Preparation of report on the exploration and development of an oil property or some phase of the industry. (2 cr for 144, 4 cr for 145; prereq MinE 141) Pfeider
- 152-153-154. Petroleum Production Technology.** Problems in oil and gas production. Mud fluids, core analysis, permeability and porosity, electrical and mechanical coring and other logging methods, oil well cements, oil flow and drainage through porous formations, water analysis, problems. (3 cr per qtr; prereq 112 or #) Lacabanne
- 155-156-157.*† Special Problems in Petroleum Engineering.** Seminar in petroleum problems. (Cr and hrs ar; prereq ¶144 or 145 or #) Lacabanne
- 201-202-203. Petroleum and Natural Gas Engineering Seminar.** (Cr ar) Lacabanne
- 206.* Engineering Study of an Oil Field.** Detailed study in the field and report of the operations of an oil field. (Term and cr ar) Lacabanne, Pfeider
- 207-208-209.*‡ Research Problems in Petroleum Engineering.** (Cr ar) Lacabanne, Pfeider

MUSIC

Professor

Paul M. Oberg
Paul Fetler
Johannes Riedel
Roy A. Schuessler

Associate Professor

Arnold F. Caswell
Heinrich Fleischer
Paul S. Ivory
Bernhard Weiser

Assistant Professor

Dominick J. Argento

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 1 of the following branches of music: (a) history and literature, (b) theory and composition, (c) normal piano, or (d) music education. Placement tests in music theory and applied music are required of all entering students.

Language Requirement—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) 1 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 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 1 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
- 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 1962-63 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 1962-63 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 1962-63 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 1 of the following: 36, 62, 72, 99, or #) Riedel
- 111. Organization and Guidance of Piano Classes.** Organization, goals, materials, techniques for handling piano classes in secondary schools. (3 cr; prereq #; offered when feasible)
- 112-113-114.† History of Vocal Art.** Significant schools of singing from 1600. (2 cr per qtr; prereq 18 cr in 12 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 1962-63 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 theater or European history from 1600, or §; offered 1962-63 and alt yrs) Argento
- 127-128-129.* **Composition.** Original work in various forms. (2 cr per qtr; prereq 99 and 123) Fetler
- 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 1962-63 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 1962-63 and alt yrs) Riedel
132. **Symphonies of the Romantic Era.** Schubert, Schumann, Mendelssohn, Berlioz, Liszt, Brahms, Franck, Dvorak, Tchaikowsky, 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 1962-63 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) Houle
- 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. **Realization and 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) Aird
- 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.** Forms, techniques, styles of late baroque and classical periods: Bach, Handel, Gluck, Mozart, Haydn, Beethoven. (3 cr per qtr; prereq 36; offered when feasible) Houle
- 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, Abelson
150. **Organ Literature.** From 14th century to present. (2 cr; prereq grad organ, 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 1963-64 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 1963-64 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 1963-64 and alt yrs) Benriccutto
- 164-165-166.* Music in the Baroque Era. In Italy, Netherlands, Germany, Austria, France, Spain. (3 cr per qtr; prereq 36; offered 1962-63 and alt yrs) Houle
175. Training in Advanced Musicianship. Sight singing and dictation of melodic, harmonic, rhythmic, 2- and 3-part contrapuntal materials; score reading, both vocal and instrumental; training in tonal memory; aspects of conducting. (3 cr; prereq 6T) Fetler
- 177.* Analysis of Contemporary Music. Twentieth-century styles and techniques including works of Bartok, Hindemith, Stravinsky, Schönberg. (3 cr; prereq 6T) Fetler
- 197-198-199. Advanced Counterpoint. Bach's *Art of the Fugue*; practice in technique of writing 3- and 4-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 144-145-146; 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 1962-63 and alt yrs) Riedel
- 204x. Graduate Applied Music. (9 cr upon completion of 3 qtrs and presentation of grad recital; prereq entr exam; minimum of 12 hrs practice per wk) Staff
- 209-210-211.* Advanced Topics. (3 cr per qtr; prereq 76) Oberg
- 212x.* Special Problems. (3-9 cr per qtr; prereq 110) Oberg, Riedel, Fetler
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 #)
- 227-228-229.* Seminar in 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
- 270-271-272. Organization and Guidance of Piano Classes. Organization, goals, materials, and techniques for handling piano classes in colleges. (2 cr per qtr, §70-80; prereq #)

For Music education courses, see index.

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

James R. Dawson, Jr., M.D.
A. B. Baker, M.D., Ph.D.
Ellis S. Benson, M.D.
Jesse E. Edwards, M.D.
Franz Halberg, M.D.
Robert Hebbel, M.D., Ph.D.
John F. Noble, M.D.

Associate Professor

Herbert M. Hirsch, Ph.D.
Paul H. Lober, M.D., Ph.D.
Nathaniel A. Lufkin, M.D.
Lee W. Wattenberg, M.D.

Assistant Professor

John I. Coe, M.D.

Clinical Instructor

Frederick A. Fox, 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) 2 foreign languages or (b) 1 foreign language and the option of a collateral field of knowledge.

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. (3 cr; prereq 102) Staff
- 110x. Seminar in 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 150, 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
118. Intracranial Neoplasms. (2 cr, §NPsy 211) Baker
119. Survey of Neuropathology. Examination of specimens from current autopsies. (Cr ar, §NPsy 151 and 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 PhCh 100 or equiv) Wattenberg
- 140f,w,s. Seminar in Experimental Pathology. (Formerly CBio 140) (1 cr) Halberg
- 141f,w,s. Problems in Experimental Pathology. (Formerly CBio 141) (Cr and hrs ar) Staff
- 150x. Problems in Pathology. (Cr and hrs ar; prereq 102, Δ) 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) Staff

PHARMACEUTICAL CHEMISTRY

Professor

Ole Gisvold, Ph.D.
 Frank E. DiGangi, Ph.D.
 George P. Hager, Ph.D.
 Taito O. Soine, Ph.D.

Assistant 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 the department's activities. Pharmaceutical chemistry 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. For the Ph.D. degree, either (a) 2 foreign languages or (b) 1 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.** Elementary investigation of the analysis, synthesis, and phytochemistry of medicinal agents. (Cr ar; prereq #) Staff
- 201-202-203.* Pharmaceutical Chemistry Seminar.** (1 cr per qtr; required of majors in pharmaceutical chemistry) 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 1963-64 and alt yrs) Staff
- 208.* Carbohydrates and Glycosides.** Origin, isolation, characterization, and chemistry. (3-5 cr; prereq OrCh 63 or #; offered 1962-63 and alt yrs) Gisvold
- 209.* Alkaloids.** Isolation, purification, and characterization. (3-5 cr; prereq OrCh 63 or #; offered 1962-63 and alt yrs) Soine
- 211.* Terpenes, Carotinoids, Tannins, and Anthocyanins.** Discussion of their chemistry; experimental investigation of methods of isolation and characterization. (3-5 cr; prereq OrCh 63 or #; offered 1962-63 and alt yrs) DiGangi
- 212.* Fats, Waxes, Steroids, and Related Compounds.** Origin, isolation, characterization, and chemistry. (3-5 cr; prereq OrCh 63 or #; offered 1962-63 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

Charles V. Netz, Ph.D.
Willard J. Hadley, Ph.D.

Associate Professor

Robert H. Miller, Ph.D.

Assistant Professor

Edward G. Rippie, Ph.D.
Hugh F. Kabat, Ph.D.

Graduate work leading to the M.S. or Ph.D. degree in pharmaceutical technology is offered to students who wish to prepare for careers as teachers in colleges of

pharmacy, hospital pharmacists, or pharmaceutical scientists in areas often designated as "new product development," "manufacturing pharmacy," "operative pharmacy," "pharmacy," etc.

Prerequisites—A degree from an accredited 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.

Minor—The choice of minor fields of study may vary considerably depending on the research and interests of the student, e.g., mathematics including statistics; engineering (industrial, chemical, electrical); economics and business administration; chemistry (physical, organic, analytical, pharmaceutical); pharmacology and other biological sciences. The selection of courses will be made after consultation with the student's adviser. All candidates for the Ph.D. degree must complete PCh 103.

Language Requirement—For the Master's degree, one foreign language. For the Ph.D. degree, either (a) 2 foreign languages or (b) with consent of adviser 1 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.

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.** A survey of established pharmacy services in hospitals. (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. **Pharmaceutical Technology Seminar.** (1 cr; required of majors in pharmaceutical technology) Staff
- 202-203-204.* **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. (3-5 cr per qtr; prereq PhmC 165, PCh 103, or #; offered when demand warrants) Rippe
- 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
221. **Homogeneous Systems in Pharmacy.** Application of physicochemical principles and processes to preparation, standardization, and therapeutic application of homogeneous dosage forms.

Required of all Ph.D. candidates in pharmaceutical technology. (3-5 cr; prereq PhmC 163, PCh 103 or #; offered when demand warrants) Hadley

222. **Heterogeneous Systems in Pharmacy.** Application of physicochemical principles and processes to preparation, standardization, and therapeutic application of heterogeneous dosage forms. (3-5 cr; prereq 221; offered when demand warrants) Hadley

PHARMACOGNOSY

Associate Professor

Herbert Jonas, Ph.D.

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. For the Ph.D. degree, (a) 2 foreign languages, 1 of which must be German, or (b) with consent of adviser, 1 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.

160. **Recent Advances in Pharmacognosy.** Crude drug production, biogenesis, enzymes, biological and fermentation products, insecticides, fungicides, and herbicides. (3 cr; prereq 3 or #) Staff
162. **Intermediate Pharmacognosy.** Biochemistry and physiology of drug-producing organisms. Chemical and physical methods for production and analysis of their medicinal constituents. (3 cr; prereq 3 and #) Staff
163. **Intermediate Pharmacognosy.** Microscopic and microchemical methods in the study of drug-producing organisms and their constituents. (3 cr; prereq 3 and #) Staff
164. **Intermediate Pharmacognosy.** Insecticides, fungicides, and plant growth regulators involved in the cultivation and preservation of medicinal plants and their products. (3 cr; prereq 3, Phcl 56, and #) Staff
165. **Basic Application of Radionuclides.** Properties and utilization of radioactive substances of importance in biology, pharmacy, public health, and civil defense. (2 cr; prereq MicB 53 and #) Jonas and staff
166. **Basic 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. (2 cr; prereq 165 or #) Jonas and staff
168. **Advanced Laboratory Course in 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. (Cr ar; prereq #) Staff
- 201-202-203.⁹ **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

Frederick E. Shideman, Ph.D., M.D.
Wallace F. White, Ph.D.
Harold N. G. Wright, Ph.D.

Associate Professor

Frank T. Maher, Ph.D., M.D.
J. Gordon Millichap, M.D.

Assistant Professor

Elizabeth M. Cranston, Ph.D.

The laboratories of the Department of Pharmacology are excellently equipped for study of both the chemical properties of drugs and their actions upon functions of living organs and tissues, for studies on detection, isolation, and estimation of poisons, and for experimental chemotherapy. By co-operation of the clinical departments, special studies may be made of the action of drugs, old and new, upon patients in the University Hospitals and allied hospitals.

Prerequisites—In addition to fulfilling requirements for admission to the Graduate School students should satisfy the requirements for entrance to the Medical School.

Minor—Work for a minor is offered to students in allied sciences.

Language Requirement—For the Master's degree, one foreign language. For the Ph.D. degree, either (a) 2 foreign languages or (b) 1 foreign language and the option of a collateral field of knowledge.

Master's Degree—Offered under Plan A.

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

- 101x. **Introduction to Pharmacology.** (3 cr; prereq Phs1 106, 107 or equiv) Wright, Cranston, White
102. **General and Experimental Pharmacology.** Detailed lecture and laboratory study of important drugs. (7 cr; prereq 101) Wright, Cranston, White
- 105x. **General and Experimental Pharmacology.** (Continuation of 101) Laboratory experiments and demonstrations. (6 cr; prereq 101; see 108 below) Wright, Cranston, White
- 106x. **General Pharmacology.** (Lecture continuation of 105) (2 cr; see 108 below) Wright, Cranston, White
- 108x. **Prescription Writing.** (1 cr; prereq 101, 105, 106 [101 and 102 are equiv to 101, 105, 106, and 108]) Wright
- 109x. **Pharmacological Problems.** (Cr and hrs ar; prereq §) Wright, White, Cranston
- 110x. **General Toxicology.** (2 cr) Wright
111. **Advanced Toxicology.** Quantitative toxicological analysis. (Cr ar; prereq 110 or ¶110) Wright
112. **Forensic Toxicology.** (6 cr; prereq 110 or §) Wright
113. **Industrial Toxicology.** (2 cr; minimum of 6 students) Wright
123. **Special Topics in Pharmacology.** (2 cr; prereq §) Wright, Cranston
- 124x. **Special Systems.** More detailed pharmacology of special organ systems and the clinical applications thereof. (Cr ar; prereq §) Wright, Cranston
- 162x. **Biological Assay of Drugs.** (3 cr; prereq 101 or §) White
- 203x. **Research in Pharmacology.** (Cr and hrs ar; prereq 101 and 102 or §) Wright, Cranston, or White
- 204x. **Advanced Pharmacology.** (1 cr; prereq 101 or §) Wright, Cranston
- 205x. **General Discussions in Pharmacology.** Seminar. (1 cr; prereq 101 or 102, §) Wright or Cranston
- 209x. **Problems in Pharmacodynamic Testing.** (Cr ar; prereq 109) White

PHILOSOPHY

Associate Professor

D. Burnham Terrell

Professor

May Brodbeck
Herbert Feigl
Ralph G. Ross

Associate Professor

Harry M. Bracken
Grover E. Maxwell
Karl H. Potter
Francis V. Raab

Assistant Professor

Homer E. Mason
Gareth B. Matthews

Graduate Major in Philosophy

Prerequisites—To be accepted as a graduate major in philosophy, the applicant must have completed 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, 1 of these languages is required; for the Ph.D. degree, 2 are required.

Master's Degree—Offered only under Plan A. The candidate shall, with the approval of his adviser, choose a thesis field, which must be one of the subfields of specialization listed. The written examination required by the Graduate School shall consist of 3 examinations: 1 in history of philosophy, and 2 others in subfields selected by the candidate from those listed above, at least 1 of which must be (b), (c), or (d).

Doctor's Degree—The candidate 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 candidate must pass a written examination in each of these 4 subfields; and a further examination either in 1 other of the subfields of specialization listed above, or in 1 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—In addition to satisfying the general Graduate School requirements, the candidate offering philosophy as a minor must pass a written examination in two subfields of specialization listed in the preceding section on Graduate Major in Philosophy.

Note—For major work in American Studies see the index.

101. **Principles of Philosophy.** Topics include knowledge, meaning, truth, reality, mind, and nature, human values, and action. (4 cr per qtr; prereq grad who has not had 1; offered when feasible) Feigl, Brodbeck, Maxwell
103. **Eighteenth-Century Philosophy.** Philosophic background of 18th-Century Enlightenment; rationalist and empiricist currents; deism; optimism; great chain of being. Readings from Locke, Hume, Voltaire, Diderot, Pope, and others. (3 cr; for history and literature students, philosophy majors; offered when feasible) Bracken
104. **Nineteenth-Century Thought.** Main currents in European philosophy; British and French philosophical psychology and social philosophy. German thought: Hegel, Marx, Schopenhauer, Nietzsche. (3 cr; prereq 52 or equiv, ‡; offered when feasible) Mason
105. **Introduction to American Philosophy: Puritanism to Pragmatism.** Puritanism, the Revolutionary period, transcendentalism, and pragmatism. Edwards, Paine, Emerson, James, Peirce. (3 cr; especially for students of American history and literature) Ross

106. **American Philosophy from William James.** (Continuation of 105) James, Dewey, Santayana, Blanshard. (3 cr; prereq 105 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
108. **Political and Social Ethics.** Ethical principles, theoretical and practical, at the basis of the social order. (3 cr; prereq 3, or §; offered 1962-63 and alt yrs) Mason
109. **History of Ethics.** Most significant contributions to development of ethical theory in Western philosophy; emphasis on British writers of modern period (17th-19th centuries). (3 cr; prereq 3, 1 qtr in history of philosophy, or §; offered 1963-64 and alt yrs) Terrell
112. **Plato.** Philosophy of Plato based on analysis of major dialogues. (3 cr per qtr; prereq 50 or §)
114. **Aristotle.** Philosophy of Aristotle based on analysis of selected passages from his major works. Particular attention given to his relationship to Plato. Survey of Aristotelian tradition in Western philosophy. (3 cr; prereq 1 course from 50-51-52, or §)
118. **Readings in Medieval Philosophy.** Analysis of selected works of principal medieval philosophers. (3 cr; prereq 50, 51 or §) Matthews
120. **Rationalism.** Philosophies of Descartes, Spinoza, and Leibniz. (3 cr; prereq 1 course from 50-51-52 or §; offered 1963-64 and alt yrs) Raab, Bracken
121. **Descartes.** Analysis of philosophical works of Descartes. (3 cr; prereq 1 course from 50-51-52 or §; offered 1962-63 and alt yrs) Raab
122. **Spinoza.** Philosophy of Spinoza based primarily on analysis of his *Ethics*. (3 cr; prereq 121 or §; offered when feasible)
123. **Leibniz.** Philosophy of Leibniz based on analysis of selected philosophical writings. (3 cr; prereq 121 or §; offered when feasible)
129. **Locke.** *Essay Concerning Human Understanding* and related works; Locke's sources and influence. (3 cr; prereq 52 or §; offered 1963-64 and alt yrs) Terrell, Bracken
130. **Berkeley.** Detailed study of Berkeley's philosophical works. (3 cr; prereq 52 or §; offered 1962-63 and alt yrs) Terrell, Bracken
131. **Hume.** Detailed study of Hume's *Treatise* and *Inquiry*. (3 cr; prereq 52 or §) Terrell
134. **Kant.** Philosophy of Kant based on analysis of selected passages from his major works. (3 cr; prereq 52 or §) Mason
137. **Kierkegaard and Scandinavian Philosophy.** Philosophical tradition in Scandinavian countries; Kierkegaard and his significance. (3 cr; prereq 1 course from 50-51-52 or §; offered 1963-64 and alt yrs) Mason
138. **Contemporary Existentialism.** Existentialist philosophy since Kierkegaard, especially in France and Germany (esp. Heidegger, Sartre, Jaspers, Marcel). (3 cr; prereq 52 or 137 or §; offered 1962-63 and alt yrs) Mason
140. **Contemporary Philosophy.** Current systematic and critical philosophies, especially idealism, naturalism, realism, pragmatism, positivism and current linguistic philosophy as represented by their principal exponents. (3 cr; prereq 52 or §; offered 1963-64) Raab
150. **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 justification of moral standards; examination of representative systems. (3 cr; prereq 3, or §) Raab, Terrell
151. **Principles of Aesthetics.** Nature of aesthetic experience; standards of aesthetic evaluations; beauty in art and beauty in nature; status of subject matter in the arts; relation of form and content; concepts of representation, expression, style, meaning, and truth in the arts; use of symbols in art; relation of the arts to knowledge, and to society; relation of aesthetics to ethics. (3 cr; prereq §) Potter
154. **Elements of Symbolic Logic.** Systematic introduction to modern logic. Dimensions of language; logic of propositions, predicates, and relations; applications to philosophy and to the foundations of mathematics. (4 cr; prereq 2 or §) Brodbeck
155. **Intermediate Symbolic Logic.** Axiomatic development of logic; properties of deductive systems; modal and many-valued logics; applications to philosophical problems. (3 cr; prereq 154; offered 1962-63) Brodbeck
157. **Metaphysics.** Some recent attempts to discover general principles characteristic of the universe. (4 cr; prereq 1 course from 50-51-52, or §) Brodbeck

158. **Theory of Knowledge.** Analysis of logical structure and experiential roots of knowledge. Topics include meaning, validity, truth, reason and experience, induction, criteria of objectivity, and reality. (4 cr; prereq 2 or §) Feigl
160. **Philosophy of Science.** Provides a clear understanding of meaning, methods, and implications of modern science through examination of basic concepts, presuppositions, and procedures. Topics include description, explanation, prediction, experimentation; space, time, number, matter, energy; causality, probability, statistics; organic life, evolution, mind. (4 cr; prereq 2 or §) Feigl
164. **The Logic of the Social Sciences I.** Philosophical examination of foundations of behavior 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 problems of concept formation, probability theory, models, and measurement in the behavioral sciences. (3 cr; prereq 164) Brodbeck
167. **Philosophy of History.** Idealistic, theological, and economic interpretations of history; concepts of progress, continuity, pluralism, etc., philosophical aspects of historical methods. (3 cr; prereq 6 cr in philosophy or 10 cr in history; offered 1962-63 and alt yrs) Mason
171. **Philosophies of India I.** Basic concepts of 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, 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-Mimansa, 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) Mason
- 190-191-192.† **Seminar in Philosophy.** Topics to be arranged according to students' interests. (3 cr per qtr; prereq 9 cr, or §) Staff
- 193-194-195.† **Seminar in the History and Philosophy of Theology.** (3 cr per qtr; prereq §)
- 210-211-212-213.† **Seminar in Moral Philosophy.** Systematic study of concepts and problems relating to ethical discourse. (3 cr per qtr; prereq 150) Mason, Raab, Terrell
- 217-218-219.† **Seminar in Social and Political Philosophy.** Especially for advanced students who are taking political science, history, or sociology as majors or minors. (3 cr per qtr; prereq §) Ross
- 223-224-225-226.† **Seminar in 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 in 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 in Philosophy of Religion.** Systematic study of 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 in Metaphysics.** Topics in metaphysics. Consult *Class Schedule* for topics to be discussed during any given year. (3 cr per qtr; prereq 157 or §)
- 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 §) Ross
- 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

PHYSICS

Professor

Alfred O. C. Nier
 J. Morris Blair
 J. William Buchta
 Warren B. Cheston
 George D. Freier
 Edward L. Hill
 Norton M. Hintz
 Edward P. Ney
 T. Michael Sanders, Jr.
 Otto H. Schmitt
 Joseph Valasek

Frank Verbrugge
 Clifford N. Wall
 John H. Williams
 John R. Winckler
 Donald R. Yennie

Associate Professor

A. Mark Bolsterli
 Stephen C. Gasiorowicz
 Walter H. Johnson, Jr.
 Paul J. Kellogg
 Homer T. Mantis

James H. Wertz, Jr.
 Cecil J. Waddington

Assistant Professor

James A. Earl
 Donald A. Geffen
 Russell A. Hobbie
 Lewis H. Nosanow
 Peter Signer
 William R. Webber
 William Zimmermann, Jr.

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, German and either French, Russian, or Italian. Other languages may be considered on petition.

Master's Degree—Offered under either Plan A or Plan B. Phys 171-172-173 or 181-183-185 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 171-172-173, 181-183-185, 210, 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 in mechanics, electricity, and electromagnetism designed to prepare students for advanced work. (4 cr per qtr, \$MM 29 and Phys 100; prereq 9 or 14, ITM 26A or Math 55, 59 or Math 55, 106 for 100...100 or MM 29 for 102...102 for 104)

100A-101A-102A.* Introduction to Analytic Mechanics. Analytic course in Newtonian mechanics; conservation principles. Topics include: particle dynamics in 1, 2, and 3 dimensions—the central force problem; dynamics of a system of particles—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 the Lagrange formulation of mechanics. Mathematics beyond the prerequisites developed as required. (3 cr per qtr [no cr for 100A if cr has been received for 100 or MM 29]; prereq 9 or 14, ITM 26A or Math 55, 59 or Math 55, 106 for 100A...100A or MM 29 for 101A...101A for 102A) Nier

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, ITM 26A or Math 55, 59 or Math 55, 106 for 103A...103A for 104A...104A for 105A) Cheston

107-109-111.* Atomic and Nuclear Physics. Interpretation of contemporary experimental phenomena. Special relativity, the nuclear atom, atomic and molecular structure and spectra, quanta and atoms, wave mechanics, nuclear physics, modern developments in classical physics, astrophysics, particle physics. (3 cr per qtr, \$50 or 51; prereq 9 or 14, ITM 26A or Math 55, 59 or 55, 106, \$ if taken out of sequence) Winckler

108-110-112.* Principles of Modern Physics. Combines elementary quantum mechanics with its historical background and applications to atomic and nuclear physics. Special relativity, 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, ITM 153 or Math 108) Hobbie
- 114-116-118x.*† **Elementary Physical Investigation.** Problems, either experimental or theoretical, in which student has special interest. Written report required. (3 cr per qtr; prereq Δ)
- 120.* **Atomic Physics.** Laboratory. Techniques and methods used in physics research laboratories. Vacuum gauges and systems, properties of charged particles, X-ray diffraction, ionization of gases, mass spectroscopy, photoelectricity, secondary electron emission. (3 cr; prereq 50 or ¶107 or ¶108, #) Blair
- 121.* **Experimental Nuclear Physics I.** Laboratory. Does not require extensive knowledge of electronic circuits. Natural radioactivity, cloud chambers, ionization chambers, properties of nuclear radiations, alpha, beta, and gamma rays, neutrons; shielding, artificial radioactivity, photographic techniques, health protection. (3 cr; prereq 50 or 107 or 108, #) Blair
- 122.* **Experimental Nuclear Physics II.** Laboratory. Techniques requiring knowledge of electronic circuits. Geiger, proportional, scintillation, and coincidence counters. Cosmic rays. Nuclear resonance phenomena. Health monitoring instruments. (3 cr; prereq 50 or 107 or 108, and #) Blair
- 123-124-125.* **Thermodynamics, Statistical Mechanics, and Theories of the Structure of Matter.** Principles of thermodynamics and introductory statistical mechanics. Laws of thermodynamics, thermodynamic potential functions, equations of state, phase transitions; transport phenomena, ensembles of identical systems, classical and quantum statistics; thermal, electric, and magnetic properties of matter. (3 cr per qtr; prereq 50 and ITM 152 or equiv for 123...123 for 124...124 for 125 or #) Zimmermann
- 126-127-128.* **Elementary Solid State Physics.** Physics of bulk matter. Structure and types of solids; ionic, molecular, and metallic solids; thermal, electrical, and magnetic behavior of matter; theory of conduction in metals and semiconductors; crystal imperfections and their effects. (3 cr per qtr; prereq 50 and ¶ ITM 26A or ¶Math 59)
- 131.* **Geometrical Optics.** Fundamentals of ray optics and its applications to optical instruments and their components. (3 cr; prereq 15 cr in physics, ITM 25A or Math 54) Valasek
- 133.* **Physical Optics.** Wave theory of interference, diffraction, polarization and double refraction and their applications. (3 cr; prereq 15 cr in physics, ITM 25A or Math 54) Valasek
- 133A. **Physical Optics Laboratory.** Parallel to 133. (1 cr; prereq ¶133) Valasek
- 134.* **Experimental Optics.** Laboratory. Spectrometry, optics of compound lenses, photometry, absorption, interferometry, and polarized light. (3 cr; prereq 15 cr in physics, ITM 25A or Math 54) Valasek
- 135.* **Spectroscopy.** Light sources, instruments, and methods used in spectroscopy of the X-ray, ultraviolet, visible, and infrared regions of the spectrum. (3 cr; prereq 15 cr in physics, ITM 25A or Math 54; offered when demand warrants) Valasek
- 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, ITM 25A or Math 54) Valasek
- 144.* **Electrical Measurements.** Lecture and laboratory. Ballistic and current galvanometers, magnetic flux measurements, potentiometer methods, D.C. bridges, and audio-frequency A.C. bridges. (4 cr; prereq 9 or 14 and ITM 25A or Math 54) Blair
- 146.* **Physics of Vacuum Tubes and Associated Circuits.** Thermionics, vacuum tube circuits, with emphasis on applications to physics research. (4 cr; prereq 144 or #) Blair
- 148.* **Application of Electronic Circuits.** Lecture and laboratory. Amplifiers, computing circuits, servomechanisms, regulating circuits, and other devices employed in physical research. (4 cr; prereq 146 or #) Blair
- 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 department) Schmitt
- 165.* **Introduction to Physics of the Atmosphere.** Laws of radiative transfer. Thermal structure of the atmosphere as determined by radiation. Hydrostatics and thermodynamics of the atmosphere, stability and convection. Basic relations between pressure, temperature, and wind and the mean state of the atmosphere. A selection from topics of current interest: atmospheric electricity, mechanism of cloud formation and precipitation, ozone and the energy budget

and circulation of the upper stratosphere. (3 cr; prereq 50 and ITM 26A or Math 55, 59 or 55, 106) Mantis

- 166.* **Meteorology I.** Basic meteorological hydrodynamics. The quantitative description of the flow processes of large-scale weather systems. (3 cr; prereq 165 or §) Mantis
- 167.* **Meteorology II.** Introduction to theoretical meteorology. Critical examination of the equations of motion. The mathematical models and methods used to describe the large-scale motions of the atmosphere. The energy of changes of large-scale weather systems. (3 cr; prereq 166, vector analysis or §) Mantis
- 171-172-173.* **Theoretical Physics.** Classical theories of physics: analytical dynamics, electromagnetism, and the relativistic formulation of these theories. Serves both as a termination course in classical physics and as preparation for more advanced courses in mathematical physics and quantum mechanics. (3 cr per qtr; prereq 104, ITM 153 or Math 108 or equiv)
- 181-183-185.* **Atomistics and Elementary Quantum Mechanics.** Structure of matter and electromagnetic radiation in the light of modern experimental and theoretical work. Fundamental particles; atomic, molecular, and nuclear structure; solid state; elementary quantum mechanics. (3 cr per qtr; prereq 111 or 112 or §) Sanders

Special prerequisites are noted for certain courses below.

- 201-202-203.* **Dynamics of Fluid Motion.** (3 cr per qtr) Hill
- 204-205-206.* **Statistical Thermodynamics.** (3 cr per qtr) Nosanow
- 207-208-209.* **Electrodynamics, Theoretical Optics, and the Theory of Relativity.** (3 cr per qtr)
- 210-211-212.* **Quantum Mechanics.** (3 cr per qtr; prereq 173 and 185) Yennie
- 213*-214*-215.*† **Seminar: Contemporary Experimental Physics.** (Cr ar)
- 216*-217*-218.*† **Seminar: Contemporary Theoretical Physics.** (Cr ar)
- 222-223-224.* **Principles of Mathematical Physics.** (3 cr per qtr) Hill
- 225-226-227.* **Advanced Quantum Theory.** (3 cr per qtr; prereq 212)
- 228-229-230.* **Nuclear Physics.** (3 cr per qtr; prereq 185 or 233) Hintz
- 231-232-233.* **Theory of Atomic and Molecular Structure.** (3 cr per qtr) Hill
- 234, 235. **Low Temperature Physics.** Properties of matter and experimental techniques at low temperatures. Topics include superfluid properties of liquid helium and superconductivity. (3 cr per qtr; prereq 125 and 111 or 112 or §)
236. **Radiofrequency Spectroscopy.** Experimental techniques and theoretical background in spectroscopy in radio and microwave frequency ranges. Typical topics: detection of signals, analysis of energy level structures, relaxation and saturation. (3 cr; prereq 125 and ¶185 or §)
- 237-238-239.*† **Seminar: Radiofrequency Spectroscopy.** (Cr ar) Sanders
- 240-241-242.*† **Seminar: Solid State and Low Temperature Physics.** (Cr ar) Sanders, Wertz
- 246-247-248.* **Cosmic Rays.** (3 cr per qtr) Webber
- 249-250-251.* **Solid State Physics.** (3 cr per qtr; prereq 173 and 185 or §)
- 252-253-254.*† **Seminar: Nuclear Physics.** (Cr ar) Williams, Hintz, and staff
- 255-256-257.*† **Seminar: Mass Spectroscopy.** (Cr ar) Nier, Johnson
- 258-259-260.*† **Seminar: Cosmic Rays.** (Cr ar) Ney, Winckler, and staff
- 264-265-266.* **Elementary Particle Physics.** (3 cr per qtr; prereq 185 or §) Casiorowicz
- 267-268-269.* **Atmospheric Physics.** (3 cr per qtr)
- 270-271-272.* **Special Topics in Nuclear Theory.** (3 cr per qtr; prereq 230)
- 273-274-275.* **Plasma Physics.** (3 cr per qtr; prereq 173) Kellogg
- 301-302-303.* **Research in Physics.** (Cr ar)

The following course will be offered when demand warrants:

261-262-263.* *Mathematical Foundations of Quantum Mechanics*. Hill

PHYSIOLOGICAL CHEMISTRY

Professor

Wallace D. Armstrong, M.D., Ph.D.
 Cyrus P. Barnum, Jr., Ph.D.
 Paul D. Boyer, Ph.D.
 Ivan Frantz, M.D.
 Ralph T. Holman, Ph.D.

Associate Professor

Charles W. Carr, Ph.D.
 William O. Caster, Ph.D.
 Helmut R. Gutmann, Ph.D.
 Leon Singer, Ph.D.
 Frank Ungar, Ph.D.
 Leslie Zieve, M.D., Ph.D.

Assistant Professor

John F. Van Pilsum, Ph.D.
 Richard W. Von Korff, Ph.D.

Prerequisites—For a doctoral major in physiological chemistry courses in analytical, organic, and physical chemistry comparable to those of a baccalaureate chemistry major are expected. The minimum requirements for candidates for the Ph.D. degree with a major in physiological chemistry are AnCh 101-102 or equivalent; OrCh 61-64 or equivalent; PCh 101-103 or in exceptional cases PCh 107-108. Candidates for the Master's degree with a major in physiological chemistry or those seeking a Ph.D. with a minor in 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) 2 foreign languages or (b) 1 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 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: PhCh 100-101, 5 of the 7 physiological chemistry courses numbered 206, 207, 208, 209, 210, 211, or 214 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 PhCh 100-101 or its equivalent has been taken 5 years or more prior to the time the candidate is to appear for the preliminary oral examination, this course must be retaken.

100f,su-101w,su. *Physiological Chemistry*. (7 cr per qtr; prereq physics, physical and organic chemistry) Armstrong, Barnum, Boyer, Carr, Ungar, Van Pilsum

153f,w,s,su. *Problems in Physiological Chemistry*. Special work arranged with qualified students. (Cr and hrs ar; may be taken 1 or more qtrs; prereq 101) Armstrong, Barnum, Boyer, Carr, Singer, Von Korff, Ungar

200f,w,s. *Seminar: Physiological Chemistry*. (1 cr) Armstrong, Barnum, Boyer, Carr, Caster, Singer, Von Korff, Ungar

205f,w,s,su. *Research in Physiological Chemistry*. (Cr and hrs ar) Armstrong, Barnum, Boyer, Frantz, Carr, Singer, Von Korff

- 206f. **Advanced Endocrinology and Steroid Chemistry.** (3 cr; minimum of 8 students; prereq 101; offered 1963-64 and alt yrs) Ungar
- 207f. **Radiotracers and Mineral Metabolism.** (3 cr; minimum of 8 students; prereq 101; offered 1962-63 and alt yrs) Armstrong, Singer
- 208s. **Advanced Laboratory Technique.** (3 cr; limited to 10 students; prereq 101 and #; offered 1963-64 and alt yrs) Staff
- 210w. **Metabolic Enzymology.** (3 cr; minimum of 8 students; prereq 101 or #; offered 1962-63 and alt yrs) Boyer
- 211s. **Nucleic Acid and Protein Metabolism.** (3 cr; minimum of 8 students; prereq 101; offered 1962-63 and alt yrs) Barnum
- 213f,w,s. **Clinical Physiological Chemistry.** (Cr and hrs ar)
- 214s. **Kinetics and Mechanism of Enzymic Reactions.** (3 cr, §PCh 214; minimum of 8 students; prereq PCh 103 and #; offered 1962-63 and alt yrs) Lumry
- 215w. **Topics in Lipid Metabolism.** (3 cr; minimum of 8 students; prereq 101 or #; offered 1963-64 and alt yrs) Frantz
- 217s. **Physical Chemistry of Proteins.** (3 cr, §PCh 215; minimum of 8 students; prereq PCh 103 and #; offered 1963-64 and alt yrs) Lumry
- 236f,w,s. **Radioisotope Seminar.** (1 cr, §Rad 236) Loken, Armstrong, and staff

PHYSIOLOGICAL HYGIENE

Professor

Ancel Keys, Ph.D.
 Joseph T. Anderson, Ph.D.
 Francisco Grande, M.D.
 Ernst Simonson, M.D.
 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, 2 foreign languages.

Master's Degree—Offered only under Plan A.

Doctor's Degree—Members of the physiological hygiene staff who are appointed to the graduate faculty in physiology or physiological chemistry may advise students majoring in physiology or physiological chemistry. 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 for 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 Phst 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 in 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

Maurice B. Visscher, M.D., Ph.D.
 Francisco Grande, M.D.
 Franz Halberg, M.D.
 John A. Johnson, Ph.D.
 Ancel Keys, Ph.D.
 Joseph T. King, M.D., 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.

Associate Professor

Marvin B. Bacaner, M.D.
 H. Mead Cavert, M.D., Ph.D.
 Charles Edwards, Ph.D.
 Eugene D. Grim, Ph.D.
 Rodney B. Harvey, M.D., Ph.D.

Assistant Professor

Robert L. Evans, Ph.D.
 Irwin J. Fox, M.D.
 Jui S. Lee, Ph.D.
 Laurence O. Pilgeram, Ph.D.

Prerequisites—For a major or minor in physiology, acceptable courses in general zoology or anatomy, general chemistry, organic chemistry, and college physics. Physical chemistry is desirable.

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, German, French, Russian, or Spanish. For the Ph.D. degree, either (a) 2 foreign languages or (b) 1 foreign language and the option of a collateral field of knowledge.

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.

106-107.† **Human Physiology.** (15 cr; 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

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

210x. **Selected Topics in Permeability.** Advanced seminar. (Cr and hrs ar; prereq 107 or equiv, #) Lifson, Evans, Johnson, Grim

211x. **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, Evans, Lorber

212x. **Selected Topics in Respiration.** Advanced seminar. (Cr and hrs ar; prereq 107 or equiv, #)

215. **Selected Topics in Intermediary Metabolism.** (Cr and hrs ar; prereq 107 or equiv, #) Pilgeram

216. **Selected Topics in Neurophysiology.** Advanced seminar. (Cr and hrs ar; prereq 106-107 or equiv, #) Terzuolo, Edwards

227. **Methods in Physiology.** (Cr and hrs ar; prereq 107 or equiv, #) Staff

230s. **Topics in General Physiology.** Relatively systematic coverage of biological transport processes; kidney and G.I. tract. (3 cr; prereq 107 within past 8 years) Grim, Johnson, Lifson

231f. **Topics in General Physiology.** Continuation of 230. (2 cr) Grim, Johnson, Lifson

232w. **Immunological Basis of Tissue Transplantation and Related Phenomena.** (2 cr; prereq 107 within past 8 yrs) Martinez

- 233s. **Biophysics of Circulation.** (3 cr; prereq 107 within past 8 yrs) Evans, Fox
- 234f. **Respiration, Acid-Base Chemistry, and Electrolyte Metabolism.** (3 cr; prereq 107 within past 8 yrs)
- 235w. **Bioenergetics of Cardiac Contraction.** (3 cr; prereq 107 within past 8 yrs; offered 1962-63) Cavert, Lorber
- 236s. **New Concepts in Physiology of Renal Function.** (3 cr; prereq 107 within past 8 yrs)
- 237f. **Biophysical Aspects of Nerve Function.** (3 cr; prereq 107 within past 8 yrs) Edwards, Terzuolo
- 238w. **Neural and Humoral Control of Circulation.** (3 cr; prereq 107 within past 8 yrs) Grande

PLANT PATHOLOGY AND BOTANY

Professor

Milton F. Kernkamp
Clyde M. Christensen
Carl J. Eide
Helen Hart
Thomas H. King
Albert J. Linck

Associate Professor

David W. French
Thor Kommedahl
John B. Rowell
Roy W. Wilcoxson

Assistant Professor

Richard D. Durbin
Theodore W. Sudia

Instructor

Matthew B. Moore

Prerequisites—To major in either plant pathology or agricultural botany, 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 agricultural botany, a student must satisfy the graduate faculty that he is adequately prepared.

Course Requirements—In addition to courses in plant pathology and agricultural botany, courses in other fields of agricultural or biological sciences may be applied toward an advanced degree for either major or minor if the adviser approves. A student majoring in these fields will continue studies during at least 1 summer.

Language Requirement—For the Master's degree, one foreign language. For the Doctor's degree, two foreign languages.

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 agricultural botany.

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 ‡)
104. **Industrial Mycology.** Fungi in relation to industrial processes and products. (3 cr; prereq 1 or 51 or 56; offered 1962-63 and alt yrs, or when demand warrants) C M Christensen
- 105, 106, 107.*† **Mycology.** Morphology and taxonomy of fungi. (3 cr per qtr; prereq 1 or 51 or 56 or equiv) C M Christensen, Anderson
111. **Diseases of Field Crops.** Symptomatology, etiology, and practical methods of control. (4 cr; prereq 1 or 51 or 120) Kernkamp
114. **Advanced Forest Pathology.** Wood rots, including deterioration of wood products. (3 cr; prereq 1 or 51 or 120) French
115. **Diseases of Vegetable Crops.** Especially those important in Minnesota. (3 cr; prereq 1 or 51 or 120; offered 1963-64 and alt yrs, or when demand warrants) Eide
116. **Diseases of Fruit Crops.** Especially those important in Minnesota. (3 cr; prereq 1 or 51 or 120; offered 1962-63 and alt yrs or when demand warrants) King

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 1963-64 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 microbiology; offered 1962-63 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. **Plant Pathology for Advanced Students.** 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
143. **Methods.** Methods used in mycological, pathological, and physiological research. (3 cr; prereq 1 or 51) Durbin
156. **Study of Fungi for Advanced Students.** General characters of fungi; cultural and taxonomic procedures and practices. (3 cr, §56, §105, §106, §107; prereq 9 cr in botany or Biol 2 or §) C M Christensen
- 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) C M Christensen
211. **History of Plant Pathology.** Development of plant pathology as a science. (2 cr; offered 1962-63 and alt yrs, or when demand warrants)
- 213x.* **Seminar.** Critical review of progress and problems in plant pathology. (1 cr) Staff
215. **Genetics of Plant Pathogens.** Physiologic specialization, sexuality, hybridization, mutation, and similar phenomena in plant pathogens; practical implications. (3 cr; prereq 1 or 51, 156 or equiv, and Agro 131) Kernkamp
216. **Physiology of Plant Pathogens.** Physical and chemical requirements and effects of plant pathogens in relation to their parasitism. (3 cr) Durbin
217. **Ecology of Plant Pathogens.** Effect of environment on plant pathogens and plant disease epidemics. (3 cr; prereq 1 or 51 or 120, 156 or equiv) Wilcoxson
218. **Principles of Plant Pathology.** Systematic consideration of basic factors governing development of plant diseases. (3 cr; prereq 1 or 51, 156 or equiv, MicB 53, and 6 addtl cr in plant pathology) Eide

Agricultural Botany

102. **Biology of Seeds.** Factors affecting germination, development, dissemination, longevity, and viability of crop and weed seeds. (3 cr; prereq 15 cr in plant sciences or §; offered 1962-63 and alt yrs) Kommedahl
135. **Ecology of Grasses and Grasslands.** Identification, morphology, and ecological geography of grasses and legumes in natural and agricultural habitats. (3 cr, §4; prereq 1 yr botany or equiv; offered fall qtr 1962-63 and alt yrs) Kommedahl
137. **Animal Diseases and Poisonous Plants.** (Same as VMC 137) Important plants poisonous to animals. Identification, toxicology, diagnosis, and treatment. (3 cr; prereq §) Kommedahl, Johnson
- 251x.* **Seminar in Agricultural Botany.** (1 cr per qtr) Staff
- 260x. **Research Problems in Agricultural Botany.** Special assignment of problems in agricultural botany. (Cr ar) Kernkamp, Kommedahl

Plant Physiology

103. **Physiology of Economic Plants.** Applications of plant physiological principles to agriculture, horticulture, and forestry. (3 cr; prereq Bot 51 or 140) Linck

108. **Physiology of Economic Plants Laboratory.** (Companion course to 103) Applications of advanced methods and apparatus in physiological research to agricultural problems. May be taken with or without 103. (2 cr; prereq Bot 140 with lab and quantitative analysis, or equiv) Linck
136. **Physiology and Ecology of Weeds.** Factors affecting growth and distribution of weeds; chemical nature of herbicides and their effects. (3 cr; prereq 3 or equiv; offered 1963-64 and alt yrs) Kommedahl, Linck
161. **Fundamentals of Plant Growth.** Nature and characterization of plant growth; hormonal control of growth processes. (3 cr; prereq Biol 2 and Bot 140 or equiv) Linck
162. **Physical Factors of the Environment and Plant Growth.** Effects of physical factors of environment on physiological processes important on growth and development of economic plants. (3 cr; prereq Biol 2 and Bot 140 or equiv) Sudia
164. **Mineral Nutrition of Economic Plants.** Mineral requirements of plants; role of minerals in plant metabolism. (3 cr; prereq Biol 2 and Bot 140 or equiv) Sudia
166. **Water Relations of Economic Plants.** Water economy of plants. Absorption, translocation, transpiration, and osmotic relations of economic plants. (3 cr; prereq Biol 2 and Bot 140 or equiv) Sudia
214. **Radioisotope Techniques Applied to Biology.** Lecture and laboratory courses on uses of radioisotopes in biological research, criteria for their use, problems in their use and measurement. Extensive experience will be given through laboratory and greenhouse experiments. (3 cr; enrollment limited to 10; prereq a course in nuclear physics) Linck, Caldwell
- 254x.* **Research Problems in Plant Physiology.** Special assignment of work in applied plant physiology. (Cr ar) Rowell, Linck, Sudia

POLITICAL SCIENCE

Professor

Charles H. McLaughlin
Harold W. Chase
Werner Levi
Benjamin E. Lippincott
Lennox A. Mills
Orville C. Peterson
Lloyd M. Short

Mulford Q. Sibley
John E. Turner
George A. Warp

Associate Professor

Robert T. Holt
Francis J. Sorauf, Jr.

Assistant Professor

Charles H. Backstrom
William H. Flanigan

Instructor

Thomas M. Scott

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) 2 foreign languages or (b) 1 foreign language and the option of a special research technique or a collateral field of knowledge.

Subfields of Specialization—When a candidate selects one of the listed subfields as part of the requirements for a degree, he is not necessarily required to take all the courses offered in that subfield. He is, however, required to prepare for examination in some extensive part of the subfield that is dealt with in courses and seminars offered by the department. The recognized subfields are:

1. *American government and politics*, comprising four subareas: (a) national and state government; (b) local government; (c) public administration; (d) public law.

2. *Comparative government and politics*, comprising four subareas: (a) Europe; (b) the Far East; (c) British Empire and Commonwealth of Nations; (d) Latin America.

3. *Theory*, comprising two subareas: (a) history of political ideas; (b) political theory.

4. *International affairs*, comprising five subareas: (a) international law; (b) diplomacy; (c) international relations and organization; (d) regional international relations (Far Eastern, European, or Latin American); (e) colonial government and administration.

5. *Political behavior*. This subfield is not at present available as a separate subfield of concentration, but may be used in combination with some other subarea.

General Requirement—All candidates for graduate degrees with major in political science are required to complete Pol 229A (Scope and Methods of Political Science), or to present evidence of satisfactory completion of a similar course at another approved institution. Candidates for the Ph.D. degree must also complete Pol 229B or the equivalent. Candidates for the Master's degree who are not in residence at a time when Pol 229A is offered are excused from the requirement.

Note—For information on work in public administration and in 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 consists of at least 3 quarters of graduate study, estimated as follows: (a) at least 18 credits in political science in addition to Pol 229A; (b) at least 9 credits in the minor department; (c) satisfactory completion of a substantial thesis based upon independent research. Courses taken in the major should be grouped in 2 subareas of specialization, lying in either 1 or 2 subfields, and those taken in the minor should consist of a single 9-credit course, or a 3-quarter sequence of related courses totaling 9 credits.

Plan A with Minor in Political Science—Candidates with political science as the minor must take at least one 9-credit course or a 3-quarter sequence of related courses lying in either 1 or 2 subareas and totaling 9 credits.

Plan B with Political Science as the Field of Concentration—Candidates for the Master's degree without thesis must take 21 to 27 credits in political science, of which at least 6 must be in courses numbered 200 or above. These courses should be a logical grouping selected from not more than 4 subareas in at least 2, and not more than 3, subfields of specialization. Candidates must also take 18 to 24 credits in at least 2 related major fields, a total program of 45 credits. Courses elected in political science along with those in the related fields should constitute an integrated plan of study. Normally at least 2 of the required research papers, if submitted in 3-credit courses, or 1, 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 3 subfields of specialization, 1 of which shall be designated as his thesis subfield or subfield of concentration. He must prepare for examination in 1 subarea in each of 2 subfields, and in 2 subareas in the subfield of concentration, pursuing a

program of courses and seminars in political science that will vary in content and amount according to his individual needs and the extent of his undergraduate work in political science and related fields. He will also satisfy requirements of the minor field. Work leading to the Ph.D. degree consists of at least 3 full years of graduate study. Course work requirements will be decreased for those who enter the Graduate School with advanced standing. The preliminary examination covers the entire major and minor; the final oral examination is 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 in 2 subareas in either 1 or 2 subfields. At least 6 credits must be completed in courses numbered 200 or above.

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 subareas of specialization included in their political science programs. Successful completion of these examinations in each subarea (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 ordinarily are scheduled only during the fall and spring quarters except that examinations for M.A. candidates only will be given in the third week of each term of 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 subareas to be offered. Further details concerning the administration of the written examinations may be obtained from graduate advisers or from a mimeographed memorandum available in the office of the Department of Political Science.

- 101.* **Principles of the American Constitution I.** Nature of constitutions, judicial review, national-state and interstate relations. (3 cr; prereq 2 or equiv) Chase
- 102.* **Principles of the American Constitution II.** Organization and powers of the national government. (3 cr; prereq 101 or equiv) Chase
- 103.* **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
- 108.* **Legislative Organization and Procedure.** Congress and state legislatures at work. (3 cr; prereq 2 or 5 or §) Short
- 116.* **Local Government.** Theory, history, units, metropolitan areas, legal basis. (3 cr; prereq 2 or 5 or §) Backstrom or Scott
- 117.* **Local Government.** Politics, structures, finances. (3 cr; prereq 2 or 5 or §) Backstrom
- 118.* **Local Government.** Major functions, administration. (3 cr; prereq 116 or §; offered when feasible) Backstrom or Scott
- 119A. **Rural Local Government.** Historical and legal foundations, units of government, organization and administration, functions, finance, politics and elections, problems and prospects of rural local government. (3 cr; offered on the St. Paul Campus for prospective rural teachers, extension workers, and students in College of AFHE; prereq 2 or 5 or §; offered 1963-64 and alt yrs) Backstrom
120. **Municipal Functions.** Line activities of municipal government: law enforcement, traffic, fire, health and hospitals, welfare, parks and recreation, education and libraries, public works, public utilities, planning, housing, urban renewal. (3 cr; prereq 2 or 5 or §) Peterson
121. **Municipal Administration.** Basic administrative relationships in municipal government, personnel and financial administration, purchasing and contracting, legal service, administrative planning and research, reporting. (3 cr; prereq 2 or 5 or §) Peterson
- 122.* **Municipal Problems.** Intensive study of selected municipal problems. Individual conferences (no regular class). (3 cr; prereq 120 or 121 or §) Peterson
- 123.* **Planning.** (Same as Arch 104 and Soc 106) Social, economic, political, geographic, and technical phases of modern city planning. (3 cr) Peterson, Vivrett, Warp, Borchert, Rose, Scott

- 124.° Recent Social Legislation. Federal, state, and local programs in the field of public assistance and social security; major programs of the Social Security Act, health insurance, and housing. (3 cr; prereq 2 or 5 or §) Warp
- 126.° Government and the Economic Order I. Relation of government to all major areas of the economy; policy-making and policy decisions emphasized. (3 cr; prereq 2 or 5) Warp
- 127.° Government and the Economic Order II. Administrative development of regulatory programs; tools and techniques of administration; problems of organization, interest groups, and safeguards. (3 cr; prereq 2 or 5 or §) Warp
- 131.° Public Administration. Organization and areas, administrative responsibility. (3 cr; prereq 2 or 5 or §) Short
- 132.° Public Administration. Personnel administration. (3 cr; prereq 131 or §) Short
- 133.° Public Administration. Financial administration. (3 cr; prereq 131 or §) Short
- 135.° Problems of Public Planning. (3 cr; prereq 2 or 5 or §; offered when feasible)
- 137.° 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 5 or §) Sorauf
- 138.° 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 5 or §) Backstrom
- 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 §) Turner, Holt
- 143.° Government and Politics of the Soviet Union. Analysis that seeks to explain rise of Bolshevism; sources and nature of its ideology; history of the 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, Holt
- 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 5, or Soc 1)
- 149.° Government and Politics of the British Empire—India and the Tropical Colonies. (3 cr; offered 1962-63 and alt yrs) Mills
- 150.° Government and Politics of the British Empire—Development of Dominion Status. (3 cr; offered 1962-63 and alt yrs) Mills
- 151.° British Problems of Closer Union. Problems of unity within the British Dominions; regional unions with adjacent states. (3 cr; prereq 149 and 150 with grade of C+ or better, or §; offered when feasible) Mills
- 153.° Japanese Government and Politics. Constitutional and political development in Japan; political ideas, government, political parties, and problems. (3 cr; offered 1962-63 and alt yrs) Turner
- 154.° Chinese Government and Politics. Constitutional and political development in China; political ideas, government, political parties, and problems. (3 cr; offered 1962-63 and alt yrs) 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 5 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.° Latin-American International Relations. Growth of inter-American system; Organization of American States; relations of Latin-American states with international organizations, other American states, the Soviet Union, and other regions; contemporary international problems. (3 cr; prereq 155 or 156 or §) Klein
- 158-159. 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 #) Turner, Holt
- 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 A-B or 9 cr in social science or #) Sibley
- 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 #) Sibley
- 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 #) Sibley
163. **Political Theory and Utopia.** Selected great utopias from the viewpoint of the political theorist; the 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.° **Development of Political Thought: Ancient.** 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.° **Development of Political Thought: the Middle Ages.** 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.° **Development of Political Thought: Early Modern.** Machiavelli; the idea of sovereignty; Protestant conceptions; English Civil War; Hobbes, Spinoza, Locke; the idea of progress; Godwin, Burke, Rousseau; rise of romanticism; German idealism. (3 cr; prereq B or 9 cr in social science or #) Sibley
- 167-168-169.° **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
- 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; offered 1963-64 and alt yrs) McLaughlin
- 176-177.°† **Conduct of U.S. Foreign Relations.** Control of foreign relations; treaties and executive agreements; structure and functions of foreign affairs agencies—Department of State, National Security Council, International Information Agency, economic, financial, military, intelligence agencies; co-ordination of agencies; the Foreign Service and other overseas agencies. (3 cr per qtr; offered 1963-64 and alt yrs) McLaughlin
- 180-181†-182.° **International Law (Pacific Relations).** 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
- 183.° **International Law (Conflict).** War and hostile measures short of war, military occupation, war crimes, neutrality, collective security sanctions. (3 cr; prereq 181 or #; offered 1962-63 and alt yrs) McLaughlin
- 184.° **International Relations and Organization I.** Fundamental principles and theoretical considerations. United Nations and regional organization. (3 cr) Levi
- 185.° **International Relations and Organization II.** Methods and institutions for international cooperation. Specialized agencies, especially in the social and economic field. (3 cr) Levi
- 186.° **International Relations and Organization III.** International offices and civil service; international administration; planning for an international order. (3 cr) Levi

- 187.° **Problems of European Politics.** Contemporary development of intra-European relations and organization; changing role of key European states; Europe's position in world politics. (3 cr; offered when feasible) Levi
- 191.° **Asia in International Relations I.** The period of separatism. (3 cr; offered 1963-64 and alt yrs) Levi
- 192.° **Asia in International Relations II.** The period of inequality. (3 cr; offered 1963-64 and alt yrs) Levi
- 193.° **Asia in International Relations III.** Contemporary development. (3 cr; offered 1963-64 and alt yrs) Levi
194. **International Politics of Asia.** Survey of Asian international relations; recent developments. (3 cr, §193; offered when feasible) Levi
- 195.° **Colonial Government and the Problems of Imperialism.** Motives of American, British, Dutch, French, and Spanish colonization; ancient and modern imperialism. (3 cr; offered 1963-64 and alt yrs) Mills
196. **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
- 197.° **The Mediterranean Area in World Affairs.** Economic, political, and strategic conditions; policies of European and Asiatic states, postwar conflict of interests between the Western powers and Russia. (3 cr; offered 1963-64 and alt yrs) Mills
- 200-201.° **Readings in American Government.** (3 cr per qtr; prereq #; offered when feasible)
- 202-203-204.° † **Seminar: Constitutional Law.** (3 cr per qtr; prereq 101, 102, 103 or #) Chase
- 205-206.° **Seminar: Administrative Law.** (3 cr per qtr; prereq 18 cr or #) Warp or Chase
- 207-208-209.° **Seminar: Jurisprudence.** Selected topics for social science students. Nature, end, and sanctions of law; its sources, forms, and modes of growth examined in typical systems; general juristic conceptions of rights, powers, duties and liabilities, persons, acts, things. (3 cr per qtr; prereq #; offered 1963-64 and alt yrs) McLaughlin
- 210-211-212.° † **Special Seminar in Public Administration.** (3 cr per qtr; regis only with consent of staff) Warp, Short
- 214.° **Seminar: Political Parties.** (3 cr; prereq 12 cr or #) Sorauf or Backstrom
215. **Seminar: Comparative Public Administration.** Each year the seminar will select a topic for comparative examination. The selected topic will constitute a central theme around which greater understanding of administrative systems of other countries will be developed. (3 cr; prereq 9 cr in public administration and/or comparative government or #; offered when feasible) Warp
- 216-217-218.° **Seminar: Comparative European Government.** (3 cr per qtr; prereq #) Turner
- 219-220-221.° **Seminar: Political Power in the Modern World.** (3 cr per qtr; offered when feasible)
- 222-223-224.° **Seminar: Recent Political Thought, American and Foreign.** Special reference to problems of democracy. (3 cr per qtr; prereq 12 cr or #; offered when feasible) Sibley
- 225-226-227.° **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
- 228.° **Seminar: Political Theory.** Freedom and control in the democratic state. (3 cr; prereq 12 cr or #; offered when feasible) Lippincott
- 229A-B.° **Scope and Methods of Political Science.** A: The field of political science; relation to other studies; types of approach; research methods and techniques; bibliography. B: Contemporary trends and currents within political science; problems in analysis and theory; normative and empirical political science. (3 cr per qtr; prereq #) Sorauf
- 230-231-232.° **Seminar: Political Behavior.** Intensive examination of selected topics, including review of available research on these topics and analysis of the research designs and techniques employed. (3 cr per qtr; prereq 167-168-169 or #) Flanigan
- 234, 235. **Political Science and Related Disciplines.** Intensive examination of outstanding writings from social psychology, sociology, anthropology, ethics, history, economics, and law to political theory and political institutions. (3 cr per qtr; prereq 164, 165, 166 and 225-226-227 or #; offered when feasible) Lippincott
- 236-237.° **Seminar in Federalism and Intergovernmental Relations.** (3 cr per qtr; prereq #; offered when feasible)

- 238-239.* Seminar in the History and System of International Law. Juristic theories of character and sanctions of international law and of its relation to the state. (3 cr per qtr; prereq 181 or §; offered 1962-63 and alt yrs) McLaughlin
- 240.* International Constitutional Law. Problems of interpretation and application of the Charter of the United Nations and of constituent instruments of other international agencies. (3 cr; prereq 181 or §; offered 1962-63 and alt yrs) McLaughlin
- 242-243-244.* Topics in Colonization. Comparative study of 20th-century political and economic problems of American, British, Dutch, and French colonies. (3 cr per qtr; prereq 195 or §) Mills
- 245-246-247.* Seminar: East Asian Government and International Relations. (3 cr per qtr; prereq §) Levi, Turner
- 248-249.* Seminar in International Organization. (3 cr per qtr; prereq §; offered 1962-63 and alt yrs) Levi
- 248A-249A.* Problems of International Relations Theory. (3 cr per qtr; prereq §; offered 1963-64 and alt yrs) Levi

The following courses, with credits arranged, offer opportunities for research and directed individual study:

- 251-252-253.* Public Law. Chase, Warp
- 254-255-256.* American Government, Politics, and Administration. Short, Chase, Warp, Sorauf
- 261-262-263.* Local Government. Backstrom
- 264-265-266.* Municipal Administration. Peterson
- 267-268-269.* Political Behavior. Flanigan
- 271-272-273.* Comparative European Government and Politics. Turner, Holt
- 274-275-276.* Latin-American Governments and International Relations. Klein
- 281-282-283.* Political Theory. Lippincott, Sibley
- 291-292-293.* Far Eastern Government and International Relations. Levi, Turner
- 294-295-296.* Colonization and Imperialism. Mills
- 297-298-299.* International Law and Relations. McLaughlin, Levi

POULTRY HUSBANDRY

Professor

Elton L. Johnson
Robert N. Shoffner
Hubert J. Sloan

Associate Professor

Ray E. Burger
Milo H. Swanson
Paul E. Waibel

Assistant Professor

David C. Snetsinger

Prerequisites—For major or minor work students must furnish evidence of satisfactory preparation. Students will be required to make up deficiencies.

Major and Minor Work—With the approval of the adviser, courses in related fields may be accepted as part of the major and minor work.

Language Requirement—For the Master's degree, none. For the Ph.D. degree, the language requirement may be met by either (a) 2 foreign languages or (b) 1 foreign language plus a special research technique or a collateral field of knowledge.

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

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

- 102w. Poultry Breeding. Principles of genetics and physiology of reproduction as applied to the breeding of poultry. (4 cr; prereq 1, Agro 30; offered 1963-64 and alt yrs) Shoffner
- 105s-106f. 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; offered s [1962-63], f [1963-64] and alt yrs) Burger

- 153s. Poultry Nutrition. Nutrients and requirements, ration formulation, and current practice in feeding of chickens and turkeys. (3 cr; prereq 1, AgBi 1A or equiv) Waibel, Johnson
- 154f. Poultry Products. Technology involved in grading, processing, packaging, storage, and merchandising of poultry meats and eggs. (3 cr; prereq 1) Swanson
- 214x.* Research in Poultry Husbandry. Problems assigned to fit the needs of the student. (Cr ar; prereq #) Staff
- 215x.* Research in Poultry Nutrition. (Cr ar; prereq 9 cr in agricultural biochemistry or equiv) Waibel, Johnson
- 216x.* Research in Poultry Breeding. (Cr ar; prereq 9 cr in genetics or equiv) Shoffner
- 217x.* Poultry Husbandry Seminar. (1 cr per qtr; prereq #) Staff
- 218x.* Research in Poultry Products. (Cr ar; prereq #) Swanson
- 222w.* Energy in Animal Nutrition. Role; its 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 AnHu 37, 37A, AgBi 6 [old 106] or #...AgBi 116 recommended; offered 1962-63 and alt yrs) Donker
- 223s.* Protein and Amino Acid Nutrition. Role; sources, how determined, measurements of protein quality, fate and use of ingested protein and interrelationships with other nutrients. (3 cr; prereq AnHu 37, 37A, AgBi 6 [old 106] or equiv or #...AgBi 116 recommended; offered 1962-63 and alt yrs) Meade
- 224w.* 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 AgBi 6 or #...AgBi 124 recommended; offered 1963-64 and alt yrs) Waibel
- 225s.* Mineral Nutrition. Principles of mineral nutrition for poultry, swine, sheep, dairy and beef cattle; mineral requirements, interrelationships, utilization, and metabolism. (3 cr; prereq AgBi 6 [old 106]; offered 1963-64 and alt yrs) Snetsinger

PSYCHOLOGY

Professor

Kenneth MacCorquodale
 Ralph F. Berdie
 John C. Darley
 Marvin D. Dunnette
 George W. England
 Norman Garnezy
 Starke R. Hathaway
 James J. Jenkins
 Gardner Lindzey
 Lloyd H. Lofquist
 Howard P. Longstaff
 Paul E. Meehl

Ephraim Rosen

Wallace A. Russell
 William Schofield
 Benjamin Willerman
 Edmund C. Williamson
 Robert D. Wirt

Assistant Professor

Dana H. Bramel
 Peter F. Briggs
 Marshall C. Greenberg
 Milton A. Trapold
 Forrest L. Vance

Associate Professor

Elliot Aronson
 Gordon T. Heistad
 David L. LaBerge
 David T. Lykken
 Gerhard Neubeck
 Warren W. Roberts

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, one foreign language. For the Ph.D. degree, either (a) 2 foreign languages or (b) 1 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.

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

- 101-102.† Experimental Psychology.** Critical treatment of content and methods of experimental psychology. Current problems in perception, learning, motivation, and complex processes. Class will design, execute, and analyze 2 or 3 experimental projects per quarter. (3 cr per qtr; prereq 2, 5, 70, or equiv) 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 2 and 1 course numbered 50 or above) MacCorquodale
- 118. Verbal Behavior.** An individual's verbal behavior in terms of his past history and current circumstances. Psy 117 is not prerequisite but the same method of analysis is used. (3 cr; prereq 2 and 1 course numbered 50 or above) MacCorquodale
- 120-121. Theories of Personality.** Summary and evaluation of major contemporary theories. Among theorists discussed are Freud, Adler, Allport, Sheldon, Murray, and Rogers. (3 cr per qtr; prereq 9 cr in psychology) Lindzey
- 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 for 125...125 for 126) Jenkins, Dunnette
- 128-129.° Psychology of Learning.** Psychological theory; characteristics and function. Critical analysis of learning theories and their application to problems of normal and abnormal behavior. (3 cr per qtr; prereq 9 cr) 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 occupational adjustments. (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
- 135-136-137. Occupational Counseling.** Occupational information, interviewing, and use of tests in counseling; educational and occupational training opportunities and requirements. Psychological techniques in case analysis, interviewing, and remedial work. Types of vocational problems. Illustrative case histories. (2 cr per qtr; prereq 9 cr or # for 135-136, 130 for 137) Lofquist
- 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) Bramel
- 141. Social Psychology of Small Groups.** Communication and influence processes; factors related to group cohesion; problem-solving behavior of groups; relation of group structure to function; emergence of leadership and relation between leadership and group process; types of member participation. (3 cr; prereq 2, 5, 9 cr in a social science) Willeman
- 144-145.† Abnormal Psychology.** Normal and abnormal behavior contrasted. Dynamics, and particularly social determinants, of personality maladjustments. (3 cr per qtr; prereq 9 cr in psychology or 6 cr in psychology plus either Biol 2 or old Biol 3 or Zool 3 or 12 cr in a social science) Rosen, Garmezly
- 148. Physiological Psychology.** Elements of neural anatomy and physiology, tonus, neuromuscular set, integration, and neural basis of learning; their importance for psychology. (3 cr; prereq 2, 5 or Biol 2 or #) Roberts
- 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
- 155. Engineering and Industrial Psychology.** Human factors as they relate to industrial production, biomechanics (adaptation of the machine to the capacities and limitations of the operator), work and effort, and role of communication, motivation, and supervision in an industrial organization. (3 cr; prereq 2, 5 or 3 cr in statistics) Dunnette
- 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
166. **Opinion and Communication: Social Factors.** Examination of processes of opinion formation and change in relation to personality and social structure lays groundwork for analysis of flow of public communications through society and impact of selected types of mass communication on particular audiences. (3 cr; prereq Soc 1 or 120 or Psy 140 or #)
167. **The Measurement of Opinions and Attitudes.** Problems of sample survey techniques; preparation of questionnaires, methods of sampling, procedures in data analysis, social implications of polling, and applications of survey techniques in public affairs and in social science research. (3 cr; prereq 70 or equiv) Dunnette
169. **Quantitative Models in Psychology.** Applications of mathematics in construction of quantitative models for description and prediction of behavior; introductions to measurement of sensation, game theory, decision theory, and information theory. (3 cr; prereq Psy 5 and calculus or #) Greenberg
- 171-172†-173. **Clinical Psychology I: Assessment.** 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, Schofield, and others
- 190x.* **Project in Psychology.** Individual library study or experimental investigation. (Cr ar; prereq #) Staff
- 200-201-202. **Systematic Psychology.** Survey of fundamental methods and concepts in theoretical psychology; systematic, historical, and philosophical aspects. Major substantive areas exemplified by selected classical papers and current research. (3 cr per qtr; prereq #) Staff
- 207-208-209. **Group Dynamics.** Structure and functioning of social groups. Problems of social change, leadership, productivity, communication, social influence, etc. (2 cr per qtr; prereq #; offered 1963-64 and alt yrs) Bramel
- 210.* 211.* 212.* **Research Problems.** (Cr ar) Graduate staff
- 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)
- 219-220. **Psychology of Personality.** Major methods, problems, and concepts in the field of personality. Major theoretical approaches to personality, e.g., Murray, Cattell, Freud, etc. (3 cr per qtr; prereq abnormal psychology and completion of undergrad major in psychology or #) Rosen
- 221, 222, 223. **Seminar: Personality Research.** Theoretical and methodological problems in contemporary research concerning the psychology of personality. (Cr ar; prereq #) Garmez and staff
- 224, 225, 226. **Seminar: Advanced Clinical Child Psychology.** (1 cr per qtr; prereq CD 248 and #) Hafner
- 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 #) Lofquist
- 230, 231, 232. **Field work in Psychometrics and Applied Psychology.** (Cr ar; prereq written permission of inst) Berdie, Darley, Lofquist, Longstaff, Schofield, Wirt, others
- 235-236-237. **Clinical Practice in Counseling.** Experience in use of psychological and related methods in dealing with individuals. (1-3 cr per qtr; prereq consent of instructor and adviser) Berdie, Snoxell
- 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 #) Russell
- 244x.* **Research Problems in Experimental Psychodynamics.** (3 cr; prereq 243) Russell
246. **Psychoanalytic Theory.** Discussion of classical psychoanalysis. (3 cr; prereq 145, 172) Lindzey
247. **Mathematical Theories of Behavior.** Critical study of current mathematical theories of learning and perception. Survey and comparison of theories of Estes, Bush and Mosteller, Luce, and others. (3 cr; prereq Math 40 or equiv) LaBerge

- 250-251-252. **Advanced Seminar in 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
- 257-258-259. † **Methods of Research in Group Behavior.** Methodology of laboratory and field research applied to small groups. Practice and participation in field studies and laboratory experiments. Techniques of observation, sociometry, interviewing, etc. (3 cr per qtr; prereq ‡; offered 1962-63 and alt yrs) Aronson
- 260-261-262.* † **Seminar: Differential Psychology and Industrial Applications.** (3 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 either by analysis and interpretation of a set of research data, or by writing reports on advanced psychometric topics. (3 cr) Greenberg
- 271-272-273. † **Clinical Psychology II: Treatment.** Theory and practice of individual and group psychotherapy. (3 cr per qtr; restricted to PhD candidates in clinical psychology; prereq 173 and 246) Meehl, Williams, Schofield, Wirt
274. **Preclinical Practicum in Clinical Psychology.** Integration of clinical data. Precedes psychometric clerkship. Representative case materials presented and discussed; organization of data from the life history, diagnostic interview, physician's findings, and psychometric tests into a meaningful personality description, aiming to develop student's skills in diagnosis, prediction, and therapy. Training in use of special tests and techniques. (2 cr; prereq grad majors in clinical psychology; prereq 172, 291 or ‡291) Schofield and staff
- 275-276-277. **Seminar: Research in Student Personnel Work.** Presentation and discussion of research being conducted by University personnel workers. Proposed, completed, and research in process. (1 cr per qtr; prereq ‡)
- 281, 282, 283. **Seminar: Psychology of Marriage.** (Cr ar; prereq ‡) Neubeck
- 284-285-286. **Seminar: Psychology of Language.** (3 cr per qtr; prereq ‡) Jenkins
- 290-291. **Projective Techniques.** Theory, methodological considerations, and published studies of reliability and validity. Instruction in administration, scoring, and interpretation of some currently used devices, especially the Rorschach. (3 cr per qtr; prereq 145, 172) Rosen
- 292-293. **Seminar: Theoretical Problems of Group Functioning.** Theoretical problems in social psychology and the behavior of groups in connection with recent or current research. (2 cr per qtr; prereq ‡)
299. **Tabulating Equipment Laboratory.** Use of electric tabulating machines in treatment of research data. (1 cr; prereq PubH 110, 111, or equiv)

PUBLIC ADMINISTRATION

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 Training Program.

Candidates for admission to such courses of study must be eligible for admission to the Graduate School, and their preparation for graduate work in public administration must be approved by the staff. 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—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. 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.

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.

Advanced graduate students who wish to major in public administration with a view to teaching or governmental service are advised to become candidates for the doctorate in political science, with public administration as the field of concentration and with a minor or minors in closely related social science departments.

For further information, see the special bulletin, *Graduate Training in Public Administration*, or write to the Public Administration Center, University of Minnesota, Minneapolis 14.

PUBLIC HEALTH

Professor

Gaylord W. Anderson, M.D., Dr.P.H.
 Richard C. Bond, M.S., M.P.H.
 Herbert M. Bosch, M.P.H.
 Donald W. Cowan, M.D., M.S.
 Ruth E. Grout, M.P.H., Ph.D.
 James A. Hamilton, M.A., M.C.S.
 Marion I. Murphy, M.P.H., Ph.D.
 Theodore A. Olson, M.A., Ph.D.
 Leonard M. Schuman, M.S., M.D.
 James W. Stephan, M.B.S.
 Stewart C. Thomson, M.D., M.P.H.

George S. Michaelsen, M.S.
 Harold J. Paulus, M.S., Ph.D.
 Ruth von Bergen, M.P.H.

Assistant Professor

Eleanor M. Anderson, M.P.H.
 Clare L. Blanchard, M.P.H.
 George E. Williams, M.D.

Lecturer

Henry Bauer, Ph.D.
 Leslie W. Foker, M.D., M.P.H.
 William A. Jordan, D.D.S., M.P.H.

Associate Professor

Harry Foreman, M.D., Ph.D.
 Kathryn M. Fritz, M.S.
 Edith M. Lentz, 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 2 foreign languages or of 1 foreign language and option of a special research technique or a collateral field of knowledge.

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.

Doctor's Degree—Work leading to the Ph.D. degree is offered for a major in environmental health, epidemiology, or hospital administration. 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 dis-

cipline appropriate to their previous training. 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. Students will be admitted to the doctoral program in hospital administration only if they have had prior formal training and experience in hospital administration. For further information on this program, see the index reference to a special description of work in hospital administration.

[Inquiries concerning other work in public health, including courses of study leading to the degrees of master of public health and master of hospital administration, should be addressed to the Director of the School of Public Health, 1325 Mayo Memorial Building, University of Minnesota, Minneapolis 14.]

- 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, 3A or 50 and a course in bacteriology) Anderson, Thomson, Schuman
- 100B, C. Elements of Public Health II and III.** Group work on selected public health problems. (1 cr per qtr; prereq 100A or #) Staff
- 102. Environmental Sanitation.** Methods for promoting man's health and comfort by controlling environment. (3 cr; prereq 100A or ¶100A and #) Bosch, Olson
- 102A. Environmental Sanitation.** General principles of urban and rural sanitation; problems encountered by official health agencies. (2 cr; prereq 100A or ¶100A and #) Bosch, 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 or 110-111) 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) Anderson, Hamilton
- 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)
- 107A. Maternal and Child Health Program.** Community programs for major maternal and child health problems. (1 cr, §107; prereq 106 or #)
- 108. Introduction to Biostatistics and Statistical Decision.** Variation, frequency distribution; probability; significance tests; estimation; trends. Statistical approach to rational administrative decision making. Lectures and laboratory. (2 cr) Bearman, Johnson
- 109. Institutional Sanitation.** Sanitation practices in hospitals and other institutions. (3 cr; prereq hospital administrators or # and 100A) Bosch, Bond
- 110. Biostatistics I.** Role of statistics in research; estimation; sampling distribution; tests of significance; power; regression; correlation; other measures of association; standard distributions including normal, t , χ^2 , F , binomial, Poisson; special distributions arising from nonparametric procedures. (3 cr; prereq ¶111, Math 10 or #) Brown
- 111. Biostatistics Laboratory I.** Presentation of data; descriptive statistics; coding and short-cut computational procedures; use of desk calculators; practical application of principles and methods covered in 110. (2 cr; prereq ¶110) Briese, Loewenson
- 112.* 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 and 102, and #) Bosch
- 113.* Public Health Engineering—Field Investigations.** 113A: Water supplies. 113B: Waste disposal. 113C: Swimming pools and plumbing. (2 cr per qtr, §114; prereq engineering degree and # and 102) Bosch
- 114. Environmental Sanitation Programs.** Public health supervision of activities in urban and rural sanitation. (3 cr, §112, §113, or §116; prereq #) Bosch

- 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
- 116.° **Public Health Engineering Administration.** Administrative organization of environmental sanitation activities. (2 cr, §114; prereq #) Bosch
- 117-118-119.° **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
- 122s. **Public Health Administration Problems.** Budgeting, program planning, and appraisal of public health procedures. (3 cr; prereq 106) Anderson
- 123.° **Topics in Public Health.** Selected readings and problems. (Cr ar; prereq #) Staff
125. **Public Health Education.** Planning educational aspects of community health programs; group procedures; public relations; selection, development, and use of mass media. (2 cr; prereq #) Grout
- 125A. **Public Health Education.** Purposes; scope; methods and materials; planning, with special emphasis on hospitals. (1 cr; hospital administrators or #) Grout
127. **Occupational Health: Nursing Aspects.** Organization and administration of nursing service in industrial health programs. (1 cr)
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 #) Fritz, Williams
135. **Conservation of Hearing.** Detection, prevention, and amelioration of hearing impairments. (1 cr; prereq #) Boies and staff
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
139. **Advanced Field Practice in Public Health Nursing—Block Placement.** Opportunity for concentration on public health nursing field practice under supervision of co-ordinator of mental health program. (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. (3 cr; prereq #)
- 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
153. **The Hospital and the Community.** Functions and classifications of hospitals; organization and relation to health care and to public health agencies. (1 cr; prereq #) Stephan, Hamilton
- 154.° **Radiological Health I.** Orientation effects and study and control of radiation hazards in laboratories, hospitals, and industrial plants. (Cr ar; prereq #) Foreman
- 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
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, personnel policy formation, human relations. (6 cr) Hamilton, Stephan, Lentz
161. **History and Development of Hospitals.** Functions; ownership and control; promoting and building new hospitals; integrated service; national associations and foundations. (3 cr) Hamilton, Stephan
- 162-163. **Principles of Organization and Management of Hospitals.** Departmental structures and functions; organizational principles and practice. (3 cr [162], 6 cr [163]) Stephan, Hamilton
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, Hamilton, Bieter

166. **Hospital Clerkship.** Assignment to local hospital for survey or solution of special problem. (5 cr) Stephan
167. **Management Problems in Hospital Administration.** Assignment and solution of specific managerial problems. (6 cr; prereq 162, 163, ¶164) Hamilton
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) Hamilton, Lentz, Stephan
170. **Seminar: 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, K Fritz
- 170A. **Public Health Nursing.** Scope; relationship to other aspects of public health. (1 cr, §170; prereq §) Murphy, K Fritz
- 171°-172.° **Studies in Public Health Nursing.** Application of scientific method to selected topics; preparation of a study. (3 cr per qtr; prereq public health nurses only) Murphy
173. **Advanced Field Practice in Public Health Nursing: Functional Area.** Opportunity for field placement in suitable functional area including administration, supervision, consultation, or teaching under guidance of faculty. (Cr ar; prereq public health nurses only, 174, 177 or §) Murphy, K Fritz, von Bergen
- 174A-B. **Seminar in Administration, Supervision, and Consultation.** Analysis of selected aspects of administrative, supervisory, and consultant process in public health nursing situations. (2 cr per qtr; prereq public health nurse, 171, 175 or §) Murphy
- 175-176-177. **Advanced Practice in Public Health Nursing.** Dynamics of human behavior; application to public health nursing practice on staff, supervisory, administrative, consultant levels through analysis of case material. (3 cr per qtr; prereq §) Williams, K Fritz, von Bergen
178. **Seminar in Public Health Nursing Consultation.** (2 cr; prereq §) K Fritz
180. **Introduction to Biostatistics.** Variation; frequency distribution; probability; estimation; significance tests; binomial, normal, Poisson distributions; serial dilutions; most probable number. (6 cr; prereq sanitation and sanitary engineering students only, others §) Bearman
- 181-182-183. **Principles and Methods in Public Health Education.** Role of public health educator; group procedures; communication theory; mass media; program planning and evaluation. (3 cr per qtr; prereq §) Grout
190. **Field Work in Health Education.** Supervised field experience. (Cr ar; prereq 183, 227) Grout
- 191.° **Science of Human Nutrition.** Surveys; nutritional status; undernutrition; malnutrition; dietetics in social relief and medical practice. (3 cr; prereq §) J Anderson, Keys
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. **Rehabilitation Nursing and Long-Term Patient Care.** Nursing problems associated with rehabilitation; selected experiences correlated with seminars. (Cr ar; prereq 171, 175) E Anderson and staff
200. **Research.** Opportunities will be offered by the School 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 §) Bosch
213. **Seminar: Epidemiology.** (Cr ar; prereq §) Schuman
214. **School Health Programs.** Review of major health problems among school children, methods of providing and evaluating school health services. (2 cr; prereq 107 or §)
215. **Maternal and Child Health.** Administration of well-child and antepartum conferences; psychosomatic problems of children. (Cr ar; prereq MD, §)
- 227.° **Problems in Public Health Education Programs.** Independent study and experimentation in health education. (Cr ar; prereq §) Grout
230. **Field Practice in Environmental Sanitation.** (Cr ar; prereq §) Bosch
- 241.° **Epidemiology of Noncommunicable Diseases.** Application of basic epidemiologic principles to noncommunicable diseases and to trauma; selected disease examples. (3 cr; prereq 104) Schuman

- 261-262-263. **Alternative Patterns for Meeting Health Care Needs.** Future role of hospitals in light of patient needs and community services. (3 cr per qtr; prereq #) Hamilton, Stephan, Lentz
264. **Seminar on Medical Care Patterns Abroad.** Readings, discussion, guest lectures on relations between health services and other social institutions. (3 cr; prereq #) Stephan, Lentz
265. **Seminar on Research Studies on Health Services.** Appraisal of design, instruments, field-work procedures, and findings of existing studies. (3 cr; prereq #) Lentz
266. **Hospital Administration Topics.** Independent study under tutorial guidance on selected problems, current issues. (Cr ar; prereq #) Hamilton

RADIOLOGY

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

RHETORIC

Courses in Which Graduate Credit May Be Earned

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
251. **Seminar in Listening Comprehension.** (2 cr; prereq undergrad spch major, #) Nichols

ROMANCE LANGUAGES

Professor

Eugene H. Falk
Walter T. Pattison
Emmert M. Brackney
Raymond L. Grismer
Aram Vartanian

Associate Professor

Rodolfo O. Floripe
Elizabeth Nissen
Armand A. Renaud
Karl L. Selig

Assistant Professor

John H. Matthews
Richard A. Narvaez
John M. Sullivan

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. 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.

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 88.

French

100. **French Phonetics.** (3 cr; prereq French major or #) Sullivan
- 103-104-105. **French Syntax and Composition.** (2 cr per qtr; prereq French major or #) Sullivan
110. **Rise of French Romanticism.** (3 cr; offered 1964-65 and every 3rd yr) Falk
111. **Nineteenth-Century Literature: The Drama.** (2 cr; offered 1963-64 and every 3rd yr) Falk
121. **Pre-Renaissance and Pléiade Poetry.** (3 cr; offered 1962-63 and every 3rd yr) Renaud
124. **Montaigne and Pascal.** (3 cr; offered 1962-63 and every 3rd yr) Renaud

125. **Renaissance and Baroque Drama: Corneille and the Origins of the Classical Drama.** (3 cr; offered 1964-65 and every 3rd yr) Renaud
126. **The Classical Tragedy: Racine.** (3 cr; offered 1962-63 and every 3rd yr) Renaud
127. **Classical Comedy: Molière.** (3 cr; offered 1963-64 and every 3rd yr) Renaud
128. **French Poetry from d'Aubigné to La Fontaine.** (3 cr; offered 1963-64 and every 3rd yr) Renaud
129. **The Novel of the Seventeenth Century.** (3 cr; offered 1964-65 and every 3rd yr) Renaud
130. **The Poetry of Victor Hugo.** (2 cr; offered 1964-65 and every 3rd yr)
131. **Baudelaire and Parnassian Poetry.** (2 cr; offered 1963-64 and every 3rd yr) Falk
132. **Symbolist Poets: Verlaine, Rimbaud, Mallarmé.** (2 cr; offered 1964-65 and every 3rd yr)
140. **The Novel of the Eighteenth Century.** (3 cr; offered 1963-64 and every 3rd yr) Vartanian
141. **Eighteenth-Century Dramatic Literature.** (3 cr; offered 1964-65 and every 3rd yr) Vartanian
142. **Voltaire.** (3 cr; offered 1964-65 and every 3rd yr) Vartanian
143. **Diderot.** (3 cr; offered 1964-65 and every 3rd yr) Vartanian
144. **Rousseau.** (3 cr; offered 1963-64 and every 3rd yr) Vartanian
148. **The Drama of the Twentieth Century: Claudel, Giraudoux, Anouilh, Montherlant, Camus, Sartre.** (3 cr; offered 1962-63 and every 3rd yr) Falk
153. **Balzac.** (3 cr; offered 1962-63 and every 3rd yr) Vartanian
154. **Stendhal.** (3 cr; offered 1962-63 and every 3rd yr) Vartanian
155. **Flaubert, Maupassant, and Narrative Techniques.** (3 cr; offered 1964-65 and every 3rd yr) Falk
156. **Zola, Goncourt, and the Naturalistic Novel.** (3 cr; offered 1964-65 and every 3rd yr) Vartanian
158. **Proust.** (2 cr; offered 1963-64 and every 3rd yr)
159. **The Art of the Novel: Mauriac and Malraux.** (3 cr; offered 1964-65 and every 3rd yr) Falk
161. **From Gide to the Existentialist Novels of Sartre and Camus.** (3 cr; offered 1964-65 and every 3rd yr) Falk
165. **Poetry in the Twentieth Century: Apollinaire, Valéry, Eluard.** (2 cr; offered 1964-65 and every 3rd yr)
- 171-172-173. **History of the French Language: Old and Middle French Periods.** (3 cr per qtr; prereq 1 yr Latin or #; offered 1962-63 and alt yrs) Brackney
- 175-176-177. **French Literary Doctrines from the Pléiade to the Present.** (2 cr per qtr; offered 1962-63 and every 3rd yr) Falk
- 204-205-206. **Reading in Old French Literature.** (2 cr per qtr) Brackney
- 207-208-209. **Old Provençal. Literature; poetry of the troubadours.** (2 cr per qtr) Brackney
210. **French Seminar: Eighteenth Century. History of "Sensibilité" in the 18th century through the Revolution.** (3 cr) Vartanian
222. **French Seminar: The Baroque in Sixteenth- and Seventeenth-Century Literature.** (3 cr) Renaud
223. **Seminar: Classical Period. Religious thought in 17th-century literature.** (3 cr) Renaud
- 230-231-232. **Research Methods and Material.** (1 cr per qtr) Grismer
- 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)
- 259-260-261.* **Directed Readings in Romance Languages.** (Cr depends upon amount of work accomplished)

Italian

- 159-160. **Dante.** (3 cr per qtr; prereq 1 course above 50; student may enter either qtr with #; offered 1963-64 and alt yrs) Nissen
- 161-162. **The Sixteenth Century.** (3 cr per qtr; prereq 1 course above 50; offered 1962-63 and alt yrs) Selig
164. **Dante in English.** (3 cr; prereq #; offered 1962-63 and alt yrs) Nissen

172. **Modern Drama** (Giacosa, Pirandello, etc.). (3 cr; prereq 1 course above 50; offered 1962-63 and alt yrs) Nissen
173. **Boccaccio**. (3 cr; prereq 1 course above 50; offered 1963-64 and alt yrs) Nissen
174. **Petrarch**. (3 cr; prereq 1 course above 50; offered 1962-63 and alt yrs) Selig
- 175-176. **The Italian Novel**. 175: Manzoni's *Promessi Sposi*, Verga's *Mastro Don Gesualdo*, Fogazzaro's *Piccolo Mondo Antico*, Deledda's *Elias Portolu*. 176: Three novels selected from the works of Svevo, Pirandello, Bacchelli, Palazzeschi, Silone, Moravia, Pratolini, Vittorini, Calvino. (3 cr per qtr; prereq 60-61-62 or #; offered 1962-63 and alt yrs) Nissen
180. **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 70 or #; offered 1963-64 and alt yrs) Selig
185. **Survey of Italian Literature**. (3 cr; prereq 1 course above 50; offered 1963-64 and alt yrs) Selig
186. **Survey of Italian Literature**. (3 cr; prereq 1 course above 50; offered 1963-64 and alt yrs) Selig
- 259-260-261. **Directed Readings in Romance Languages**. (Cr depends upon amount of work accomplished) Nissen, Selig

Spanish

- 107-108-109. **Structure of Modern Spanish**. A scientific approach. Syntax. Phonology, word formation, and dialectal differences. (3 cr per qtr; prereq 60 or # or ¶60) Narvaez
- 110-111-112. **Spanish Literature: Nineteenth Century**. (3 cr per qtr; prereq 65, 66, 67 or 68, 69; offered 1962-63 and alt yrs) Pattison
115. **Spanish Literature of the Seventeenth Century: The Drama**. (3 cr; prereq 65, 66, 67 or 68, 69; offered 1963-64 and alt yrs) Grismer
116. **Spanish Literature of the Seventeenth Century: The Novel**. (3 cr; prereq 65, 66, 67 or 68, 69; offered 1963-64 and alt yrs) Grismer
117. **Spanish Literature of the Seventeenth Century: Poetry**. (3 cr; prereq 65, 66, 67 or 68, 69; offered 1963-64 and alt yrs) Grismer
120. **The Ballad**. (3 cr; prereq 65, 66, 67 or 68, 69; offered 1963-64 and alt yrs) Selig
130. **Cervantes: Don Quijote**. (3 cr; prereq 65, 66, 67 or 68, 69; offered 1962-63 and alt yrs) Selig
131. **The Picaresque Novel**. (3 cr; prereq 65, 66, 67 or 68, 69; offered 1963-64 and alt yrs) Selig
140. **Latin-American Literature: Poetry**. Silva, Dario, Neruo, Chocano, Herrera y Reissig, Lugones, Augustini, Mistral, Ibarbourou, Storni, López, Verlarde and Neruda. (3 cr; prereq 65, 66, 67 or 68, 69 or 76; offered 1962-63 and every 3rd yr) Floripe
141. **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 68, 69 or 76; offered 1962-63 and every 3rd yr) Floripe
142. **Latin-American Literature: Novel**. Gallegos, Azuela, Rivera, Güiraldes, Barrios, Gálvez, Lynch, Ciro Alegria. (3 cr; prereq 65, 66, 67 or 68, 69 or 76; offered 1962-63 and every 3rd yr) Floripe
- 143-144-145. † **Colonial and Nineteenth-Century Latin-American Literature**. (3 cr per qtr; prereq 65, 66, 67 or 68, 69 or 76; offered 1963-64 and every 3rd yr) Floripe
- 146-147-148. † **Spanish-American Novel and Short Story**. (3 cr per qtr; prereq 65, 66, 67 or 68, 69 or 76; offered 1964-65 and every 3rd yr) Floripe
155. **Spanish Literature of the Sixteenth Century: The Novel**. (3 cr; prereq 65, 66, 67 or 68, 69; offered 1962-63 and alt yrs) Grismer
156. **Spanish Literature of the Sixteenth Century: The Drama**. (3 cr; prereq 65, 66, 67 or 68, 69; offered 1962-63 and alt yrs) Grismer
157. **Spanish Literature of the Sixteenth Century: Poetry**. (3 cr; prereq 65, 66, 67 or 68, 69; offered 1962-63 and alt yrs) Grismer
- 161-162-163. **Hispano-Arabic Literature and Culture**. (2 cr per qtr; prereq 21 and #) Irving
- 171-172-173. † **History of the Spanish Language**. (1 cr per qtr; prereq 20 and 1 yr Latin or #) Grismer
174. **Contemporary Spanish Literature: Drama**. Benavente, Martínez Sierra, Linares-Rivas, Álvarez Quintero, Valle Inclán, Marquina, García Lorca, and Casona. (3 cr; prereq 65, 66, 67 or 68, 69; offered 1963-64 and alt yrs) Pattison

175. **Contemporary Spanish Literature: Prose.** Unamuno, Azorin, Baroja, Valle Inclán, Ortega y Gasset, Perez de Ayala, Gómez de la Serna. (3 cr; prereq 65, 66, 67 or 68, 69; offered 1963-64 and alt yrs) Pattison
176. **Contemporary Spanish Literature: Poetry.** Juan Ramón, Jiménez, Unamuno, Antonio and Manuel Machado, Valle Inclán, Garcia Lorca, Alberti, Moreno Villa, Aleixandre, León Felipe, Guillén and Salinas. (3 cr; prereq 65, 66, 67 or 68, 69; offered 1963-64 and alt yrs) Pattison
180. **The Eighteenth Century: Studies in the Principal Writers.** Feijóo, Jovellanos, Cadalso, Moratin, and others. (3 cr; prereq 65, 66, 67 or 68, 69) Selig
- 230-231-232. **Research Methods and Materials.** (1 cr per qtr; offered 1963-64 and alt yrs) Grismer
- 241-242-243.* **Old Spanish Philology.** (2 cr per qtr; offered 1962-63 and alt yrs) Grismer
- 244-245-246.* **Old Spanish Literature.** Every year a different genre is studied, such as the epic. Subject decided by arrangement with students. (2 cr per qtr; offered 1963-64 and alt yrs) Irving
- 250-251-252.* **Spanish Seminar.** (2 cr per qtr) Pattison, Selig
- 253-254-255.* **Seminar: Spanish-American Literature.** (2 cr per qtr; offered when feasible)
- 259-260-261. **Directed Readings in Romance Languages.** (Cr depends upon amount of work accomplished)

SCANDINAVIAN

| Professor | Associate Professor | Assistant Professor | Visiting Lecturer |
|----------------|---------------------|---------------------|-------------------|
| Arik Gustafson | Cecil Wood | Marion Nelson | Jules Zentner |

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 1 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.

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 88.

Courses identified by the ff symbol require no knowledge of the Scandinavian languages except for majors in Scandinavian.

- 157-158-159.† **Old Norse Language and Literature.** (Same as Ger 157-158-159) Knowledge of one Germanic dialect other than modern English recommended. (3 cr per qtr; offered when feasible) C Wood
- 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 6 or 12, or 8 cr in literature) Gustafson
- 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 6 or 12, or 8 cr in literature) Gustafson
- 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 6 or 12, or 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 6 or 12, or 8 cr in literature) Gustafson
- 173.*§§ **The Contemporary Scandinavian Theater.** Its "experimental" trends both in dramatic composition and staging. (3 cr; prereq 6 or 12, or 8 cr in literature) Gustafson

- 191-192-193. Readings in the Scandinavian Literatures. Intensive readings in representative texts—Danish, Norwegian, or Swedish. (3 cr per qtr; prereq 6 or 12) Gustafson
- 215-216-217.* Studies in Scandinavian Romanticism. (3 cr per qtr; offered 1962-63 and alt yrs) Gustafson
- 218-219-220.* Studies in Late Nineteenth-Century Scandinavian Literature. (3 cr per qtr; offered 1963-64 and alt yrs) Gustafson
- 221-222-223.* Dramatic Interpretative Problems in Strindberg. (3 cr per qtr) Gustafson
- Art 140. Scandinavian Architecture. (3 cr; prereq 9 cr in history of art or 9 cr in literature or history with Δ) Nelson
- Art 141. Scandinavian Painting. (3 cr; prereq 9 cr in history of art or 9 cr in literature or history with Δ) 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 Δ) Nelson
- Ger 113. Gothic. (3 cr; prereq Ger 80 and 11 cr above Ger 69 or equiv; offered 1963-64) C Wood
- Ger 114-115. Methods of Comparative Germanic Linguistics. (3 cr per qtr; prereq Ger 113; offered 1963-64) C Wood
- Phil 137.§§ Kierkegaard and Scandinavian Philosophy. (3 cr; prereq 1 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) Johnson
- Pol 146.§§ Social Legislation and Social Institutions in the Scandinavian Countries. (3 cr; prereq Pol 2 or 5 or Soc 1) Johnson
- Soc 117.*§§ Scandinavian Folk Movements: Their Social and Political Significance. (3 cr; prereq Soc 1 or #) Johnson

SLAVIC AND ORIENTAL LANGUAGES

Associate Professor

Richard B. Mather
Thomas B. Irving
Pearl C. Niemi

Assistant Professor

Edward M. Copeland, Jr.

Lecturer

Wassilij Alexeev

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. (3 cr per qtr; prereq 73) Irving
- Arab 151-152-153. Directed Readings. (1-3 cr per qtr; prereq 63 or #) Irving
- Arab 161-162-163. Hispano-Arabic Culture. (3 cr per qtr; prereq Span 21 and #) Irving
- Arab 191H-192H-193H. Honors Course: Research. (1-3 cr per qtr; prereq 153 or #) Irving

Chinese

- Chin 101-102-103. Advanced Chinese. Readings in modern vernacular literature; introduction to classical language. (3 cr per qtr; prereq 53 or equiv) Mather
- Chin 110-111-112. Chinese Literature in Translation. Survey of Chinese literature from first millennium B.C. to present. (3 cr per qtr; prereq 6 cr in literature; knowledge of Chinese not required; offered 1963-64 and alt yrs) Mather
- Chin 151-152-153. Directed Readings. (1-3 cr per qtr; prereq 103 or #) Mather
- Chin 191H-192H-193H. Honors Course: Research. (1-3 cr per qtr; prereq 153 or #) Mather

Indic

- Ind 110. Indian Literature in Translation. From the Vedas to the present. (3 cr; prereq 6 cr in literature or 3 cr in courses pertaining to India; offered when feasible) Staff

Japanese

- Jap 101-102-103. Advanced Japanese.** Readings in modern prose and poetry; introduction to the classical language. (3 cr per qtr; prereq 53) Copeland
- Jap 110-111-112. Japanese Literature in Translation.** Chronological survey of literature from the 8th century A.D. to present. (3 cr per qtr; prereq 6 cr in literature; knowledge of Japanese not required; offered 1962-63 and alt yrs) Copeland
- Jap 151-152-153. Directed Readings.** (1-3 cr per qtr; prereq 103 or #) Copeland
- Jap 191H-192H-193H. Honors Course: Research.** (1-3 cr per qtr; prereq 153 or #) Copeland

Russian

- 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 not required) Niemi
- Slav 113-114-115. Old Church Slavic (Old Bulgarian).** Introduction to Slavic linguistics. (3 cr per qtr; prereq Clas 56 or equiv; offered 1962-63) Staff
- Russ 125-126-127. History of the Russian Language.** (3 cr per qtr; prereq 53 or equiv) Staff
- Russ 131-132-133. Russian Poetry: Nineteenth Century.** (3 cr per qtr; prereq 73 or #) Niemi
- Russ 141-142. Dostoevsky.** Analytic approach to study of the novel of Dostoevsky. (3 cr per qtr; prereq 9 cr in literature; offered when feasible) Niemi
- Russ 151-152-153. Directed Readings.** (1-3 cr per qtr; prereq 73 or #) Staff
- Slav 161-162-163. Comparative Balto-Slavic Grammar.** Philological and linguistic study of relations among the Baltic and Slavic languages; Balto-Finnic and Slavo-Finnic relations. (2 cr per qtr; prereq Russ 6 or Clas 56 [general linguistics], or equiv; offered when feasible)

Oriental

- 196. Proseminar in East and South Asia.** (See Anth 196, Hist 196, and Pol 196) (3 cr)

SOCIAL WORK

Professor

John C. Kidneigh
Werner W. Boehm
Gisela Konopka
Hyman S. Lippman
Elio D. Monachesi
Ruby B. Pernell
Henriette E. Saloshin
Lyndell N. Scott
Dorothy A. Whitmore

Associate Professor

Edward W. France
Mayo K. Newhouse
Anne W. Oren
Helen C. Yesner

Assistant Professor

Miriam R. Cohn
Beulah E. Compton
John A. Crane
William T. Hall

Philip C. Hovda
Laurence F. Merl
Ida Rapoport

Instructor

James H. Bridges
Dagny Johnson
Margaret F. Steen

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 1 or more courses in at least 3 of these social sciences, and a course in statistics.

Application blanks and instructions regarding admission may be secured from the School of Social Work, University of Minnesota, Minneapolis 14.

Applications and transcripts in duplicate must be filed at least 4 weeks 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 ex-

perience 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. For the Ph.D. degree, 2 foreign languages with the option of substituting for 1 of these a special research technique or a collateral field of knowledge.

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 seminar research papers or a single research report requiring independent work under faculty supervision which shows capacity for critical evaluation and analysis must be presented. Preferably all 9 credits should be earned under the supervision of 1 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 dis-

tinctly 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 Readings Courses

- 201, 202, 203. **Special Topics in Social Work.** (Cr ar)
 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) Yesner, Compton, Guzie, Hovda, Steen, Rapoport, Bridges, Johnson
 215-216-217. **Field Instruction in Social Work II.** Field practice in social work process under direct supervision. (Cr ar; prereq 212) 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, Pernell

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 inter-group 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, Oren, Hall
 228. **Social Policy and Programs IV-V.** Continuation of 227. (3 cr; prereq 227) Newhouse
 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) Boehm
 243. **International Social Welfare.** (3 cr; prereq §) Boehm
 245x. **General Seminar in the Social Services.** (Cr ar; prereq grad social work students) Newhouse

D. Human Growth and Behavior

- 248A-B. **Concepts of Human Growth and Behavior in Social Work Practice I.** Socio-psycho-biological factors associated with individual and group development as applied to social work practice. (3-2 cr; prereq ¶210 or §) Saloshin, Lewis, Hall, Crane
 249A-B. **Concepts of Human Growth and Behavior in Social Work Practice II.** Socio-psycho-biological factors associated with individual and group development as applied to social work practice. (2 cr per qtr; prereq ¶211 or §) Saloshin, Lewis, Hall, Crane
 250A-B. **Concepts of Human Growth and Behavior in Social Work Practice III.** Psychiatric and psychological factors associated with individual and group development as applied to social work practice. (2-1 cr; prereq ¶212 or §) Lippman, 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) Lewis, 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, Crane, Hall
 256x. **General Seminar in 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) Pernell
263. **Administration in Social Group Work.** Principles applied to subexecutive positions in agencies offering group work services. (2 cr; prereq 260, 278) Pernell
264. **Seminar in Social Work Administration.** (Cr ar; prereq 228 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, Boehm
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 in 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, Pernell
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. (2 cr; prereq 275, ¶211) Pernell
277. **Social Group Work III.** Intensified understanding of individualization process in working with groups. (2 cr; prereq 276, ¶212) Pernell
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
- 281A-B. **Use of Program in Groups I.** Understanding and use of program as a tool in meeting the needs of the individual in the group, and of the community. Consideration of skill and planning in executing program activities. (1 cr per qtr; prereq 275) Guzie
282. **Use of Programs in Groups II.** Program planning and execution related to principles and practices of the discussion method. (1 cr; prereq 275) Guzie
- 285-286-287. **Special Studies in Social Work.** (Cr ar; fulfills 9 cr requirement for degree project) Francel, Crane
- 290-291. **Seminar: Recent Research in Social Work.** (Cr ar; primarily for doctoral students) Scott
- 295x. **General Seminar in Social Work Methods.** (Cr ar; prereq #) Scott, Konopka
- 298-299-300. **General Seminar in Social Work.** (Cr ar; prereq MSW degree) Kidneigh, Saloshin, Scott

SOCIOLOGY

Professor

Elio D. Monachesi
Roy E. Carter
Roy C. Francis
Edward Gross
Reuben L. Hill, Jr.
Don A. Martindale
Arnold M. Rose
John Sirjamaki

Murray A. Strauss

Marvin J. Taves
George B. Vold
Malcolm M. Willey

Assistant Professor

John Forster

Associate Professor

Robert L. Hall
Arthur L. Johnson
Gregory P. Stone

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) 2 foreign languages or (b) 1 foreign language and the option of a special research technique or a collateral field of knowledge.

Master's Degree—Offered under Plan A except in special cases when Plan B may be followed by petition and approval of the graduate faculty.

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 expected to present course work and to pass a written comprehensive examination in 3 subareas at least 2 of which must be from subfield A, including subarea III.

Candidates for the degree of doctor of philosophy are expected to pass comprehensive written examinations in all subareas of subfield A and in four 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.

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 241.

- 100. **Contemporary Penology.** More important developments in recent attempts at treatment of criminals and prevention of crime. (3 cr; prereq 1, 53, or #) Vold
- 101. **Criminological Theories: Historical and Contemporary.** Evaluation of the major historical and contemporary theories of criminal behavior. (3 cr; prereq 1, 53, or #) Vold
- 102. **Adult Parole and Probation.** Critical examination of problems and practices in supervision of adult criminals. (3 cr; prereq 1, 53 or #; offered 1962-63 and alt yrs) Vold
- 104. **Police Problems and Practices in the United States.** Personnel, organization, and public relations of police forces; successful techniques of integrating police work with other community agencies. (3 cr; prereq 1, 53, or #; offered 1963-64 and alt yrs) Vold
- 106. **Planning.** (Same as Arch 104 and Pol 123) Social, economic, political, geographic, and technical phases of city planning. (3 cr) Broek, Rose, Sirjamaki, Vivrett, Warp
- 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 #) Francis
- 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 #) Francis
- 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 #) Sirjamaki
- 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) Ellingston
- 120x. **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
121. **Advanced Social Psychology.** Methods of acquiring knowledge in social psychology; analysis of outstanding pieces of research concerned with social psychology of small groups, neurotic behavior, mass behavior, and the making of political and economic choices. Familiarizes student with current thinking and research in this field in light of concepts and theories presented in the 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 #) Vold
123. **Minority Group Relations.** Interaction of social and cultural groups in America. 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
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-qtr sequence with Psy 167 and Jour 115. (3 cr; prereq 1 or 120 or Psy 140 or #) Carter
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, CD 80 and #) Hill
- 140x. **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, Sirjamaki
- 141x. **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.** (3 cr; prereq 1, or #) Johnson, Taves
143. **The Newspaper as a Social Institution.** (3 cr; prereq 1, or #; offered when feasible)
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 #) Gross
145. **Urban Sociology.** Urban ecology; urban institutions and the urban way of life. (3 cr; prereq 1 or #) Sirjamaki
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
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 #) Forster
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 #; offered 1963-64 and alt yrs) Rose, Stone
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 #) Taves
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 #) Taves

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 §) Taves
- 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 §) Taves
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) Monachesi, Taves
182. **Statistical Methods.** Selected problems of social relationship described, analyzed, and interpreted by means of the common statistical methods. (3 cr; prereq 45 or equiv) Francis
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) Francis
- 184-185-186. **Field Work and Laboratory Training in Social Research.** Open to students whose records in statistical and research courses indicate ability to carry on individual research projects to advantage under supervision. (2-3 cr per qtr; prereq 45 or 182 or ¶45 or ¶182) Francis, Stone, Taves

Seminars

- 201-202.*† Seminar: Research Problems in Crime and Social Conflict. (2 cr per qtr) Vold
- 203-204-205.*† Seminar: Research Problems in Juvenile Delinquency. (2 cr per qtr; offered when feasible) Monachesi
- 210-211-212.*† Seminar: Problems in Population Research. (2 cr per qtr; offered 1962-63 and alt yrs) Francis
- 220-221-222.*† Seminar: Social Psychology. (2 cr per qtr) Rose
- 223-224-225.*† Seminar: Research in Problems of Modern Mass Society. (2 cr per qtr; offered when feasible)
- 226.* Seminar: Family Development Theory. (2 cr; prereq §; offered spring 1963 and alt yrs) Hill
- 227-228.* Seminar: Contemporary Research on Marriage and the Family. (3 cr per qtr; offered winter and spring 1963 and alt yrs) Hill
- 230-231-232.*† Seminar: Research in Group Structure and Function. (2 cr per qtr) Stone
- 233-234-235.*† Seminar: Methods for the Evaluation of Social Action Programs. (2 cr per qtr; offered 1962-63 and alt yrs)
- 238-239.*† Seminar: Principles of Sociology. (3 cr per qtr) Sirjamaki
- 241-242-243.*† Seminar: Research Problems in the Family. (2 cr per qtr; offered 1963-64 and alt yrs) Johnson
- 245-246.*† Seminar: Research in Urban Sociology. (2 cr per qtr; offered 1963-64 and alt yrs)
- 247-248-249.* Seminar: Research in Large Scale Organization. (2 cr per qtr) Gross
- 251-252-253. Selected Problems in Comparative Sociology. (2 cr per qtr) Forster
- 260-261-262.*† Seminar: Rural Sociology. (2 cr per qtr; offered 1963-64 and alt yrs)
- 263.* Seminar: Research Methods in Rural Sociology. (2 cr; offered when feasible)
- 270-271-272.*† Seminar: Social Theory. (2 cr per qtr) Martindale
- 280-281-282.*† Seminar: Recent Developments in Sociological Research Techniques. (2 cr per qtr; offered when feasible) Francis
- 284-285-286.*† Seminar: Statistical Theory in Relation to Social Theory and Practice. (2 cr per qtr) Monachesi
- 297-298-299.† General Seminar. (Cr ar) Graduate staff

SOILS

Professor

William P. Martin
George R. Blake
Paul M. Burson
Alfred C. Caldwell
John M. MacGregor
Cornelius A. Van Doren

Associate Professor

Harold F. Arneman
Richard H. Rust
Edwin L. Schmidt

Assistant Professor

Donald C. Baker
Rouse S. Farnham
Janis Grava

Research Associate

Raymond R. Allmaras
William C. Burrows
Charles E. Clapp
Robert Holt

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 soils, the student must satisfy the graduate faculty that his preparation is adequate.

Major and Minor—A graduate student in soils may concentrate on such areas of soils as classification, chemistry, fertility, microbiology, or physics. The course of study will vary with the requirements of the area and the interests of the student, and in any case will be guided by and under the direct supervision of the major adviser. A minor 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 soils will take the courses acceptable to the minor adviser.

Language Requirement—For the Master's degree, none. For the Ph.D. degree, either (a) 2 foreign languages, or (b) 1 foreign language and the option of a special research technique or a collateral field of knowledge may be submitted.

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.

119. **Intermediate Soils.** (Same as 19) Graduate students required to do extra work. (4 cr; prereq InCh 5) Arneman, Martin
121. **Soils of Minnesota.** (Same as 21) Graduate students required to do extra work. (3 cr; prereq 1 or 3 or 19) Farnham
- 123.* **Fertilizers.** History of the fertilizer industry; 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 21 or 121 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. (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 3 or 19 or 119) MacGregor
- 128A. **Soil Chemistry Laboratory.** Methods of chemical analysis in soils. (2 cr; prereq 128 or ¶128) MacGregor

- 130x.* **Special Problems in Soils.** Research, readings, instruction. (2-4 cr; prereq 1 or 3 or 19 or 119)
- 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. (3 cr; prereq physical chemistry or #) Rust
- 132.* **Soil Fertility.** Plant root-soil relationships; chemistry of essential elements in the soil and plant; diagnosing soil deficiencies. (3 cr; prereq 3 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 3 or 19 or 119; offered 1963-64 and alt yrs) 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, Arman, Rust, Farnham, Baker
- 203x. **Seminar in 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, Arman, Rust, Farnham, Baker
214. **Radioisotope Techniques Applied to Biology.** 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; enrollment limited to 10; prereq a course in nuclear physics) Caldwell, Linck

SPEECH AND THEATER ARTS

Professor

Donald K. Smith
 Kenneth L. Graham
 Ernest H. Henrikson
 William S. Howell
 Frank M. Lassman
 Ralph G. Nichols
 David W. Thompson
 Frank M. Whiting
 E. William Ziebarth

Associate Professor

Arthur H. Ballet
 Ernest G. Bornmann
 Wendell J. Josal
 Robert D. Moulton
 Robert L. Scott
 Clark D. Starr

Assistant Professor

Gerald Siegel

Prerequisites—For major work, 18 credits in speech. A comprehensive entrance examination is a prerequisite for graduate work in theater.

Language Requirement—For the Master's degree, one foreign language. For the Doctor's degree, either (a) 2 foreign languages or (b) 1 foreign language and the option of either 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 speech 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, interpretative reading, public address, radio and television, rhetoric, speech pathology, theater, voice science.

Additional reading requirements in dramatic literature for a candidate emphasizing theater are to be selected with the approval of his adviser.

Doctor's Degree—In consultation with his major adviser the candidate will elect three of the following areas of study: theater, oral interpretative reading, rhetoric, speech pathology, radio and television, voice science, public address, audiology. The choice of a minor is subject to the approval of the major and minor advisers.

The student may earn the Ph.D. degree either in the field of speech pathology and audiology or in speech and theater arts.

Additional reading requirements in dramatic literature for a candidate emphasizing theater are to be selected with the approval of his adviser.

- 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) Howell, Scott
- 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; offered 1962-63 and alt yrs) Thompson
- 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) Howell, Smith, Bormann
- 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; offered 1963-64 and alt yrs) Thompson
- 109.* **Classical Rhetoric.** Greek and Roman theories of speech making; historical and philosophic context and influence on education. (3 cr; prereq 5, and Δ) Scott
- 110.* **History and Criticism of British Public Address.** British orators, their works, the historical setting. British rhetorical theory. (3 cr; prereq 5, and Δ) Scott
- 111, 112, 113.* **Stage Direction.** Theory; preparation of the prompt book with exercises in blocking. Rehearsal problems; direction of 1 full-length and 2 one-act plays. Management and staging. (3 cr per qtr; prereq 5, 31, 32, 33, 34, 90 or 92, 91 and Δ) Whiting
- 115, 116. **Playwriting and Production.** Creative practice in dramatic construction. The one-act play. The full-length play. (3 cr per qtr; prereq 5, 31, 32, or Δ; 116 offered when feasible) 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 5, 31, 32, or Δ) Thompson
- 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
- 124.* **Experiments in General Speech.** Correlates of speech skills, audience reactions, and speech improvement. (3 cr; prereq 5, Psy 2; offered when feasible)
- 126.* **History and Criticism of Public Address.** Historical and critical studies of oratory. Orators: education and training, style, speech composition, topics and issues, historical settings. (3 cr; prereq 5, Psy 2) Bormann
127. **Language Training for the Deaf.** Language problems resulting from marked and/or early deafness. Methods of developing and teaching language to the deaf. Underlying theory and supervised practice with deaf individuals. (3 cr; prereq 152 or #; offered when feasible) Lassman
- 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 5, 31 or elementary education major, or #...Spch 32 recommended) Graham
- 132.* **Children's Theater.** Selection, direction, and production of plays for children's audiences, co-ordinated with current productions of the Young People's University Theater. (3 cr; prereq 5, 31 or #) Graham
- 135, 136, 137. **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 65, 66, 78, 111, 112 and #) Ballet
- 140.* **Introduction to Voice Science.** Phonetic, anatomic, physiologic, and physical bases of speech. (3 cr; prereq 5, Psy 2)
- 141.* **Anatomy and Physiology of the Voice Mechanism.** Respiration, articulation, and phonation. (3 cr; prereq 5, 67, or #, Psy 5)
- 142.* **Physical Bases and Instrumentation of Speech.** Basic principles of sound to speech mechanism. Analysis of speech sound production. Application of mechanical and electronic equipment to speech; basic theory and uses. (3 cr; prereq 5, 67, 140, or #, Psy 5)
- 149.* **Speech Habilitation for Persons with Neuromuscular Disorders.** Physiological, neurological, and psychological characteristics of persons with cerebral palsy and other types of neuro-

- muscular disorders; methods used in their speech habilitation. (2 cr; prereq 161, 162, 163, or #) Starr
- 150.* **Organic Speech Disorders—Aphasia.** In adults and children. Etiology, language, and associated nonlanguage problems; therapeutic considerations and procedures. (2 cr; prereq 161, 162, 163 or #; offered when feasible) Henrikson
151. **Cleft Palate Speech Problems.** Survey of research and clinical procedures in treatment of children with cleft palate. Observation. (2 cr; prereq 141, 161, 163 or #) Starr
152. **Hearing Disorders.** Basic orientation to audiology. Physiology and anatomy of auditory mechanism. Symptomatology and pathology of hearing disorders, their medical and surgical treatment. Clinical and classroom management, including discovery programs, hearing aids, language development, lip reading, speech correction, auditory training, psychology of hard-of-hearing and deaf, vocational guidance, educational channels. (3 cr; prereq 5, 67, Psy 2 or #) Lassman
- 153.* **Audiometry and Hearing Aids.** Clinical and group audiometry; screening and diagnostic techniques, pure tone and speech audiometry; hearing conservation programs. Modern hearing aids; selection and usage problems. (3 cr; prereq 5, 67, 152, Psy 2 or #) Lassman
- 155.* **Lip Reading and Lip Reading Methods.** Schools and methods of teaching lip reading. Supervised practice in teaching lip reading to hard-of-hearing persons. (3 cr; prereq 5, 67, 152, Psy 2, or #) Lassman
156. **Auditory Training.** Problems of auditory discrimination and of hearing aid usage in persons with hearing deficiencies. Methods of developing skills in listening with and without acoustic amplification. Supervised practice with acoustically handicapped children and adults. (3 cr; prereq 152 or #; offered when feasible) Lassman
- 157, 158, 159. **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 per qtr; prereq 152, 153 and #) Lassman
- 161x. **Introduction to Speech Correction.** Basic orientation in speech correction. Analysis of common disorders of speech, their characteristics, prevention, and correction. Basis for more advanced study in speech pathology or for a basic understanding of the field. (3 cr; prereq 5, or Δ) Henrikson and staff
162. **Speech Pathology.** Causes, characteristics, and therapy. Stuttering. (3 cr; prereq 5, 67, 161) Henrikson
163. **Pathologies of Speech.** Voice and articulation disorders. (3 cr; prereq 5, 67, 161) Starr
- 164-165-166.* **Clinical Methods and Practice in Speech Pathology.** (3 cr per qtr; prereq 2 or 5, 61, 67, 161, 162, 163) Henrikson, Starr
- 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
- 170.* **Radio and Television Programming.** Theory and practice. Principles of program effectiveness; program policies of the industry. Building and production of experimental programs; talk and discussion. (3 cr; prereq 65 or 66, or #) Goldstein
- 171, 172, 173.*† **History of the Theater.** Plays, arts, and crafts of the theater from their beginnings to the present. Reports and projects. (3 cr per qtr; prereq 5, 31) Graham
177. **Theater on Tour.** Selection, preparation, production, and touring of a school assembly program. (3-6 cr; prereq 12 or more Upper Division speech cr and approval of faculty committee) Whiting and staff
178. **Theater on Tour.** Preparation, production, and touring of 1 or more full-length plays. (3-6 cr; prereq 12 or more Upper Division speech cr and approval of faculty committee) Whiting and staff
- 181, 182, 183.* **Readings in Speech.** Directed reading and preparation of reports on selected subjects. (Cr ar; prereq 5 and 6 addtl cr and #) Smith and staff
- 190, 191, 192.*† **Advanced Technical Stage Problems.** Theory of stage costume (190), scenic design (191), and stage lighting (192). Special projects and reports. (3 cr per qtr; prereq 111, 112 or #) Moulton (190), Josal (191, 192)
- 201x.* **General Seminar.** Survey of current literature and general problems. (1 cr per qtr; prereq #) Smith
- 203-204.† **Debate Coaching.** Literature concerning and methods of directing extracurricular inter-scholastic public speaking, discussion, and debate activities. (2 cr per qtr; prereq 5, Psy 2, 10 cr in social science) 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
- 211-212-213.*† 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) Ballet
- 214-215-216.† Seminar: **Stage Direction.** Great plays and their potentials for meaningful and effective production in the modern theater. (3 cr per qtr; prereq 111, 112, 113) Whiting, Moulton
217. 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 theater or ‡) Josal
218. Seminar: **Theater Planning.** Principles in planning and design of stages, auditoriums, and associated facilities; their application to the educational theater. Both building and equipment analyzed. (3 cr; prereq 191, 190 or 193 or equiv) Josal
- 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
- 231-232-233.*† Seminar: **Advanced Speech Problems.** Evaluation of research methods in the general field. (3 cr per qtr; prereq undergrad major in speech, or equiv, ‡)
- 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
251. Seminar: **Listening Comprehension.** Research problems and methods. Evaluation of published research. (2 cr; prereq undergrad speech major, ‡) Nichols
257. **Language Retardation.** Analysis of causation, diagnosis, and current research techniques. (3 cr; prereq ‡) Siegel
- 261-262-263.*† Seminar: **Speech Pathology.** Significant literature in speech pathology; evaluation of research methods. (3 cr per qtr; prereq 3 or 6, 67, 161, 162, 163, Psy 2, or ‡) Henrikson and staff
- 267, 268, 269. Seminar: **Experimental Phonetics.** Critical analysis of significant research in physiological and acoustic phonetics. Examination of theory, method, instrumentation, and data. (2 cr; prereq 67 and 142)
270. **Advanced Clinical Audiology.** Theory of abnormal auditory function. Problems in description, measurement, integration, and interpretation including discrimination assessment, nonorganic deafness, integrity of the sensory-neural system, galvanometric indicators, localization phenomena, etc. (3 cr; prereq 152, 153, ¶157 and ‡) Lassman and staff
- 271-272-273.* Seminar: **Hearing.** Major experimental research in psychophysiological and psychoacoustical nature of hearing. Critical analysis of theory, experimental method, and treatment of data. (3 cr; prereq 152, 153, 155, ‡) Lassman
- 275-276-277.† Seminar: **Rhetoric.** History and critical study of rhetorical theory. Examination of research in rhetoric. (3 cr; prereq 109 or ‡) Smith, Scott
- 281-282-283.*† Seminar: **Organic Disorders of Speech.** Anatomical, physiological, and neurological abnormalities that are characterized by disorders of speech or voice. Pertinent literature; medical sources. (2 cr per qtr; may be repeated with consent; prereq 263, ‡) Henrikson
- 291-292-293.*† Research. Open to graduate students engaged in research on special problems. (Cr ar) Staff

STATISTICS

Committee:

Professor

I. Richard Savage, *chairman*
Jacob Bearman
Leonid Hurwicz

Gerhard K. Kalisch
Edgar Reich
Paul C. Rosenbloom

The Committee on Statistics of the Graduate School guides the graduate program. Listed below are the substantive areas for work in statistics; under each area is listed the graduate faculty in statistics for that area as well as representative courses of that area.

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 application.

Prerequisites—Before becoming a candidate for the degree M.A. or Ph.D. with a major in statistics the student is required to present differential and integral calculus as minimum preparation in mathematics.

Approval of Programs—Courses of study for the degrees M.A. and Ph.D. with a major in statistics are supervised by the above Committee on Statistics.

Selection of Adviser—Candidates for advanced degrees should see the chairman of the special committee or the chairman of the Department of Statistics about selecting an appropriate adviser. A major adviser must be a full member of the graduate faculty in statistics.

Major in Statistics—Master of Arts

Either Plan A or Plan B may be followed. When Plan A is chosen, the minor shall be in mathematics or in some field of application. Under Plan B, the field of concentration may be statistics, or statistics and mathematics, with the related fields selected from the several areas of application and mathematics.

Language Requirement—There is no language requirement under either plan except as recommended in special cases by the student's adviser and approved by the Committee on Statistics.

Major in Statistics—Doctor of Philosophy

Major—The course program in the major normally should be chosen from the courses listed below, with such changes in this list as may be made later by the Committee on Statistics, and from additional courses in mathematics which are particularly pertinent for the candidate's objective. The minimum requirements (taken in undergraduate or graduate work) shall include the equivalent of the following courses: Math 121-122-123, Mathematical Theory of Statistics (9 cr); 9 credits selected from advanced calculus (9 cr), and Math 131, Advanced Algebraic Theory (3 cr) or its equivalent.

Minor—The minor may be a field in which the candidate expects to apply his statistical theory. Or, the minor may be mathematics, provided that the major program alone gives satisfactory acquaintance with statistical techniques in a field of application.

Language Requirement—A reading knowledge of 2 foreign languages, or a reading knowledge of 1 foreign language and a special research technique or a collateral field.

Minor in Statistics—Doctor of Philosophy

The candidate for a minor in statistics must not assume that an arbitrary selection of courses from the following list will satisfy the minor requirements. However, the minimum requirements will include completion of one of the sequences Econ 121A, B, C, Math 121-122-123, or ITM 132-133-134 and evidence of familiarity with procedures of least squares, multiple regression, and analysis of variance, at the level of Mood's book. The minor program should be planned in advance; a list of eligible advisers is obtainable from the chairman of the Committee on Statistics of the Graduate School, listed above.

Fellowships and Teaching Assistantships

In applying for financial aid, a candidate for an advanced degree with a major in statistics should specify an *associated* field. This field should be his proposed main field for application, if he intends to prepare primarily as an applied statistician. Or, he should specify mathematics as the associated field if he desires to emphasize the mathematical theory of statistics, and thus qualify as a theoretical statistician, with the ability to develop new theory and also to aid in applications of statistics in diverse fields. Then, usually, the Committee on Statistics will transmit the candidate's application, with a recommendation for the appropriate action, to the associated department—Agricultural Economics, Biostatistics, Quantitative Analysis, Economics, Educational Psychology, Mathematics, Mechanical Engineering, Psychology, Sociology, or Statistics, where teaching assistantships or fellowships may be available.

Courses Eligible for Credit in Statistics

It is possible to prepare Plan B papers for the Master's degree in any one of these courses not listed as laboratory.

AGRICULTURAL SCIENCE FIELDS

Professor

Ralph E. Comstock
Merrill F. Roff
Robert N. Shoffner

Associate Professor

Charles E. Gates
Elmer W. Learn
James C. Sentz
Horace L. Thomas

- AgEc 101. Statistical Methods for Social Sciences. (4 cr; prereq Biom 100 or equiv)
- Agro 248. Applied Statistics. (3 cr; prereq Biom 100 or equiv)
- AnHu 204. Quantitative Inheritance II. (3 cr; prereq Agro 261)
- Biom 100. Introduction to Statistical Analysis I. (4 cr; prereq college algebra and Biom 90 or grad)
- Biom 101. Introduction to Statistical Analysis II. (4 cr; prereq Biom 100 or equiv)
- Biom 201. Experimental Design. (3 cr; prereq Biom 101)

BIOSTATISTICS

Professor

Jacob E. Bearman
Joseph Berkson
Richard B. McHugh
I. Richard Savage

Associate Professor

Byron W. Brown, Jr.

- PubH 120. Biostatistics II. (3 cr; prereq PubH 110 with grade not lower than C, ¶PubH 121)
- PubH 121. Biostatistics Laboratory II. (2 cr; prereq ¶PubH 120)
- PubH 130. Biostatistics III. (3 cr; prereq PubH 120 with grade not lower than C, ¶PubH 131)
- PubH 131. Biostatistics Laboratory III. (2 cr; prereq ¶PubH 130)
- PubH 150. Vital Statistics II. (3 cr; prereq #)
- PubH 201. Topics in Biometry. (Cr ar; prereq PubH 120, 130 and #)
- PubH 203*-205*-207.* Research Design in Biometry. (3 cr per qtr; prereq PubH 130)
- PubH 204-206-208. Theory of Research Design in Biometry. (2 cr per qtr; prereq calculus and ¶PubH 203-205-207)
- PubH 211. Seminar in Biometry. (Cr ar)
- PubH 216-218. Biomedical Measurement Problems, Assays. (3 cr per qtr; prereq PubH 120 or #)

PubH 217-219. Theory of Biomedical Measurement Problems, Assays. (2 cr per qtr; prereq ¶PubH 216-218 and §)

PubH 250-251-252. Foundations of Biometry. (2 cr per qtr; prereq PubH 208, 219 or §)

QUANTITATIVE ANALYSIS

Professor

Delbert C. Hastings
John Neter

QA 171. Statistical Methods for Sample Surveys. (3 cr; prereq QA 51 or 161 or equiv)

QA 181. Quality Control and Industrial Statistics. (3 cr; prereq QA 51 or 161 or equiv)

QA 191A-B. Statistical Methods in Business Administration. (3 cr per qtr; prereq QA 51 or 161 or Econ 121A or §)

QA 291A. Readings in Statistics. (Cr ar; prereq consent of adviser and instructor in field covered)

QA 291B. Graduate Research in Statistics. (Cr ar)

ECONOMICS

Professor

Oswald H. Brownlee
John S. Chipman
Leonid Hurwicz
I. Richard Savage

Econ 101B. Introduction to Decision Theory. (3 cr; prereq QA 5, Econ 101A or §...Math 40 advised)

Econ 121A-B-C. Theory of Statistics. (3 cr per qtr; prereq Math 40 or ¶Math 40 for 121A, Math 53 or § for 121B)

Econ 181A, B, C. Topics in Statistics. (3 cr per qtr; prereq Econ 121C or ¶121C or §)

Econ 195B. Decision Making and Operations Analysis. (3 cr; prereq Econ 165, Math 53 or equiv or §)

Econ 201A. Econometrics A. (3 cr; prereq Econ 165, 166, 121C or equiv [some background in matrix theory highly desirable])

Econ 201B. Econometrics B. (3 cr; prereq Econ 201A)

Econ 201C. Econometrics C. (3 cr; prereq Econ 201B)

Econ 301. Seminar: Statistical Inference and Econometrics. (3 cr; prereq §)

Econ 391A-B-C.† Seminar: Workshop in Econometrics. (Cr ar; prereq Econ 201A, B, C or 101C or ¶201A, B and §)

EDUCATION

Associate Professor

Raymond O. Collier

CD 227. Multiple Factor Analysis. (2 cr; prereq 3 qtrs of statistics and mental measurement)

EPsy 208. Methods in Educational Research. (3 cr)

EPsy 216-217-218. Statistical Methods in Education. (3 cr per qtr)

EPsy 216A-217A-218A. Statistical Methods in Education—Laboratory. (2 cr per qtr)

EPsy 219. Design and Analysis of Statistical Investigations. (3 cr; prereq EPsy 218, §)

EPsy 219A. Design and Analysis of Statistical Investigations—Laboratory. (2 cr; recommended for all students taking EPsy 219; sections limited to 18 students; prereq EPsy 218, §)

EPsy 243. Problems in Statistics. (3 cr per qtr)

ENGINEERING, MATHEMATICS, AND PHYSICAL SCIENCE FIELDS

Professor

Glen E. Baxter
Bernard R. Celbaum
Gayle W. McElrath
Edgar Reich

Associate Professor

Eugene A. Johnson
Steven Orey

Assistant Professor

Bernard W. Lindgren
William E. Pruitt

- IE 171. Quality Control. (3 cr; prereq ITM 90 or ITM 132 or #)
- IE 197. Industrial Sampling Techniques. (3 cr; prereq IE 171 or ITM 132 or #)
- IE 198. Sequential Analysis. (3 cr; prereq ITM 133 or #)
- IE 199. Design of Industrial Experiments. (3 cr; prereq ITM 133 or #)
- ITM 132. Introduction to Statistics and Probability. (3 cr; prereq integral calculus)
- ITM 133-134. Statistical Theory with Applications. (3 cr per qtr; prereq ITM 132)
- ITM 133A-134A. Mathematical Methods in Operations Analysis. (3 cr per qtr; prereq ITM 90 or 132 or #)
- ITM 133B-134B. Probability with Technological Applications. (3 cr per qtr; prereq ITM 132, 153 or 132, 148, 149 or #)
- ITM 284A-B-C. Stochastic Processes. (3 cr per qtr; prereq Math 245 or #)
- Math 121-122-123. Mathematical Theory of Statistics. (3 cr per qtr; prereq Math 55)
- Math 178A-B-C. Introduction to Probability. (3 cr per qtr; prereq Math 108 or 123 or #)
- Math 203-204-205. Advanced Mathematical Statistics. (3 cr per qtr; prereq Math 123 and either Math 108 or #)
- Math 258-259-260. Theory of Probability. (3 cr per qtr; prereq Math 245 or #)
- Math 293A, B, C. Seminar in Stochastic Processes. (3 cr per qtr; prereq Math 208 or ITM 263, #)

THEORETICAL STATISTICS

Professor

Leonid Hurwicz
I. Richard Savage

Associate Professor

Sudhish G. Ghurue
Milton Sobel

- Stat 181A, B, C. Topics in Statistics. (3 cr per qtr; prereq Econ 121C or ¶121C or #)
- Stat 221A. Statistical Theory I. Development of special probability tools used in statistical analysis, e.g., transformations of distributions, moments of linear function, conditional expectations, and limit theorems. (3 cr; prereq Econ 121C, Math 123, or ITM 134, ¶Math 107 or ITM 151A, or #)
- Stat 221B. Statistical Theory II. Topics in point estimation theory, e.g., properties of maximum likelihood estimates, the Markoff principle and least squares, minimum variance unbiased estimation, Bayesian procedures, and sufficient statistics. (3 cr; prereq Stat 221A, ¶Math 131A or ITM 142, or #)
- Stat 221C. Statistical Theory III. Topics in the testing of hypotheses and decision theory, e.g., likelihood ratio procedures, the general linear hypotheses, Neyman-Pearson fundamental lemma, monotone likelihood ratio situations, confidence, and tolerance regions. (3 cr; prereq Stat 221B or #)
- Stat 231A, B, C. Linear Models. Principles of point and confidence set estimation. E.g., least squares, Gauss-Markov Theorem, linear hypotheses, multiple comparisons. Analysis of variance and covariance in models with fixed effects, e.g., one-way, two-way and higher-way classification, orthogonality and sums of squares, missing observations, other designs. Other topics: random-effects, mixed, randomization models; effects of departures from the underlying assumptions, comparison of the efficiency of designs. (3 cr per qtr; prereq ¶Stat 221A, B, C, or #)
- Stat 241A, B. Nonparametric Inference. Optimality properties of sufficiency, completeness, and invariance will be 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 ¶Stat 221 or #)
- Stat 241C. Nonparametric Inference. Continuation of 241B with student presentation and beginning of research. (3 cr; prereq #)
- Stat 251A. Multivariate Analysis I. General discussion. Multivariate distributions. Derivation of distributions: noncentral chi-square and F, Wishart distribution, joint distribution of the roots of a determinantal equation, with emphasis on methodology. Cochran's theorem; independence properties and the characterization of normal distribution. Asymptotic distributions. Multivariate Chebyshev inequalities. (3 cr; prereq Math 131A, ¶Stat 221A, or #)
- Stat 251B, C. Multivariate Analysis II, III. Statistical inference based on the multivariate normal distribution. Estimation of the mean vector and covariance matrix, general linear hypothesis,

independence of sets of variates, classification of observations. (3 cr per qtr; prereq Stat 251A, ¶Stat 221B)

Stat 281A, B, C. Advanced Topics in Statistics. (3 cr per qtr; prereq #)

Stat 301x. Statistics Seminar and Workshop. Presentations will consist of expositions of current research articles, book reviews, plans for research, and reports of research activity. Course will be given each quarter. (1-3 cr per qtr; prereq #)

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

William T. S. Thorp
Robert K. Anderson
John P. Arnold
Archie L. Good
Henry J. Griffiths
Paul B. Hammond
John M. Higbee
Harvey H. Hoyt
Ralph L. Kitchell
Donald G. Low

George W. Mather
Benjamin S. Pomeroy
Jay H. Sautter
Dale K. Sorensen
Clarence M. Stowe
Alvin F. Weber
Raimunds Zemjanis

Associate Professor

Robert K. Lindorfer
Robert A. Merrill

Francis A. Spurrell
Edward A. Usenik

Assistant Professor

William J. Bemrick
Donald H. Clifford
Harold E. Dziuk

Instructor

Griselda F. Hanlon
Victor Perman

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 parasitology, veterinary pathology, and veterinary physiology and pharmacology.

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 is required. For the Ph.D. degree, either (a) 2 foreign languages or (b) 1 foreign language and the option of a special research technique or a collateral field of knowledge.

Master's Degree—Offered under Plan A. In special circumstances and when the candidate has had considerable research experience, Plan B may be followed by petition.

Doctor's Degree—Work for the Ph.D. degree is offered in the fields outlined 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. Anatomy of the Dog. Gross anatomical structures and their functions. (7 cr; prereq #) Kitchell

102. Anatomy of Nonruminants. Anatomy of the horse, pig, and poultry as compared to the dog. (5 cr; prereq 101 or #) Kitchell

- 103. **Anatomy of Ruminants.** Anatomy of the cow and sheep. (3 cr; prereq 102 or #) Kitchell
- 106. **Veterinary Surgical Anatomy.** Topographical anatomy of domestic animals as applied to surgery and practice of veterinary medicine. (1 cr; prereq 103, VMC 101, #) Kitchell
- 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 #) Kitchell
- 143. **Avian Gross and Microscopic Anatomy.** Gross and microscopic anatomy of the chicken and certain significant anatomical areas of other fowl. (5 cr; offered 1963-64 and alt yrs) Kitchell
- 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 #) 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
- 190.* **Seminar in Veterinary Anatomy.** (1 cr; prereq 101, 151, #) Kitchell, Weber
- 191x.* **Special Studies in Veterinary Anatomy.** Individual problems in gross anatomy, histology, embryology, neurology, hematology, and histological techniques. (1-5 cr per qtr; regis for more than 1 qtr permitted; prereq 151 or equiv, #) Kitchell, Weber
- 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, #) Kitchell
- 203. **Experimental Comparative Veterinary Neurology.** Principles, methods, and laboratory exercises in investigating the central nervous system of domestic animals. (3 cr; prereq 202, #) Kitchell
- 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, #; offered 1963-64 and alt yrs) Weber
- 252s. **Applied Optical Methods in Veterinary Medical Research.** Studies of applications of qualitative and quantitative microscopic methods in evaluation of components of cells and tissues of domestic animals as related to veterinary research problems. (3 cr; prereq 153, #; offered 1962-63 and alt yrs) Weber

Veterinary Bacteriology and Public Health

- 101. **General Veterinary Bacteriology and Immunology.** Morphology, physiology, and classification of bacteria. Basic principles of infection and immunity. (6 cr; prereq 10 cr in zoology, 13 cr in chemistry, #) Lindorfer, Loken
- 102. **Pathogenic Bacteria and Fungi.** Bacteria, actinomycetes, fungi, and spirochetes which cause animal diseases. (6 cr; prereq 101 or equiv, #) Lindorfer, Loken
- 103. **Veterinary Virology.** Basic techniques of virology and of those 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
- 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, PoHu 1, MicB 53; offered 1963-64 and alt yrs) Pomeroy
- 131. **Poultry Diseases.** Infectious and noninfectious avian diseases. (4 cr; prereq 103, VPAP 153 or equiv, #) Pomeroy
- 201x.* **Advanced Poultry Diseases.** Investigations of specific infectious disease problems of poultry. (Cr ar; prereq 131, #) Pomeroy, Higbee
- 205x.* **Advanced Veterinary Bacteriology.** Special topics, techniques, collateral reading, and conferences. (Cr ar; prereq #) Pomeroy, Lindorfer, Higbee, Anderson
- 211. **Seminar in Veterinary Bacteriology.** (1 cr; prereq #) Pomeroy, Anderson, Lindorfer

221. **Advanced Veterinary Public Health.** Veterinary public health programs and selected diseases common to animals and man. (Cr ar; prereq 127, §) Anderson

Veterinary Medicine and Clinics

101. **Veterinary Physical Diagnosis.** Fundamentals of clinical veterinary medicine, procedures in physical diagnosis and restraint of animals. (4 cr; prereq §) Low
- 102-103-104. **Large Animal Medicine.** Diseases of the systems, metabolic diseases, nutritional deficiencies and diseases caused by toxic agents. (5 cr per qtr; prereq §) Hoyt, Sorensen
119. **Veterinary Jurisprudence and Business Methods.** Fundamentals of legal responsibilities of a veterinarian, public relations, jurisprudence, veterinary ethics, and regulatory procedures. (2 cr; prereq §) Hoyt
- 121-122. **Small Animal Medicine.** Medical diseases of small animals. (4 cr for 121, 5 cr for 122; prereq §) Mather
- 131-132. **Infectious Diseases of Large Animals.** Principles of host-parasite relationship; mechanisms of infection, epizootiology, pathogenesis, symptomatology, differential diagnosis, treatment, prevention and control procedures. (5 cr per qtr; prereq §) Hoyt
137. **Animal Diseases and Poisonous Plants.** Important plants poisonous to animals: identification, toxicology, diagnosis, and treatment. (3 cr; prereq §) Johnson, Kommedahl
- 201x.* **Advanced Studies in 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, §) Hoyt, Mather, Sorensen, Low
- 202x.* **Advanced Studies in Diagnosis and Therapeutics of Animal Diseases.** Detailed examination, discussions, and treatment of cases of animal diseases. (Cr ar; prereq 104, 131, §) Hoyt, Mather, Sorensen, Low
- 203x.* **Seminar in Veterinary Medicine.** (Cr ar; prereq §) Hoyt, Sorensen
- 204x.* **Veterinary Medical Conference.** Medical, surgical, or obstetrical cases supported by anatomic, bacteriologic, pathologic, physiologic, pharmacologic, and radiologic evaluations whenever applicable. (Cr ar; prereq 104, 131, §) Hoyt, Mather, Sorensen, Low

Veterinary Obstetrics

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 101, VMC 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
- 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, PhCh 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 VPpP 151, §) Griffiths, Bemrick
102. **Veterinary Parasitology.** Helminth parasites and parasitic diseases of animals; principles of control. (5 cr; prereq §) Griffiths
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, §) Sautter, Dennis

152. **Special Veterinary Pathology.** Diseases of respiratory, cardiovascular, digestive, hemopoietic, urinary, genital, endocrine, nervous, locomotor systems. (5 cr; prereq 151, §) Sautter, Perman, Dennis
153. **Special Veterinary Pathology and Pathology of Infectious Diseases of Animals.** (5 cr; prereq 152, or equiv, §) Sautter, Perman, Dennis
154. **Veterinary Clinical Pathology.** Application and interpretation of laboratory tests used in clinical diagnosis. (2 cr; prereq 153, §) Perman, Joel
156. **Diseases of Fur-Bearing Animals.** Etiology, symptomatology, and treatment of diseases of fur-bearing animals. (2 cr; prereq 153, VMC 122, §) Higbee
- 157x. **Veterinary Necropsies.** Necropsies, techniques, examination of tissue sections and preparation of records. (1-3 cr per qtr; prereq 153, §) Sautter
- 158x.* **Veterinary Surgical Pathology.** Neoplasms, surgical biopsies, postmortem material; review of pertinent literature. (1-3 cr; prereq 153, §) Sautter, Perman
- 201x.* **Advanced Veterinary and Poultry Pathology.** Clinical material, collateral reading, and conferences. (Cr ar; prereq §) Higbee, Sautter
- 202x.* **Seminar: Veterinary Pathology.** (1 cr; prereq 153, §) Sautter, Dennis
- 203x.* **Neoplasms of Domestic Animals.** (Cr ar; prereq §) Sautter, Perman
- 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
- 241x.* **Problems in Veterinary Parasitology.** (Cr ar; prereq 102 or equiv, §) Griffiths

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 VAn 153, PhCh 103, §) Good, Dziuk
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, Sullivan
- 120.* **Seminar in Animal Physiology.** (2 cr; prereq 109, §) Good
- 130x.* **Problems in Animal Physiology.** (Cr ar; prereq 109 or Phs 106, 107, §) Good
151. **Veterinary Pharmacology.** Local and general anesthetics, analgesics, and antipyretics. (4 cr; prereq 108 or equiv, §) Stowe, Hammond
152. **Veterinary Pharmacology.** Chemotherapeutic, autonomic, cardiovascular, and gastrointestinal drugs. (4 cr; prereq 151 or equiv, §) Stowe, Hammond
153. **Veterinary Clinical Pharmacology.** Continuation of veterinary pharmacology; clinical aspects in domestic animals. (3 cr; prereq 152 or equiv, §) Stowe, Hammond
- 161.* **Seminar: Veterinary Pharmacology.** (Cr ar; prereq 152 or equiv, §) Stowe, Hammond
- 171x.* **Problems: Veterinary Pharmacology.** (Cr ar; prereq 152 or equiv, §) Stowe, Hammond
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 §) Stowe, Good, Hammond

Veterinary Surgery and Radiology

101. **Principles of Veterinary Surgery.** General fundamentals of surgery as applied to systems of the body; discussion of inflammation with relationship to tissue repair; principles of anesthesia, preoperative evaluation and postoperative care. (5 cr; prereq VMC 101, §) Arnold, Clifford, Usenik
102. **Special Veterinary Surgery.** Lectures in surgical procedures for small animals; laboratory exercises covering small animal operations. (5 cr; prereq 101, §) Arnold, Clifford, Usenik
103. **Special Veterinary Surgery.** Surgical procedures for large animals. Laboratory exercises covering selected large animal operations. (4 cr; prereq 101, §) Arnold, Clifford, Usenik
104. **Lameness of Domestic Animals.** Etiology, diagnosis, and treatment. (1 cr; prereq 103, §) Spurrell

- 105. Special Surgery.** Training in advanced surgical techniques. (1 cr; prereq 103, #) Arnold, Clifford, Usenik
- 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
- 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, Clifford
- 225f,w,s,su. Advanced Small Animal Surgery.** Surgery of the various systems in small animals with preoperative and postoperative evaluation and treatment. (Cr ar; prereq 103 or equiv, #) Arnold, Usenik, Clifford
- 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
- 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, Caldecott, Loken

ZOOLOGY

Professor

Nelson T. Spratt
 Walter J. Breckenridge
 Huai-Chang Chiang
 Alexander C. Hodson
 William H. Marshall
 Magnus Olson
 Sheldon C. Reed
 A. Glenn Richards
 Otto H. Schmitt

Associate Professor

V. Elving Anderson
 Edwin F. Cook
 Joseph G. Gall
 David J. Merrell
 Grover C. Stephens
 Franklin G. Wallace
 Dwain W. Warner

Assistant Professor

Robert M. Benolken
 Marion A. Brooks
 Robert K. Josephson
 Norman S. Kerr
 Roger D. Price
 James C. Underhill

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.

Language Requirement—For the Master's degree, one foreign language. For the Doctor's degree, 2 foreign languages, of which 1 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.

Biophysics—For information on this program, see index.

100, 101, 102. Basic Zoology. These course numbers are a special arrangement for the making up of certain deficiencies in background course work. (Cr ar; majors must consult major advisers, others consult department chairman)

Geol 105. Invertebrate Paleontology. (3 cr; prereq Geol B or #) Sloan

107. Protozoology. Introduction to taxonomy, morphology, physiology, development, and genetics of free-living protozoa. (4 cr; prereq #) Kerr

Geol 107. Vertebrate Paleontology. (3 cr; prereq Geol 105 or Zool 56 or #) Sloan

108. **Comparative Neurology.** Comparative study of morphology and physiology of nervous systems with emphasis on evolutionary trends in invertebrate phyla. (5 cr; prereq 10 cr in biology) Josephson
110. **Animal Behavior.** Survey of effector mechanisms, their nervous and endocrine control, and behavior patterns of animals. (3 cr; prereq 15 cr incl Biol 2 or equiv and §) Stephens
112. **Advanced General Physiology.** Quantitative study of transport processes and related phenomena in biological systems. (3 cr; prereq 15 cr incl Biol 2 and §)
113. **Special Topics in Advanced General Physiology.** (3 cr; prereq 15 cr incl Biol 2 or equiv with §)
114. **Sensory Physiology.** Survey of general properties of receptor organs; visual, auditory, and mechano receptor units. (3 cr; prereq Zool 50 or equiv and §; offered 1963-64 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. (4 cr; prereq 15 cr in zoology; offered at Itasca Biology Session only) Underhill
116. **Population Ecology.** General principles of population, covering population dynamics and trophic relationships. (3 cr; prereq 65 or §...Bot 50 or 130 or equiv recommended; offered 1962-63 and alt yrs) Underhill
- Ent 118. **Experimental Ecology.** Experimental approach to study of environmental factors affecting animal populations. For companion laboratory course see Ent 201. (3 cr; 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. (4 cr; prereq 15 cr in zoology incl Biol 2 or equiv; offered at 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 incl Biol 2 or equiv) Eddy
- Ent 125. **Insect Morphology.** Comparative studies of external and internal macrostructure of insects; phylogeny and function. (4 cr; prereq Zool 52 and §) Cook
- Ent 126. **Microanatomy and Development of Insects.** Histochemistry and fine structure; reproductive behavior, embryology and postembryonic development of insects. (4 cr; prereq Ent 125, OrCh 42 or 62, §) Brooks
- Ent 127. **Insect Metabolism and Co-ordination.** Homeostasis, permeability, circulation, metabolic systems and products, properties of muscle and nerves, sensation, behavior. (4 cr; prereq Ent 126, §...AgBi 106, PhCh 101 recommended) Richards
- Ent 130. **Principles of Systematic Entomology.** Lectures on history of systematic entomology, the species concept and higher categories, systematics, procedures and zoological nomenclature. (2 cr; prereq 15 cr in entomology or zoology, §) Cook
- 135su. **Field Ornithology.** Field and laboratory studies of ecology and life histories of the birds in the Itasca Park region. (4 cr; prereq 15 cr in zoology; offered at Itasca Biology Session only)
138. **Seminar: General Physiology and Biophysics.** (Cr ar; prereq special requirements) Schmitt, Benolken
- Ent 140. **Biological Microscopy.** Necessary elements of optics, use and limitations of various types of microscopes, interpretation of microscopical data. Laboratory and demonstrations plus project in field of student's interest. (4 cr; prereq 15 cr in zoology, entomology, or botany, and §; offered when demand warrants) Richards
144. **Medical Entomology.** Principal arthropods noxious to man and animals, especially those arthropods which serve as vectors of pathogenic organisms of man and animals. (3 cr; prereq 15 cr incl 52 or equiv or §) Price
145. **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 equiv and §) Wallace
146. **Helminthology.** Worm parasites of man and animals, their structure, life histories, and biological relationships. (3 cr; prereq 15 cr incl Biol 2 or equiv and §) Wallace
153. **Molecular Biology.** Quantitative analysis of cellular processes which may be treated on a molecular basis: osmotic pressure, brownian motion, ion distributions, phase separations, intermolecular forces. (3 cr; prereq Zool 55, Phys 9 or equiv and §; offered 1962-63 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 (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 mechanism.** (3 cr per qtr; prereq 28 cr distributed between physics and biology, #...physical chemistry and general physiology recommended; schedule ar) Schmitt, Benolken
- 162su.* **Ecology of Terrestrial Vertebrates.** Ecological relationships of northern Minnesota terrestrial vertebrates. (6 cr; prereq Ent 68 or Zool 58, Ent 63 or equiv, Bot 50; offered at Itasca Biology Session only) Marshall, Tester
170. **Advanced Genetics.** General laws involved in heredity and variation; applications to microorganisms, higher plants, and animals exclusive of man. (3 cr; prereq 15 cr incl 83, and #) Reed, Merrell
171. **Genetics and Speciation.** Application of genetic principles to problems of speciation and evolution. (3 cr; prereq 15 cr incl 83 or #) Merrell
175. **Human Genetics.** Inherited characters in man, particularly in relation to medicine, with some reference to relation of genetics to marriage and to social conditions. (3 cr; prereq 83 and #) Reed
176. **Problems and Methods in Human Genetics.** Principal tools and methods for research. Importance of statistical thinking and appropriate statistical techniques. Use of genetic concepts in exploring new problems and necessity of stating hypotheses in testable form. Individual study of current problems and group discussion. (3 cr; prereq 175 or #) Anderson
182. **Experimental Embryology.** Growth, differentiation, and metabolism of developing organisms. (5 cr; prereq 50 and 59 or equiv and #) Spratt
- Ent 196su.* **Special Problems in Entomology and Economic Zoology.** Advanced work in field zoological research; faunistic studies and terrestrial, aquatic, and forest entomology and economic zoology. (1 or more cr per qtr; prereq #; offered at Itasca Biology Session only) Marshall, Tester, and staff
- 197, 198, 199.* **Advanced Work.** Individual work in some special discipline. (Cr ar; prereq Biol 2 or equiv or #)
- Ent 201.* **Experimental Ecology Laboratory.** Laboratory companion course of Ent 118. (2 cr; prereq Ent 118 or ¶Ent 118) Chiang
- Ent 202.* **Insect Ecology.** Dispersal, distribution, abundance, natural control, and related problems. (3 cr; prereq Ent 118) Chiang
- Ent 203.* **Insect Physiology.** General and comparative: survey of organ systems and their functioning; research methods and evaluation of data. (Cr ar; prereq #) Richards
209. **Topics in Comparative Physiology.** Intensive coverage of comparative animal physiology: neuromuscular mechanisms, invertebrate endocrinology, biological rhythms, related topics. (2 cr; prereq 50 or 60 or equiv or #; offered 1963-64 and alt yrs) Stephens
- 211, 212, 213.* **Research: Ecology.** Eddy, Hodson, Underhill, Chiang
214. **Field Ecology.** Field work in major and minor communities in Minnesota; extended field trips to neighboring states. (3 cr; prereq 65 or #... Bot 50 or 130 or equiv recommended; offered 1962-63 and alt yrs) Underhill
- 217, 218, 219.* **Research: Physiology.** Richards, Stephens, Josephson
- 221, 222, 223.* **Research: Biophysics.** Schmitt, Benolken
- 229, 230, 231.* **Research: Histology.** Olson
- 233, 234, 235.* **Research: Embryology.** Spratt
- 237, 238, 239.* **Research: Cytology.** Gall
- Ent 240-241-242-243.* **Research in Entomology.** Chiang, Cutkomp, Hodson, Holdaway, Richards, Cook, Haydak, Peterson, Brooks, Price
- 244, 245, 246.* **Research: Protozoology.** (Cr ar; prereq #) Kerr
- 251, 252, 253.* **Research: Genetics.** Reed, Merrell, Anderson
- 261, 262, 263.* **Research: Parasitology.** Wallace
- 270-271. **Cytology.** Organization of cells and their components. Ultrastructure, cytochemical analysis, and genetic aspects. (2 cr per qtr; prereq 55, #) Gall
- 272-273. **Cytology Laboratory.** Practical work in various types of microscopy, staining, cytochemistry, individual research projects. (2 cr; prereq #) Gall
- 283, 284, 285. **Physiology of Development.** Organization, presentation, and evaluation of results of research in experimental embryology. 283: Chemical embryology, metabolic aspects of

growth, differentiation, and morphogenesis. 284: Embryonic differentiation, including neuro-embryology. 285: Endocrines in development, including sex-differentiation. (4 cr per qtr; prereq 182 or equiv and §; 283 offered fall 1962-63, 284 offered fall 1963-64, 285 offered fall 1964-65) Spratt

291, 292, 293. General Seminar.

296, 297, 298.* Seminar in Special Research Fields.

Note—For additional courses in the related economic field, see Entomology and Economic Zoology in this bulletin.

GRADUATE OFFERINGS, DULUTH CAMPUS

Majors in Education, Curriculum and Instruction, Educational Psychology, and English

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, and English. This 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 program 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 Dean of the Graduate School, 316 Johnston Hall, University of Minnesota, Minneapolis 14, or to the Academic Dean, University of Minnesota, Duluth, Duluth 12.

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 12.

Prerequisites—Six quarter credits in psychology and a total of not less than 18 quarter credits of undergraduate work in education (including Ed 61A, B, C, or Ed 81A, B, C 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.

Admission to Candidacy—Before a student at Duluth is admitted to candidacy 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.

Examinations—Final examinations, and all other work for the degree, are conducted by the graduate faculty at Duluth.

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 and Psychology

GENERAL COURSES

- AgEd 154. Rural Education and Community Leadership.** (3 cr; prereq 10 cr in education)
- 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
- CD 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 61B-81B or equiv) Loy
- EdAd 116. The Teacher and School Administration.** (3 cr; prereq Ed 61A, B, C, or Ed 81A, B, C or equiv) Cramer, Wood
- EdAd 117. Schools in Rural Areas.** (3 cr; prereq §) Millbrath
- EdAd 123. Organization of Community School Programs.** (3 cr; prereq EdAd 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 §) Wells
- EdCI 109. Audio-Visual Materials and Equipment Laboratory.** (3 cr; prereq EdCI 105 or §) Wells, Keith
- EdCI 118. The Community School.** (3-6 cr; prereq §) M Peterson
- EdCI 145. Reading Difficulties.** (3 cr; prereq course in reading or basic training in counseling or school psychological work) D Smith
- 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, Johnson, Lindquist, Plumb, A Smith, Crawford, Wells, Wood, Bowne, Quereshi, Verrill, Walther, Green
- EPsy 110. Educational Measurement in the Classroom.** (3 cr; prereq Psy 58 or §) Johnson, Plumb
- EPsy 116. Statistical Methods in Education.** (3 cr; prereq §) Tamminen
- EPsy 140. Instruments and Techniques of Measurement.** (3 cr; prereq 110 or 116) Quereshi, Tamminen
- EPsy 150. Clinical Practice in Remedial Teaching.** (3-6 cr; prereq EdCI 64 or 143 or equiv, tchg exper, and §) D Smith
- 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
- 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
- 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 §) Bowne

ELEMENTARY EDUCATION

- EdAd 115. Elementary School Organization and Administration. (3 cr; prereq #) Cramer
- EdCI 102. Teaching Social Studies in the Elementary School. (3 cr) Crawford
- EdCI 103. Teaching Science in the Elementary School. (3 cr; prereq 9 cr in education) Verrill
- EdCI 119. Curriculum of the Elementary School. (3 cr; prereq #) Johnson
- EdCI 143. Teaching and Supervision of Reading in the Elementary School. (3 cr; prereq EdCI 64 or equiv or #) D Smith
- EdCI 149. Teaching and Supervision of Mathematics in the Elementary School. (3 cr) Johnson
- EdCI 150. Supervision and Improvement of Instruction. (3 cr; prereq #) Johnson
- EdCI 153. Teaching and Supervision of English in the 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 EdCI 55 or tchg exper) Green
- EPsy 182. Education of Exceptional Children. (3 cr; prereq Ed 61B or 81B 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)
- EPsy 184. Education of Mentally Retarded Children in the Elementary Schools. (3 cr; prereq 182 or #; offered at Duluth summer only)
- MuEd 150. Organization and Supervision of Vocal-Instrumental Music in Elementary Schools. (3 cr; prereq 15 cr in music and 6 cr in education or #) House

SECONDARY EDUCATION

- CD 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
- 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 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, Walther
- EdCI 131. Advanced Course in Teaching the Technical Business Subjects. (3 cr) Sielaff, Dettmann
- EdCI 132. Teaching the Basic Business Subjects. (3 cr) Sielaff, Dettmann
- EdCI 135. Group Procedures in Guidance. (3 cr; prereq EPsy 133 or #) Wood, Gum
- EdCI 144. Teaching of Reading in Junior and Senior High Schools. (3 cr; prereq 9 cr in education) Stensland
- EdCI 155. Materials and Laboratory for Social Studies Teachers. Printed and audio-visual materials useful in social studies classes. (3 cr; prereq tchg exper, #, and EdCI 89 or equiv) Crawford
- EdCI 168. Current Developments in the Social Studies. (3 cr; prereq EdCI 89 or #) Lindquist
- EdCI 169. Student Organizations and Activities. (3 cr; prereq Ed 81B, C or equiv) Wood
- EdCI 294. Advanced Course in Curriculum and Methods in Secondary School English. (3 cr; prereq Engl 90 or equiv) Stensland
- 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 EPsy 110 or 116, 133 and #)
- EPsy 233.* Problems in Guidance and Personnel Work. (1-9 cr; prereq #) Tamminen
- EPsy 282B. Supervised Practicum in Counseling. (3 cr; prereq #)
- HEEd 194A. Adult Education in Home Economics. (3 cr; prereq HE 88, EdT 82A) Palmer

- Ind 101. Tests in Industrial Subjects.** (3 cr) Kovach
- Ind 102. General Shop.** (2 cr) Kovach
- Ind 106. Industrial Education Workshop.** (3 or 6 cr [may be repeated for a maximum of 6 cr]; prereq tchg exper or #) Kovach, Voss
- Ind 107. Co-ordination.** (3 cr; prereq Ind 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 #) Kovach
- Ind 150. Vocational Education Surveys.** (3 cr; prereq #) Voss
- MuEd 105. Advanced Topics in Instrumental Music Education.** (3 cr; prereq #) Murphy, House
- MuEd 151. Supervision and Administration of Secondary Music Education.** (3 cr; prereq Mus 61, 62, 71, 72 or #) House

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 Δ) 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 Art 96 or #) Kiser
- 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 Art 98 or #) 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 Art 97 or #) 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 #) Kiser, Bailey
- 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 #) Tezla
- Engl 162. Milton.** (3 cr; prereq Engl 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 Engl 165 or #)
- Mus 121, 122. Advanced Harmony.** (2 cr per qtr; prereq Mus 9 or equiv) Alspach, Miller, J Smith
- 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 #) Hathaway
- Mus 141, 142. Orchestration.** (2 cr per qtr; prereq Mus 9 or equiv) Miller, J Smith, Murphy
- Mus 177. Analysis of Contemporary Music.** Twentieth-century styles and techniques including works of Bartok, Hindemith, Stravinsky, Schönberg. (3 cr; prereq Mus 9 or equiv) Miller
- Mus 193. Proseminar in 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 Mus 9 and 66 or #) Miller, J Smith
- Mus 196. Opera Production.** Historical development and staging techniques, with rehearsal and production of excerpts from chosen works. (3 cr [may be repeated for cr, maximum of 6 cr allowed toward MA]; prereq vocal, piano, or orchestral training) Herz
- Mus 204. Graduate Applied Music.** (2 cr per qtr, maximum 6; prereq placement test by Music Dept) Alspach, Beverley, Murphy, Downs, House, J Smith, van Appledorn, Edson

- Mus 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 #) Herz, House
- Spch 105. Theory of Reading and Acting.** (3 cr; prereq Spch 81, 82 or #) Hayes, Meitzer
- Spch 106. Discussion.** (3 cr; prereq Spch 3 or #) Hayes
- Spch 119. Introduction to Speech Correction.** (3 cr; prereq Spch 3 or #) Pierce
- Spch 131. Creative Dramatics.** (3 cr; prereq Spch 31 or # ...EdCI 63 recommended) Hayes
- 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 #) Meitzer
- 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) Hayes, Meitzer, 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. Spring Flora of Minnesota.** (3 cr; prereq Bot 52 or #) Monson
- Chem 103. Qualitative Organic Analysis.** Identification of pure organic compounds; separation of mixtures and identification of their components. (3 cr; prereq Chem 63) Passer
- Chem 111, 112, 113. Advanced Organic Chemistry.** Theories of organic chemistry; reactions of organic compounds; lectures and outside reading. (2 cr per qtr; prereq Chem 63) Passer
- Chem 121. Instrumental Analysis.** Theory and practice of various instrumental methods of analysis. (3 cr; prereq Chem 141 or ¶141) Moore, Thompson
- Chem 124-125. Quantitative Analysis.** Theory and practice in chemical analysis. (4 cr per qtr; prereq Chem 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 per qtr; prereq 2 yrs chemistry or #) Cowles, Thompson
- Chem 140-141-142.† Physical Chemistry.** (Formerly 140-141-142 and 143-144) Quantitative treatment of physical principles and theories underlying chemistry. Laboratory, physico-chemical measurements. (3 cr for 140, 3 or 5 cr each for 141-142; prereq 2 yrs chemistry, incl 50 or #, Phys 9, Math 51; 3 hrs lect for 140, 3 hrs lect [3 cr] or 3 hrs lect and 6 hrs lab [5 cr] for 141-142) Nichol
- Chem 146. Chemical Thermodynamics.** A treatment of laws of thermodynamics with a brief introduction to statistical thermodynamics. (3 cr; prereq Chem 142) Nichol
- 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 Math 26 or 50) McEwen
- Math 107-108. Advanced Calculus.** 107: Partial differentiation, multiple integrals and change of variable, operations with series, basic ideas and applications of vectors. 108: Line and surface integrals, Stokes's and Green's theorems, exact differentials, Beta and Gamma functions, Fourier series. (3 cr per qtr; prereq Math 92) Hafstrom, Burgstahler
- Math 136. Solid Analytic Geometry.** Algebraic treatment of planes and lines, direction cosines, systems of planes, cylinders, surfaces of revolution, quadric surfaces; tangent planes, ruled surfaces; co-ordinate transformations, invariants; general equation of the second degree. (3 cr; prereq Math 24 or 50) Hafstrom, McEwen
- Phys 106-108-110. Modern Physics.** (3 cr per qtr; prereq Phys 50 or equiv and ¶Math 27) Hanson
- Phys 113-115-117. Mechanics, Electricity, and Magnetism.** Theoretical course to prepare students for advanced work. (3 cr per qtr; prereq Phys 9 or 50, ¶Math 27) Gergen
- Zool 123. Advanced Insect Biology.** (3 cr; prereq Zool 60 or equiv)
- Zool 146. Helminthology.** (3 cr; prereq Zool 62 and #) Odlaw

Social Sciences

- BE 105A. Intermediate Accounting I.** Review of accounting processes, measurement of income, accounting treatment of inventories and plant assets. (3 cr, §BE 71; prereq BE 33 or equiv) Dettmann, Sielaff
- BE 105B. Intermediate Accounting II.** Accounting treatment of cash, receivables, investments, intangible assets, and applications of actuarial mathematics. (3 cr, §BE 72; prereq BE 105A or §) Dettmann, Sielaff
- BE 105C. Intermediate Accounting III.** Accounting treatment of stockholder's equity, interpretation and analysis of financial statements. (3 cr, §BE 73; prereq BE 105A or §) Dettmann, Sielaff
- BE 115A. Cost Accounting.** Practices, principles, and procedures of handling production costs for use in inventory valuation and income determination. Examination of job order, process, and standard cost systems. Brief introduction to standard cost as a tool of cost control. (3 cr, §BE 74; prereq BE 33 or equiv) Dettmann, Sielaff
- BE 115B. Cost Accounting.** Analysis of use of cost information in managerial decision making. (3 cr, §BE 75; prereq BE 115A or §) Dettmann, Sielaff
- BE 125. Auditing Principles and Procedures.** Instruction and laboratory in which a set of working papers and an audit report are prepared. (4 cr, §BE 78; prereq BE 105B or §) Dettmann, Sielaff
- BE 157. Marketing Management.** (3 cr; prereq BE 1, 2, 3 or §) 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, §BE 94; prereq BE 1, 2, or 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, §BE 15; prereq BE 1, 2, or 3 or §) Meyers, Sielaff
- Econ 168. Economics of Public Finance.** (3 cr, §BE 96; prereq BE 1, 2, 3 or §) Meyers
- Geog 101. Western Europe.** Physical and cultural geography of the countries of western Europe considered regionally and by a more detailed discussion of topics related to the geography of the Scandinavian countries, British Isles, France, and the Low Countries. (3 cr; prereq Geog 10) Witzig
- Geog 102. Central Europe.** Physical and cultural geography of the central European countries studied regionally and by individual countries. (3 cr; prereq Geog 10) Witzig
- Geog 105. Mediterranean.** (3 cr; prereq Geog 10) Witzig
- Geog 107. Soviet Union.** (3 cr; prereq Geog 10) Chamberlin
- Geog 110. South America.** (3 cr; prereq Geog 10) Hoag
- Geog 112. Western Anglo-America.** (3 cr; prereq Geog 10) Belthuis
- Geog 113. Eastern Anglo-America.** (3 cr; prereq Geog 10) Belthuis
- Geog 126. Australia and New Zealand.** (3 cr; prereq Geog 10) Belthuis
- Hist 103A, 104A, 105A. Renaissance and Reformation.** (3 cr per qtr; prereq Hist 1, 2, 3) 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 Hist 20, 21, 22) Lindquist, Larsen
- Hist 141D, 142D, 143D. American Diplomatic History.** 141D: Beginnings of American diplomacy to 1848. 142D: National diplomatic development. 143D: United States emergence as world power. (3 cr per qtr; prereq Hist 20, 21, 22) Livingston
- 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 Pol A-B or 9 cr in social sciences or §; offered when feasible) 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: 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 Soc 1 or §) Schmidt
- Soc 151. Sociology of Education. Sociological analysis of the institution 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 Soc 1 and 15 cr in social sciences, education, or psychology, or §) Stub
- Soc 161. Rural Community Analysis. (3 cr; prereq Soc 1, or §) Pearson

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College and Department Abbreviation Code

| | |
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| Acct, Accounting | Math, Mathematics (SLA) |
| Aero, Aeronautical Engineering | ME, Mechanical Engineering |
| AgBi, Agricultural Biochemistry | MeAg, Mechanized Agriculture |
| AgEc, Agricultural Economics | Med, Medicine |
| AgEd, Agricultural Education | MetE, Metallurgical Engineering |
| AgEn, Agricultural Engineering | Mgmt, Management |
| Agro, Agronomy and Plant Genetics | MicB, Microbiology |
| AmSt, American Studies | MinE, Mining Engineering |
| Anat, Anatomy | Mktg, Marketing |
| AnCh, Analytical Chemistry | MM, Mechanics and Materials |
| Anes, Anesthesiology | MuEd, Music Education |
| AnHu, Animal Husbandry | Mus, Music |
| Anth, Anthropology | |
| Arch, Architecture | NPsy, Psychiatry and Neurology |
| ArEd, Art Education | NSci, Natural Science |
| Art, Art | |
| Ast, Astronomy | |
| | Obst, Obstetrics and Gynecology |
| BFin, Finance | OMgt, Office Management |
| BLaw, Business Law | Oph, Ophthalmology |
| Bot, Botany | OrCh, Organic Chemistry |
| | Otol, Otolaryngology |
| CD, Child Development | |
| CE, Civil Engineering | Path, Pathology |
| ChEn, Chemical Engineering | PCh, Physical Chemistry |
| Clas, Classics | Ped, Pediatrics |
| Comp, Composition | PEM, Physical Education for Men |
| | PetE, Petroleum Engineering |
| DInd, Dairy Industries | PEW, Physical Education for Women |
| DyHu, Dairy Husbandry | Phcg, Pharmacognosy |
| | PhCh, Physiological Chemistry |
| Econ, Economics | Phcl, Pharmacology |
| Ed, General Education | Phil, Philosophy |
| EdAd, Educational Administration | Phsl, Physiology |
| EdCI, Curriculum and Instruction | Phys, Physics |
| EdT, Methods and Student Teaching | PIPa, Plant Pathology and Botany |
| EE, Electrical Engineering | PMed, Physical Medicine and Rehabilitation |
| Engl, English | PoHu, Poultry Husbandry |
| Ent, Entomology, Fisheries, and Wildlife | Pol, Political Science |
| EPsy, Educational Psychology | Prod, Production |
| | Psy, Psychology |
| For, Forestry | PubH, Public Health |
| Fren, French | |
| | QA, Quantitative Analysis |
| GeCh, General Chemistry | |
| Geog, Geography | Rad, Radiology |
| Geol, Geology and Mineralogy | Russ, Russian |
| Ger, German | |
| GPhy, Geophysics | Scan, Scandinavian |
| Grk, Greek | Soc, Sociology |
| | Soil, Soil Science |
| HE, Home Economics | Span, Spanish |
| HEd, History and Philosophy of Education | Spch, Speech and Theater Arts |
| HEEd, Home Economics Education | Surg, Surgery |
| Hist, History | SW, Social Work |
| Hort, Horticulture | |
| Hum, Humanities | Tran, Transportation |
| Hydr, Hydromechanics | |
| | VAna, Veterinary Anatomy |
| IE, Industrial Engineering | VBac, Veterinary Bacteriology and Public Health |
| InCh, Inorganic Chemistry | VMC, Veterinary Medicine and Clinics |
| Ind, Industrial Education | VObs, Veterinary Obstetrics |
| Ins, Insurance | VPaP, Veterinary Pathology and Parasitology |
| Ital, Italian | VPP, Veterinary Physiology and Pharmacology |
| ITM, Mathematics (Institute of Technology) | VSR, Veterinary Surgery and Radiology |
| | |
| Jour, Journalism | Zool, Zoology |
| Lat, Latin | |
| Law, Law | |
| Lib, Library Science | |

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Library School

1962-1964



Walter Library . . .
Location of the
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Bulletin

of the UNIVERSITY of MINNESOTA

UNIVERSITY OF MINNESOTA

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Volume LXV

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BULLETIN OF THE UNIVERSITY OF MINNESOTA

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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 Science, Literature, and the 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 a minor in librarianship to undergraduates in the College of Science, Literature, and the Arts and to undergraduates in the College of Education. 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 14.

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 1961 graduates averaged \$5,556.

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 Science, Literature, and the Arts or the College of Education 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. For information concerning evening study, telephone or write the Library School office, Room 3, Walter Library, University of Minnesota, Minneapolis 14. (Telephone 373-3100.)

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 two 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. All prerequisite courses are offered each summer, and 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 6 years under Plan A (with thesis), or 7 years under Plan B (with no thesis). The Library School encourages all students planning to become candidates for the M.A. to begin their study in the summer preceding the academic year in which they plan to enroll for graduate study.

Correspondence Courses—The Library School, in accordance with the standards of the American Library Association, offers no correspondence courses.

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. Students who would like positions as clerical or student assistants in the University Library should inquire at the Librarian's office.

Scholarships—Several scholarships are available. Applications are invited for the following financial aid:

| | |
|--|--|
| John C. Hutchinson Scholarship | \$ 250 |
| Lura C. Hutchinson Scholarship | 75 |
| H. W. Wilson Scholarship | 1,000 |
| Blanche L. Thompson Scholarship | 500 (for a school librarian) |
| Irene Fraser Jackson Scholarship | 1,000 |
| Minnesota Library Association Scholarship..... | 600 (offered every other year for a college or public librarian) |
| H. W. Wilson Company Scholarship..... | 1,000 (for 1963-1964 only) |

Graduate Library Assistantships—Through the co-operation of the University Library, students who have completed the 15 credits of prerequisite study are eligible to apply for a Graduate Library Assistantship. Appointees work 20 hours per week in the University Library, at a salary of \$2,000 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 University-maintained residence halls or in private rooming houses. Information concerning residence halls may be obtained from the director of University Housing, 108 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.

CURRICULAR REQUIREMENTS

Master of Arts Degree

Master's degree candidates will be required to demonstrate knowledge of the following subjects as prerequisite to graduate study:

| | |
|---|---|
| Lib 50—History of Libraries and Librarianship (3) | Lib 62—Reference I (3) |
| Lib 55—Library Administration (3) | Lib 70—Selection of Library Materials (3) |
| | Lib 83—Cataloguing and Classification (3) |

The prerequisite requirement can be met in 1 of 3 ways: (a) by successful performance in these courses, earning B marks; (b) by holding the B.S. in L.S. degree from an accredited library school; or (c) by satisfactory performance on a qualifying examination. When the student has demonstrated his mastery of these subjects, he may select graduate courses for further study.

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.

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 for the thesis. The Library School recommends Plan B for most students, but any student may request permission to work under Plan A after completion of the prerequisite courses.

Under Plan A (with thesis), the candidate must complete a minimum of 18 quarter credits of graduate courses (courses numbered 100 or above) in library science, with no grade lower than B. In addition, he must complete 9 quarter credits in a minor related field, with no grade lower than C. The thesis counts for 18 credits, thus completing the 45 quarter credits necessary for the degree.

Under Plan B, the candidate must complete, with an average of B, a minimum of 45 quarter credits in graduate courses. No graduate credit is allowed for work of D quality. At least 21 and not more than 27 of the 45 credit hours should be in library science. From 18 to 24 credit hours in at least 2 related minor fields are required. Under Plan B the student must prepare written reports of Master's thesis quality in 9 credits of advanced study. Such papers are usually referred to as Starred Papers. They may be written in connection with any graduate course or courses in the Library School, and may be 3- or 6- or 9-credit papers. Not more than one 3-credit starred paper in a related field will be approved. Two copies of starred papers must be prepared, and one copy must be submitted to the Library School office for permanent filing.

Library Minor in Ph.D. Programs

A student who wishes to declare a minor in library science on a doctoral program may do so with the approval of the Library School faculty and the approval of the major department.

Programs for School Librarians

1. The Library School offers a fifth-year graduate program, terminating in an M.A. degree, as full preparation for school librarians. Students who hold teaching certificates may apply for admission to this graduate program.

2. Graduates of liberal arts colleges who lack teaching certificates 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. This program, designed for a liberal arts graduate who wishes to become a school librarian, can be completed in 4½ or 5 quarters of full-time study.

3. The Library School also offers a 24-credit minimum certification program for Minnesota school librarians. It should be noted that according to the American Library Association's Standards any fully qualified professional librarian should have completed a fifth-year study program and be graduated from an accredited library school. Students admitted to this minimum certification program who plan a career as a school librarian should recognize the need for continuing their library education through the fifth year, graduating with the M.A. degree. For postgraduate students admitted to the Graduate School, 6 of the 8 courses in this certification program, or 18 quarter credits, may be counted in the 60-credit M.A. degree program.

The minimum certification program includes the following courses:

General, Basic Courses

- Lib 62—Reference I (3)
- Lib 70—Selection of Library Materials (3)
- Lib 83—Cataloguing and Classification (3)
- Lib 50—History of Libraries and Librarianship (3)
- (or) Lib 55—Library Administration (3)

Courses for School Librarians

- Lib 53—School Library Management (3)
- Lib 74—Library Materials in the Classroom (3)
- Lib 171—Reading Guidance for Children (3)
- Lib 172—Reading Guidance for Adolescents (3)

Students who wish to be admitted to this program should request from the Library School an application form for admission to the minimum certification program for Minnesota school librarians. This program is governed by the following policies and standards:

1. Admission to the College of Education of the University is required.
2. Up to 9 quarter credits of library science can be transferred from one other institution toward this program.
3. To be recommended for certification as a Minnesota school librarian on the basis of this program, the student must meet the following standards:
 - a. Hold a teaching certificate based upon a degree from an approved teacher training institution.
 - b. Be admitted to the program by both the Library School and by the College of Education.
 - c. Earn at least a 2.5 average in the 8 library science courses, with no mark below C and at least 4 marks of B or better.

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—During the academic year 1962-1963, full-time graduate students and undergraduate students in the College of Education or in the College of Science, Literature, and the Arts pay \$100 per quarter if they are residents of Minnesota, or \$240 per quarter if nonresidents. Foreign students are required to pay a health fee of \$5 per quarter.

Summer 1962 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 for Undergraduates—Undergraduate students in the University of Minnesota should ask for a conference with a member of the Library School faculty before planning their junior- and senior-year programs. The Library School recommends the following courses for the library minor:

| | |
|---|---|
| Lib 50—The History of Libraries and Librarianship (3) | Lib 62—Reference I (3) |
| Lib 55—Library Administration (3) | Lib 70—Selection of Library Materials (3) |
| | Lib 83—Cataloguing and Classification (3) |

These courses are all offered in the summer and in the fall quarter. At least one of them is available in the winter and in the spring. Students who complete these five courses as undergraduates with satisfactory performance may register for the graduate program as soon as they receive their Bachelor's degrees, and may expect to complete the M.A. requirements in 9 months of full-time graduate study (15 credits per quarter).

Admission for Students Not Candidates for Any Degree—Nondegree candidates seeking to register should ask for a conference with the director of the Library School or his assistant.

Admission for Graduate Students—Any student with a Bachelor's degree from a recognized college or university may apply for admission to the Graduate School. His acceptance will depend on his undergraduate scholastic record, and on the approval of the Library School. Sometimes the Library School discourages students over age 35 from embarking on a career in librarianship. All degree candidates in the Library School will take the Miller Analogies Test. An applicant of unsatisfactory scholastic record and qualification 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.

After completing a Bachelor's degree, *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, two transcripts of undergraduate records. Applicants for admission to the Graduate School will be notified by letter, usually after 4 weeks or more, as to the action taken by the Graduate School.

College graduates without previous library education may apply for admission and be admitted with the provision that they begin their study by enrolling in the five courses prerequisite to graduate study in library science. Students who have had library experience or who have studied similar courses in other colleges may request permission to take qualifying examinations in these courses. Students demonstrating their mastery of these subjects will be excused from taking them. Students who hold a B.S. in L.S. degree from an accredited library school are not usually required to repeat these courses.

There are definite advantages in beginning study toward the M.A. in the summer or in the fall. All prerequisite courses are available at these times. The student who wishes to begin in the winter or spring may find that few library courses are open to him since he lacks the prerequisites.

Graduate students registering for the first time in the Library School should request a conference with the director of the Library School or his assistant.

Articulation—The graduate Library School at the University of Minnesota encourages articulation between undergraduate and graduate library instruction programs by excusing students who demonstrate their mastery of five areas of librarianship by their performance on qualifying examinations.

Articulation must be on a sound educational basis, and it is no service to the student or to the library profession to waive prerequisites without clear evidence that the student has mastered the general foundation subjects and is ready for graduate study.

Policies on Qualifying Examinations—The following policies should insure the student's readiness for graduate study in the Library School:

1. Students who have applied for admission to the Graduate School and who have completed general, basic, introductory courses in reference, cataloguing and classification, selection of library materials, library administration, or the history of libraries with a grade of B in an accredited graduate library school will be excused from taking the course at Minnesota.

2. Other students who have applied for admission to the Graduate School and who wish to demonstrate their readiness for graduate library study by taking one or more of the qualifying examinations may arrange to take such examinations at least 1 week before the beginning of their first term in the Library School. The examinations must be taken in the Library School. The secretary of the Library School will schedule such examinations and administer them.

3. Graduate students may try qualifying examinations for any given course only once.

DESCRIPTION OF COURSES

Means "consent of instructor."

** Indicates courses prerequisite to graduate study.

For Juniors and Seniors

- 50.** **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
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)
- 55.** **Library Administration.** Principles of library administration, organization, and management. A general course for all librarians. (3 cr) Berninghausen
- 62.** **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 is also considered. (3 cr) Wezeman, Simonton, Berninghausen
- 70.** **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
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)
- 83.** **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

Advanced Undergraduate and Graduate Courses

131. **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. Students are encouraged to carry on research studies in the field in connection with starred paper requirements. (3 cr; prereq 55) Wezeman
153. **The 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 courses: 154, 155, 156, or 157 indicated by ##.
- 154.## **The Public Library.** History and development. Service standards. Modern trends and problems. Overview of the literature of the field. Guest lecturers, field trips. Development of the materials collection of the public library. (3 cr; prereq 55) Wezeman
- 155.## **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 55) Shove

- 156.## **Special Libraries.** Procedures, practices, and problems of newspaper, music, insurance, medical, technical, and other special libraries. (3 cr; prereq 55) Simonton
- 157.## **School Library Problems.** Library objectives in relation to educational objectives, larger units of school service, value and effect of standards. (3 cr; prereq 55)
160. **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 62) Shove
161. **Literature of the Humanities.** Bibliographical and other reference sources, including reviewing mediums. Developments and trends in the subjects covered. (3 cr; prereq 62) Shove
162. **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 62) Shove
165. **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) Shove
166. **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 62) Wezeman
168. **Research Methods in Librarianship.** Evaluation of research reported in library literature. (3 cr; prereq #) Simonton
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. (3 cr; prereq 70)
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 70)
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, science. Books are reviewed from the standpoint of adult reader interest and use. The promotion of adult reading and the evaluation of book collections. Various catalogues and lists of adult books. (3 cr; prereq 70) Wezeman
175. **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
176. **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
177. **History of Children's Literature.** Traced to gain a general appreciation, to discover the characteristics of books chosen by children, and to help develop standards for the selection of children's books. (3 cr)
181. **Advanced Subject Cataloguing.** History, theory, and practice of classification and subject heading; the Library of Congress Classification. (3 cr; prereq 83) Simonton
182. **Advanced Descriptive Cataloguing.** Intensive study of rules of entry, including foreign cataloguing codes. The cataloguing and classification of nonbook materials, such as serials, maps, and music. Administrative problems in cataloguing. (3 cr; prereq 83) Simonton
185. **Special Problems.** Individual study on library problems for advanced students in library science. (1-3 cr; prereq approval of director of Library School) Staff

Seminars for Graduates Only

258. **Problems in College and University Librarianship.** Personnel, buildings and equipment, appraisal of collections, administration, and policy-making. (3 cr; prereq 55 and 155) Berninghausen, Hopp, Stanford
259. **Problems in Public Librarianship.** Critical evaluation of the ingredients of public library service: personnel, materials, buildings. Case studies, readings, field research when possible. Guest lectures by administrative personnel from public libraries of the area. (3 cr; prereq 55, 154) Wezeman
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 154 or 157)
281. **Theories of Bibliographical Organization.** Recent developments in the organization of knowledge, particularly in specialized fields. The Universal Decimal Classification, the Colon Classification, Coordinate Indexing, the use of machines in information retrieval and other allied topics. (3 cr; prereq 83, 181) Simonton

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1962-1964



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Bulletin

of the UNIVERSITY of MINNESOTA

UNIVERSITY OF MINNESOTA

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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 19 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, a number of practicing lawyers are used for lectures in fields of their specialties.

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 14.

The Law Library

The library of the Law School, containing over 265,000 volumes, ranks fifth among law school libraries in the United States and is an outstanding legal research center. 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, research in practically any field of Anglo-American law can be carried on here. A user will find all the current materials he needs and also materials for historical studies. In addition to the Anglo-American section, the library has extensive sections in foreign and international law and a good working collection of literature in related social science fields. The primary function of the library is to serve the faculty and students of the Law School, but 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 may 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.

PROGRAM OF INSTRUCTION

Purpose and Method

The curriculum of the Law School has three objectives: (a) 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; (b) to create an understanding of and appreciation for the role of the lawyer and legal tribunals in the administration of justice; and (c) to prepare the School's 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.

Other teaching methods are used at Minnesota to develop the student's ability to solve problems. In the first year each student is given specific problems to resolve. He engages in independent research and study upon the problem and prepares a legal memorandum, opinion letter, or brief. He is then given intensive tutorial assistance. His analysis and writing are 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 research and writing program consists of an appellate moot court, with tutorial assistance in the preparation of briefs. The cases are also argued orally.

In his senior year the student participates in a seminar in which a small group of students examine 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. Each senior is also given experience in the basic method of resolving controversies: he prepares and tries 2 cases in the practice court, 1 to a judge and 1 to a jury.

Summary of Requirements for the Professional Degree in Law

The Law School program leading to the bachelor of laws degree requires 3 academic years, plus 15 quarter credits, of full-time Law School study carried on at prescribed levels of academic achievement.

The 15 quarter credits required in addition to the 3 academic years are equivalent to 1 academic "quarter" or $\frac{1}{4}$ of an academic year. They are ordinarily earned by attending one full summer program at this or another accredited law school, usually after the first or second year of law. This permits graduation at the end of the

third year of law in time for the July bar examinations in Minnesota and other states. The student may, however, choose to earn the 15 credits by attending an additional semester instead of summer school.

The purpose of the 15 credits is to provide the additional instruction time necessary to insure that the student not only becomes thoroughly grounded in courses necessary to technical competence in the law and its techniques, but at the same time is well trained for his responsibilities to improve the administration of justice and provide leadership in governmental and community affairs. For this reason the Law School program includes such courses as Judicial Administration, Standards of the Legal Profession, Jurisprudence, International Law, Modern Social Legislation, Labor Relations, Trade Regulation, Legislation, and Family Law.

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. The regular course in Criminal Law given in the Law School will be required of students pursuing this program. The seminar in Advanced Criminal Law is open to graduate students in the School of Social Work and the Department of Sociology upon approval of the instructors in the seminar and of the dean of the Law School.

Those interested in pursuing the undergraduate program should consult the Department of Sociology.

Graduate Study in Law

The Law School has no regular program for graduate study in law. In special cases it awards the degree of master of laws to the student who arranges a program of academic work, research, and writing under the supervision of a member of the faculty. The details of the program are worked out on the basis of the particular needs and desires of the individual. Students interested in such a program should confer with the dean's office.

Summer School

The Law School regularly offers at least 24 quarter credits of advanced courses in summer school. These courses extend without interruption through the 2 University terms of Summer Session. Students who have completed 1 year at any accredited law school are eligible for admission to this summer school.

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, or a special 3-year liberal arts program that embodies completion of the distribution plan and the major sequence. The Law School accepts the degrees bachelor of science and bachelor of business administration in place of the B.A. degree when a reasonably well-balanced

program of courses has been taken, but it urges that students taking these degrees plan a program with as wide a cultural distribution as possible.

The Law School does not recommend particular areas or departments for pre-law 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. It is for this reason that the special 3-year liberal arts program on the combined B.A.-LL.B. program requires a course in advanced English composition and the completion of 2 substantial research and writing projects at the Upper Division level.

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 at the University of Minnesota requires the following:

1. A bachelor of arts degree or its equivalent; or
2. Completion of a special 3-year liberal arts program outlined below that will qualify the student for the B.A. degree upon successful completion of his first year of law.

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 recommends completion of the regular 4-year college program before entering Law School. The 3-year liberal arts program is made available for those whose financial or military obligations make a 7-year combined college-law program too great a hardship. But the student with a well planned 4-year college program is better prepared, both for law studies and for the practice of law, than one who enters the Law School after 3 years of college. Twice as much advanced, Upper Division work ordinarily results in a student better qualified for the independent critical thinking required in the Law School, and in a lawyer better educated for his private and public responsibilities. Only a few students enter Law School without a 4-year degree.

The student who enters without a degree must have completed 3 years of liberal arts study under a program that entitles him to a B.A. degree from his college upon

successful completion of the first year of law. His 3 years of college work must include the following:

1. Completion of $\frac{3}{4}$ of the credits required for a B.A. degree.
2. Completion of the college cultural distribution or breadth requirements, except for the minor sequence.
3. Completion of the college requirements for a "major" in the department of the student's choice.
4. Completion of a course in advanced English composition.
5. Completion of two substantial papers involving independent research at the Upper Division level, either as a part of the requirements of a course or as an independent research assignment.

This special 3-year liberal arts program is available at the University of Minnesota in the College of Science, Literature, and the Arts and on the Duluth Campus, at a number of other colleges in Minnesota, and elsewhere. None of the work in this 3-year liberal arts program may be taken by correspondence study.

Academic Achievement and Aptitude Requirements

Admission is limited to applicants whose prelaw scholastic record, score on the Law School Admission Test, and other relevant data indicate a reasonable prospect for success in law study.

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 three parts. The first part is designed to measure aptitude for law study, rather than knowledge of the subject matter. The second part is a test of writing ability and the third part is a test of general background. No special preparation is necessary. 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 the University of Minnesota. The test should be taken during the academic year preceding the one for which admission is sought, preferably in February or before to facilitate early decisions on admission and scholarship applications.

Application forms and information bulletins about the test can be obtained from the University of Minnesota Law School, Minneapolis 14. The completed application form, together with the required fee of \$10, must be received in Princeton at least 10 days prior to the test date. Early inquiry should be made to obtain the exact dates when the tests will be given.

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.

Nonresidents

The requirements for admission of nonresidents of Minnesota are as above specified except that the academic records should be better than average as determined by the dean of the Law School. Applications from nonresidents must be accompanied by a credential examination fee of \$5.

Registration and Applications for Admission

Students are admitted to the Law School in the fall of the year. First-year students are not accepted at any other time. Dates of registration are mailed to applicants with their acceptance. Applications for admission may be obtained by writing to the Office of Admissions and Records, University of Minnesota, Minneapolis 14. Students who have not completed their college work may apply during their last quarter, semester, or term. Students who have completed college may apply at any time.

Registration with Bar Admission 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 Minnesota.

Since several states of major commercial importance require that applicants for the bar examination must have a degree before entering law school, the student who may be interested in practice in other jurisdictions should ascertain their pre-legal educational requirements.

Outside Earnings

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. Therefore, all students engaged in outside employment are required to submit a statement concerning the number of hours of work and to counsel with the dean or assistant dean. 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.

STUDENT ACTIVITIES AND HONORS

Minnesota Law Review

The *Minnesota Law Review*, established in 1917, is a legal periodical of the Law School. In addition to leading articles on law and related subjects, notes and comments on recent developments of the law are 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 ex-

change 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

Upperclassmen may participate in the school's Legal Aid Clinic, which is conducted in co-operation with the Minnesota State Bar Association. The clinic offers legal advice and assistance to students enrolled in the University of Minnesota who are financially unable to obtain private counsel. Volunteer attorneys from the local junior bar associations counsel with the student attorneys and with the student clients.

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.

EXPENSES AND FINANCIAL AIDS

Expenses

Careful estimates of the expenses of the students attending the Law School, together with other general information useful to students, are to be found in the *Bulletin of General Information* to be had upon application to the Office of Admissions and Records. The estimated expenses of a law student who is a resident of Minnesota

are \$1,670 per year (\$990 for a Twin Cities commuter). The expenses for a non-resident are \$375 greater.

Note—All University of Minnesota fees are subject to modification without notice.

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| Tuition fee per quarter (resident) | \$100.00 |
| Tuition fee per quarter (nonresident) | 225.00 |
| Credit hour fee (resident) | 8.50 |
| Credit hour fee (nonresident) | 18.75 |
| Incidental fee per quarter | 20.00 |
| Special examination fee | 5.00 |
| Graduation fee | 10.00 |
| Large diploma fee | 5.00 |
| (Tuition and fees for the academic year—residents \$360, nonresidents \$735) | |

Scholarships

Scholarships are awarded annually to promising students with financial need. They are available to first-year students as well as advanced students. The stipends vary with the financial need, but usually cover the cost of tuition, books, and other incidental education expenses. Aid on living expenses can be secured through loan funds.

Application forms for scholarships may be obtained from the dean's office and should be submitted not later than March 15.

Law Firm Scholarships—Annual scholarships are supported by each of the following law firms and individual lawyers. This list is not complete; solicitation for these scholarships was under way at the publication date for this bulletin.

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| Altman, Geraghty & Mulally, St. Paul | Robert G. Johnson, Willmar |
| Anderson, Anderson & Skinner, Grand Rapids | John B. King, Philadelphia, Pennsylvania |
| S. H. Bellman, Minneapolis | Kueppers, Strong & Kueppers, St. Paul |
| Benton & Weber, Grand Rapids | Sheldon S. Larson, Winthrop |
| Erling Berg, Duluth | Leonard, Street & Deinard, Minneapolis |
| Best, Flanagan, Lewis, Simonet & Bellows, Minneapolis | Levitt & Palmer, Minneapolis |
| Blethen, Ogle & Gage, Mankato | Lindquist, Fraser & Magnuson, Minneapolis |
| Briggs & Morgan, St. Paul | Mackall, Crouse, Moore, Helme & Holmes, Minneapolis |
| Lyman A. Brink, Hallock | Maslon, Kaplan, Edelman, Joseph & Borman, Minneapolis |
| Bundlie, Kelley & Torrison, St. Paul | Maun, Hazel, Green, Hayes, Simon & Aretz, St. Paul |
| Arthur A. Burck, New York, New York | McCabe, Van Evera & Mundt, Duluth |
| Butchart, Fredin & Eaton, Duluth | Meagher, Geer, Markham & Anderson, Minne- apolis |
| Cant, Haverstock, Beardsley, Gray & Plant, Minneapolis | Meighen, Sturtz, Peterson & Butler, Albert Lea |
| John F. Dablow, Cambridge | Merchant & Merchant, Minneapolis |
| Doherty, Rumble & Butler, St. Paul | Montague, Applequist, Lyons, Nolan, Nordine & Knetsch, Duluth |
| Dorsey, Owen, Barber, Marquart & Windhorst, Minneapolis | Moses, Friedell, Share, Rosen & Goldstein, Minneapolis |
| Stanley Efron, Minneapolis | Murphy & Preece, Grand Rapids |
| Erickson, Popham, Haik & Schnobrich, Minne- apolis | Neville, Johnson & Thompson, Minneapolis |
| Faegre & Benson, Minneapolis | Allen I. Nilva, St. Paul |
| Faricy, Moore, Costello & Hart, St. Paul | Nye, Sullivan, McMillan, Hanft & Hastings, Duluth |
| Felhaber, Larson & Fenlon, St. Paul | O'Brien, Ehrick & Wolf, Rochester |
| Robert H. Ford, Chicago, Illinois | O'Connor, Green, Thomas & Walters, Minne- apolis |
| Helmer A. Frankson, Hibbing | O'Leary & Trenti, Virginia |
| I. R. Calob, Hibbing | Olson & Graven, Albert Lea |
| James E. Gotlieb, St. Paul | Herbert E. Olson, Bemidji |
| Grannis & Grannis, South St. Paul | Oppenheimer, Hodgson, Brown, Baer & Wolff, St. Paul |
| Hall, Hedlund, Juster, Forsberg & Merlin, Minneapolis | |
| H. G. Haugland, Minneapolis | |
| Hultstrand, Abate & Wivoda, Hibbing | |
| Hvass, Weisman & King, Minneapolis | |

Pemberton, Michaels, Bishop & Seeger,
 Rochester
 Richard H. Plunkett, Rochester
 E. E. Ranta, Minneapolis
 Harvey T. Reid, St. Paul
 Arthur Roberts, Duluth
 Robins, Davis & Lyons, Minneapolis and
 St. Paul
 Millard Ruud, Austin, Texas
 Stanton D. Sanson, Miami Beach, Florida
 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 & Anderson, Marble
 Stacker & Stacker, St. Paul
 M. D. Steen of Cleary Gotlieb & Steen,
 New York, New York
 Stringer, Donnelly & Sharood, St. Paul
 Sullivan & Cromwell, New York, New York
 Van Valkenburg & Moss, Minneapolis
 Vennum, Newhall, Ackman & Goetz, Minne-
 apolis
 Wangenstein & Bangs, Chisholm
 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 \$1,245 from the Cargill Foundation of Minneapolis to provide 1 first-year, 1 second-year, and 1 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 with the co-operation of the Greater University Fund 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.

Homer B. Dibell Law Scholarship Fund—An anonymous gift of \$5,000 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 \$6,000 created by friends and associates 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.

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.

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 Wives' Scholarship—An annual gift by the Law Wives' Club to be awarded by the faculty to a married student with emphasis first on need and second on scholastic ability.

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.

Samuel Lipschultz Scholarship—A \$250 annual scholarship given by Nathan Shapiro in memory of the late Samuel Lipschultz, Esq., of St. Paul

Minneapolis-Honeywell Regulator Company Law Scholarship—An annual \$500 scholarship for a promising student with financial need.

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.

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.

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 \$500 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.

Harry G. Pliam Law Scholarship—An annual \$500 scholarship given by Nathan Pliam in memory of his brother Harry G. Pliam.

Harold J. Richardson Law Scholarship—A \$500 scholarship given annually by Mrs. H. J. Richardson in honor of her husband, Harold J. Richardson.

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.

Loan Funds

The revolving loan funds listed below, with total assets of \$107,000, are available exclusively to Law School students of good character and dependable scholarship in case of financial need. Loans from other University funds are also available in appropriate cases. Repayment of loans is expected on a reasonable periodic payment basis after graduation.

Henry J. Fletcher Memorial Aid Fund—Approximately \$18,000 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.

Frank B. Kellogg Loan Fund—A bequest by the late Frank B. Kellogg now valued at over \$39,000.

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*.

Wheeler, Fredrikson & Larson Loan Fund—A growing fund increased annually by substantial gifts to provide loans interest free until graduation.

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.

Since other departments of the University operate on a quarter system the credits indicated are quarter credits. However, Law School classes are scheduled on a full year or semester basis. 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 attend an orientation period immediately preceding the regular opening of classes.

REQUIRED COURSES

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) Kinyon
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) Kamisar, Pirsig, Ellingston
103. **Legal Process.** Function, sources, and development of law; introduction to judicial, legislative, executive, and administrative processes and their interrelations; law-making institutions in action as they are called upon to handle social problems. (4½ cr) Auerbach, Choper, Sandalow
106. **Legal Research.** Books and other tools of the legal profession; preparation of memoranda 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. (6 cr) Cound, 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
109. **Introduction to Procedure.** Pleading, common-law, code and rule; demurrers and related motions; functions of judge and jury; judgments. (3 cr) Cound, Miller
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, Kamisar, Lockhart

Second Year

105. **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. (For law students with inadequate background in accounting.) (3 cr) Choper

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) Kinyon
121. **Appellate Advocacy.** Practice before appellate courts; preparation by each student of briefs and argument in two appellate moot court cases with tutorial instructions 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) Choper
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) Choper
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) Sandalow
125. **Remedies.** Equity, damages, restitution; primary emphasis upon equitable relief, with legal material largely restricted to contract. (6 cr) Miller
126. **Sales.** The sale of goods at common law, under the Uniform Sales Act, and under the Uniform Commercial Code. (4½ cr) 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, Waterbury
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
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, Kamisar

Third Year

147. **Independent Research.** Preparation in depth of a major paper on a difficult legal problem. (3 cr) All faculty
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
163. **Practice.** Rules of civil procedure including pre-trial and post-trial motives, parties, pleading and discovery, appeals; legal medicine; practice trials including court and jury cases. (12 cr) Hetland, Cound
173. **Taxation II.** Federal income taxation of partnerships and corporations as applied to common current problems in business planning. (3 cr; prereq 128 and 123) Waterbury

ELECTIVES

140. **Administrative Law.** Administrative process in our society; powers and procedures common to all administrative agencies; interrelations of legislative, judicial, executive, and administrative agencies in development of public policy. (4½ cr) Auerbach
142. **Conflicts.** Jurisdiction, judgments, choice of law. (4½ cr) Cound

143. **Creditors' Remedies.** State remedies, including attachment, garnishment, and execution; selected bankruptcy problems. (4½ cr) McClure
144. **Criminal Law Seminar.** Problems of criminal law administration and of the juvenile court; the seminar 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) Pirsig, Ellington
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) Waterbury
146. **Estate Planning Seminar.** 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 interests. (3 cr; prereq 128, 127, 145 [145 may be taken concurrently]) Waterbury
150. **Insurance.** Primarily the law governing the making of insurance contracts and their construction; also regulation of the insurance industry. (4½ cr) Hogg
152. **Judicial Administration.** A study of 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
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) McCoid
156. **Labor Law Practice.** For students intending to engage in labor practice; arbitration of labor disputes; NLRB proceedings in representation 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
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) Sandalow
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) McCoid
164. **Regulated Industries Seminar.** 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 antitrust 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

167. **Securities Regulation.** Legal and financial aspects of federal and state securities acts; registration; prospectus; distribution; remedies implied from statutes. (3 cr) Choper
169. **Supreme Court Seminar.** Work of the United States Supreme Court during its current term; special emphasis on important recent decisions, jurisdiction, practice. (3 cr) Choper
170. **Judicial Administration Seminar.** 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, etc. (3 cr) Pirsig
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, pacific settlement of disputes; international organization. (4½ cr) Christie
177. **International Commercial Transactions.** Problems of foreign trade and investment. (4½ cr) Hogg
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) Sandalow
182. **Secured Transactions Seminar.** 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
184. **Unfair Competition.** Trademarks and unfair competition; other interference with business relationships; copyright law. (4½ cr) Miller
185. **Jurisprudence.** Philosophies of law; theories of justice; analysis of legal language; law as 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. (3 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
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. (3 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, Raup
193. **Criminal Procedure Seminar.** 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) Kamisar
195. **Family Law Clinical Seminar.** Limited to 10 students who will participate with psychiatrists in interviewing and representing indigent clients seeking divorces; includes participation in 195A. (4½ cr; prereq 186) Levy
- 195A. **Family Law Seminar.** 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. **Trusts and Estates Seminar.** Builds on the materials covered in the basic Trusts and Estates course; specific content varies from year to year. (3 cr; prereq 127) Hogg