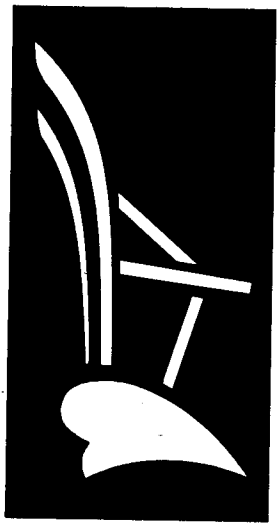

GRADUATE SCHOOL 1964 - 1966

UNIVERSITY OF MINNESOTA BULLETIN

How to Use This Bulletin

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

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

Do Not Fail to Read . . .

(1) The complete description of conditions and requirements for the degree you expect to earn (for the Master's degree, page 8; for the Ph.D. degree, page 13).

(2) The paragraphs headed "Time Limit for Earning the Ph.D. Degree," page 14.

(3) The section entitled "Symbols and Explanations," page 38. This is your guide to the understanding of terms and symbols used in course descriptions.

The office of the Graduate School is located in Johnston Hall. During the academic year the Registration and Information Office, 316 Johnston Hall, is open from 8 a.m. to 12 noon and from 1 p.m. to 4 p.m. Summer hours of the Registration and Information Office are 7:45 a.m. to 12 noon and 1 p.m. to 3:30 p.m.

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GRADUATE SCHOOL

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UNIVERSITY OF MINNESOTA BULLETIN

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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 1963, the Graduate School had awarded 5,431 Ph.D. degrees and 20,285 Master's degrees.

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

The Graduate School is organized under seven advisory group committees in the areas of Agriculture; Biological Sciences; Education, Philosophy, Music, Psychology, Child Development, Speech Pathology; Language, Literature, and Art; Medical Sciences; Physical Sciences, Mathematics, Engineering; and Social Sciences. The dean, the associate dean, and the chairmen of these committees form the Executive Committee of the Graduate School. In addition there are 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 1,500, teaches both in the Graduate School and in the several undergraduate and professional colleges.

The following pages contain detailed information with respect to the structure and rules of the Graduate School, fellowships and assistantships open to graduate students, the programs of study made possible by the offerings in 130 majors, and a list of courses offered.

ADMISSION

Any student with a Bachelor's degree or its equivalent from a recognized college or university may apply to the dean of the Graduate School for admission. University of Minnesota undergraduates who lack not more than 9 quarter credits toward the Bachelor's degree (taking into account required sequence courses) if they meet admission standards may register in the Graduate School. 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, Child Psychology, Economics, Education (Education and Educational Administration [for the Ph.D.]; all applicants for the Specialist in Education Certificate regardless of major; and Educational Psychology), Genetics when the program emphasizes human genetics, Industrial Relations, International Relations, Library Science, Political Science, Psychology, Public Administration, Social Work, Sociology, Speech and Theatre 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.

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

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, or to the Student Counseling Bureau, 101 Eddy Hall, University of Minnesota, Minneapolis, Minnesota 55455.

Information concerning admission may be obtained from the Graduate School, 316 Johnston Hall, University of Minnesota, Minneapolis, Minnesota 55455. Applications for admission to the Graduate School must be received *complete in every detail* —two 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, Univer-

sity 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.

For estimates of living expenses, see the *Bulletin of General Information.*

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. A physical examination is required of all students entering the Graduate School. Students who have met the physical examination requirement for entrance into one of the other colleges of the University of Minnesota will not regularly be required to repeat this examination. When students are admitted to the Graduate School and are required to take the physical examination, the forms on which their physicians will report the results of the examination will accompany the letter of acceptance.

Registration by Mail (Ph.D. Candidates)—The student who has been admitted to candidacy for the Ph.D. (for definition of candidacy see page 14) and is not registered for course work may register by mail. He must return his registration form and check or money order in the appropriate amount to the Office of Admissions and Records, Morrill Hall, University of Minnesota, Minneapolis, Minnesota 55455. Registration forms for this purpose will be mailed to the candidate prior to the opening of each academic quarter.

FEES

For 1963-64 the following fees apply. See *Bulletin of General Information* for possible changes.

Tuition fees for residents** (except in dentistry, pharmacy, clinical medicine, veterinary medicine) per quarter	
6 credits or less, or thesis only	$ 45.50
More than 6 credits	91.00
Tuition for nonresidents per quarter (except in dentistry, pharmacy, clinical medicine, veterinary medicine) per quarter	
6 credits or less, or thesis only	122.50
More than 6 credits	245.00
Tuition fees for Ph.D. candidates (for definition of candidacy, see page 14)	
6 credits or less or to meet continuous registration requirement (resident or nonresident) per quarter (Incidental fee optional for students in residence)	20.00
More than 6 credits (residents)	91.00
More than 6 credits (nonresidents) (Incidental fee required)	245.00
Incidental fee (per quarter)	20.00

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

Foreign students—special instruction in English (per quarter) (consult Graduate School office or Office of Adviser to Foreign Students)	15.00
Health fee for foreign students (per quarter)	5.00
Special deposit for chemistry laboratory	10.00
Graduation fee	10.00
Fee for binding Master's thesis	5.00
Fee for microfilming Ph.D. thesis	25.00

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

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

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

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

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

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

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

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

CANDIDACY FOR 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 can be transferred to the Graduate School only under the following conditions:

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

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

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

From 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 and Specialist Certificate in courses numbered 100 and above offered by the Extension Division of the University of Minnesota and 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 expected to be present at commencement, but may petition to be excused by the dean of the Graduate School.

REQUIREMENTS FOR THE MASTER'S DEGREE**

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

The Two Plans for the Master's Degree

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

In either of the two plans, it is possible and acceptable under the rules (except in certain specified areas) for the student who is adequately prepared and who can devote full time to graduate study to complete the requirements for the Master's degree in 1 academic year of 3 quarters,‡‡ or its equivalent in summer sessions.†† (Not all major fields afford sufficient course work in summer sessions to meet degree requirements.) 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 S—"satisfactory." This indicates the instructor's approval of the quality of the student's work on the graduate level. It signifies a letter grade of B at least. Grades A, B, C, or D may be received for these courses. In courses open to both graduates and undergraduates the system of marking by letters is used.

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

Admission to Candidacy—Following completion of 9 to 15 graduate credits, at least 3 of which must be in the major, and not later than the opening of the quarter

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

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

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

preceding the final quarter or final summer term, the student who expects to obtain a Master's degree shall present his program and his thesis title (for Plan A) or his program (for Plan B) for his adviser's signature. He shall then submit his signed program to the Graduate School for group committee action. Blanks for this purpose are provided by the Graduate School. A transcript of all graduate work the student has taken must accompany the program. Approval by the graduate group committee and the Graduate School indicates the student's admission to candidacy for the degree.

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

Plan A: Master's Degree with Thesis

Major and Minor Work—In choosing a field for major or minor work, the student must present the minimum undergraduate preparation prescribed in the departmental statements. He must complete in the Graduate School a minimum of 18 quarter credits in the major and 9 in the minor with a grade not lower than B in any course 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 and the appropriate graduate group committee, is required of candidates for the Master's degree, unless exemption is made in individual cases with the approval of the adviser and appropriate group committee or the requirement is specifically waived in a given area. The requirement can be satisfied either

(1) by passing a proficiency examination or

(2) by presenting to the appropriate language department certification of a grade of A in the third quarter of study of a language or a grade of B in the fourth quarter of study of a language, assuming: (a) that the course work was completed at the University of Minnesota; (b) that the course work was completed no longer than 5 years prior to the time the student applies for language certification; and (c) that any language department at Minnesota has the right to specify minimal course requirements in excess of those mentioned above. **Note:** Courses taken in the Exten-

sion Division for credit or in Correspondence Study may not be used in lieu of the proficiency examination or

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

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

For regulations on transfer of language certificates from other institutions, see page 17.

For regular dates of language examinations, see page 17.

Master's Thesis—The student shall submit the title of his thesis and a complete program of the work to be offered for the degree on a form secured at the Graduate School office. The thesis title must be approved by his adviser and by the appropriate group committee. The thesis should be on a topic falling within the field of the major. The candidate will ordinarily devote approximately half of his time to the preparation of the thesis, including courses on which the thesis is based. The thesis must be written in acceptable English, show ability to work independently, and give evidence of power of independent thought both in perceiving problems and making satisfactory progress toward their solution. Familiarity with the bibliography of the special field and correct citation of authorities are expected.

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

The thesis must be finished and registered in the office of the dean of the Graduate School *at least 8 weeks* before the commencement convocation at which the candidate presents himself for his degree.

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

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

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

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

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

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

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

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

Students eligible for the "preliminary examination" for the Doctor's degree may 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 forms are provided for signed reports concerning the thesis and the final written or oral examinations. All reports must be filed in the office of the dean of the Graduate School *5 weeks before the end of the last quarter.*

SUMMARY OF REQUIREMENTS FOR MASTER'S DEGREE WITH THESIS

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

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

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 24). While it does not permit an indiscriminate scattering of courses over unrelated fields, it does not stress concentration on one major and one minor field. It is understood that more than one field will be included outside the field of concentration. Insofar as it has a professional aspect, the Master's degree under Plan B is less a test of research interest and more adapted to individuals who will profit by a broader range of knowledge in their fields. Whether taken for professional or cultural purposes, the requirements under Plan B are meant to test interests and intellectual abilities for a different purpose but not on a different level from those for Plan A.

Under Plan B, candidates for the Master's degree must complete, with 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 the major field. Not less than 18 of the 45 credits should be offered in at least two related fields with a minimum of 6 credits required in each. It should be kept in mind that these are minimum requirements and that some major fields require more. Papers representing the quality but not the range of the Master's thesis shall be prepared in three advanced courses or seminars or in problems courses or courses which permit independent work under faculty supervision and involve 9 credits. This requirement may be satisfied with a combination of the above which is acceptable to the Graduate School. The work may be done either in the major field or in related fields. 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.

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

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

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

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

REQUIREMENTS FOR THE MASTER OF FINE ARTS DEGREE

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

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

REQUIREMENTS FOR THE DOCTOR'S DEGREE

In the Graduate School, one Doctor's degree, the doctor of philosophy (Ph.D.), is conferred by the University of Minnesota. This degree is granted not on the basis of successful completion of a definite amount of prescribed work but chiefly in recognition of the candidate's high attainments and ability in his special field, as shown, first, by passing of the required examinations covering both the general and the special fields of the candidate's subjects as detailed later, and second, by the preparation of a thesis. Grades of B or better are required in the major and grades of C or better in the minor or in the *supporting program of study.*

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

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

residence or staff status. The required period of 3 years will normally suffice only for students who devote full time to graduate study. Students who intersperse graduate study between periods of professional or other regular employment will need to extend the total period of study over a longer time.

Program of Study

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

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

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

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

1. A list of all graduate courses completed and proposed in the major.

2. A list of all graduate courses completed and proposed in the minor.

3. Courses offered as a collateral field or special research technique when either is being proposed.

4. If the candidate wishes to present graduate courses taken elsewhere toward the Ph.D. degree from the University of Minnesota, these should be listed under 1, 2, and 3 on his Doctoral Program Form. 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 completed graduate work the student lists on his program, whether taken here or elsewhere, must accompany the program.

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

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

Time Limit for Earning the Ph.D. Degree—Effective with the quarter immediately following admission to candidacy for the Ph.D. (or fall quarter 1962 for students who have been admitted to candidacy prior to fall quarter 1962) the student must:

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

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

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

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

Language Requirements

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

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

(1) by passing the proficiency examinations or

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

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

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

The foreign languages selected for fulfilling this requirement should be relevant to the field of scholarly work of the candidate. The burden of proof of the relevance of proposed languages rests upon the candidate and his major adviser. In no case may English be submitted as a foreign language. The foreign language requirement must be completed before the student is admitted to the preliminary examinations for the Ph.D.

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

In meeting the foreign language requirement, credits earned in other approved institutions may be transferred to the University of Minnesota record if these have been completed within a 3-year period immediately prior to entering this Graduate School.

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

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

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

Collateral Field Option—A collateral field of knowledge is defined as not less than 15 credits of work in courses numbered 100 or above, completed with a grade not lower than C. For this purpose a maximum of 6 of the 15 credits may be transferred from the Extension Division, provided that the courses are taught by approved members of the graduate faculty. The collateral field of knowledge is expected to broaden the candidate's scholarly and scientific background by permitting exploration of knowledge in a field related to the major and minor. The collateral field of knowledge may include in this sense any work now available or to be developed in the preparation for college teaching, including supervised instruction at the college level.

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

Where a collateral field of knowledge is offered in place of one foreign language, this collateral field must be completed before the student is admitted to

the final oral examination for the Ph.D., and the work to be presented in meeting this requirement shall be entered on the student's doctoral program. Completion may be in terms of earned course credits, or of validated transfer of credits from another institution, or of special proficiency examinations where feasible and practical.

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

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

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

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

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

Major Work

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

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

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

Minor Work

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

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

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

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

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

Supporting Program of Study

With the approval of his major adviser and the appropriate group committee, a student may include, in place of the minor, a *supporting program* of study in his

over-all doctoral program. The traditional minor will continue to be available at the option either of the student or of his adviser.

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

A student electing to use the supporting program option will not be expected to take written preliminary examinations in the fields included in his supporting program, nor will he be expected to have competency in each of the fields in his supporting program comparable to that of a person with a traditional minor in the field concerned.

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

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

Examinations

Written Examination—A written examination in the major subject shall be given by the graduate faculty in the major field prior either to the preliminary or to the final examination or to both, as the graduate faculty may decide. This examination shall cover all the work done in the major, and *may include any work fundamental thereto.* The passing or failing of this written examination shall be reported by the major adviser to the Graduate School office on forms which students will obtain in that office. In case of failure, the candidate will normally be allowed only one opportunity to retake the failed examination; this re-examination will be permitted not earlier than the following academic quarter.

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

The preliminary oral examination shall cover both the major and minor fields or supporting program and may include any work fundamental thereto, except the

thesis. Only after passing the preliminary oral examination may the student be considered a candidate for the Doctor's degree.

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

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

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

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

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

Doctor's Thesis

The thesis, for which accumulation of material may well be started by the middle of the second year, must show originality and power of independent investigation and embody results of research that form a real contribution to knowledge as well

as exhibit mastery of the literature of the subject and familiarity with the sources. The matter must be presented with a fair degree of literary skill.

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

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

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

When he submits his *final oral examination report,* the candidate will sign in duplicate a *Memorandum of Agreement* with University Microfilms, Ann Arbor, Michigan, under which the ribbon copy of the thesis will be microfilmed before being permanently filed in the University of Minnesota Library. He will then pay his microfilm fee of $25. If he wishes his thesis to be copyrighted he will pay an additional $5 plus 1¼ cents per page for 2 positive microfilm copies of his thesis, which will be deposited in the Library of Congress.

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

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

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

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

Reports—Special forms are provided for signed reports on the written examination in the major, the preliminary oral examination, the review of the thesis, and the final oral examination. *All these must be filed with the Graduate School office:* the report on the written examination in the major before the preliminary oral examination can be scheduled, the thesis review report at the time the final oral examination is scheduled, and the final oral report form at least 5 *weeks* before graduation.

** 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.

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

SUMMARY OF REQUIREMENTS FOR THE DOCTOR'S DEGREE

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

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

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

MASTER'S DEGREE

Aeronautical Engineering
Agricultural Biochemistry
Agricultural Economics
Agricultural Education
Agricultural Engineering

PH.D. DEGREE

Aeronautical Engineering
Agricultural Biochemistry
Agricultural Economics

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

MASTER'S DEGREE

Agricultural Plant Physiology
Agronomy
American Legal Institutions
American Studies
Analytical Chemistry
Anatomy
Anesthesiology
Animal Husbandry
Anthropology
Architecture
Area Studies
Art
Art Education
Astronomy
Biophysics
Biostatistics
Botany
Business Administration
Chemical Engineering

Child Psychology
Civil Engineering
Classical Civilization
Classics
Comparative Literature

Curriculum and Instruction
Dairy Husbandry
Dairy Industries
Dentistry
Dermatology
Economics
Education
Educational Administration
Educational Psychology
Electrical Engineering
Electrical Science
English
Entomology
Environmental Health
Epidemiology
Fine Arts
Fisheries and Wildlife

Forestry
French
Genetics
Geography
Geology
Geophysics
German
Greek
History
History and Philosophy of Education
Home Economics
Home Economics Education
Horticulture

Hospital Pharmacy
Industrial Education
Industrial Engineering
Industrial Relations
Inorganic Chemistry
International Relations
Journalism
Latin
Library Science
Linguistics and Comparative Philology
Mathematics
Mechanical Engineering

PH.D. DEGREE

Agricultural Plant Physiology
Agronomy

American Studies
Analytical Chemistry
Anatomy

Animal Husbandry
Anthropology

Art (History and Criticism)

Biophysics
Biostatistics
Botany
Business Administration
Chemical Engineering
Chemical Physics
Child Psychology
Civil Engineering
Classical Civilization
Classics
Comparative Literature
Control Sciences

Dairy Husbandry
Dairy Industries

Dermatology
Economics
Education
Educational Administration
Educational Psychology
Electrical Engineering

English
Entomology
Environmental Health
Epidemiology

Fisheries and Wildlife
Fluid Mechanics
Forestry
French
Genetics
Geography
Geology

German
Greek
History

Home Economics

Horticulture
Hospital Administration

Industrial Engineering
Industrial Relations
Inorganic Chemistry
International Relations
Journalism
Latin

Linguistics and Comparative Philology
Mathematics
Mechanical Engineering

MASTER'S DEGREE	PH.D. DEGREE
Mechanics and Materials	Mechanics and Materials
Medical Technology	
Medicine (Internal)	Medicine (Internal)
Metallurgical Engineering	Metallurgical Engineering
Microbiology	Microbiology
Mineral Engineering	Mineral Engineering
Mineralogy and Petrology	Mineralogy and Petrology
Museology	
Music	Music
Music Education	
Neurology	Neurology
Neurosurgery	Neurosurgery
Obstetrics and Gynecology	Obstetrics and Gynecology
Ophthalmology	
Organic Chemistry	Organic Chemistry
Orthopedic Surgery	Orthopedic Surgery
Otolaryngology	Otolaryngology
Pathology	Pathology
Pediatrics	Pediatrics
Pharmaceutical Chemistry	Pharmaceutical Chemistry
Pharmaceutical Technology	Pharmaceutical Technology
Pharmacognosy	Pharmacognosy
Pharmacology	Pharmacology
Philosophy	Philosophy
Physical Chemistry	Physical Chemistry
Physical Education	
Physical Medicine and Rehabilitation	Physical Medicine and Rehabilitation
Physical Therapy	
Physics	Physics
Physiological Chemistry	Physiological Chemistry
Physiological Hygiene	Physiological Hygiene
Physiology	Physiology
Plant Pathology	Plant Pathology
Plastic Surgery	
Political Science	Political Science
Poultry Science	Poultry Science
Proctology	
Psychiatric Nursing	
Psychiatry	Psychiatry
Psychology	Psychology
Public Administration	
Public Health	
Radiology	Radiology
Scandinavian	
Social Work	Social Work
Sociology	Sociology
Soil Science	Soil Science
Spanish	Spanish
Speech and Theatre Arts	Speech and Theatre Arts
Speech Pathology and Audiology	Speech Pathology and Audiology
Statistics	Statistics
Surgery	Surgery
Theatre Arts	
Urology	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

Considerable graduate work specifically of interest to teachers is offered in the Summer Session. Students interested in graduate summer study for other purposes will find relatively limited offerings in a wide range of fields. Announcement of these

courses may be found in the *Bulletin of the Summer Session.* Graduate work is also offered through federally supported institutes, the Biology Session at Lake Itasca Forestry and Biological Station, and in the Summer Session at the University of Minnesota, Duluth.

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

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 $1,100 for 25 per cent of full-time service to $2,200 for half-time service for the academic year, to $2,933 for half-time service for the 12-month period. Also available are a limited number of appointments as teaching associates with stipend of $2,400 for half-time service for the academic year. Partial tuition scholarships in varying amounts may be attached to any of these appointments. The amount of graduate work that can be carried is proportionate to the service burden of the appointment.

Applications must be received in the Graduate School office by 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, Min-

neapolis, Minnesota 55455, but all application blanks should be returned to the head of the department appointing the assistant.

Administrative and Clinical Fellowships (not rigidly restricted as to major field of study) are available in the offices of the Graduate School, the School of Dentistry, the College of Education, the School of Home Economics, the School of Journalism, the Department of Electrical Engineering, the Department of Political Science, Audio-Visual Education Service, the Department of Radio and Television, Coffman Memorial Union, the University Village Union, the Dean of Admissions and Records, the Student Counseling Bureau, the Bureau of Student Loans and Scholarships, and 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 30 hours of work a week provide room and board and a stipend of $90 a quarter for new counselors and $100 a quarter for counselors who are reappointed. Residence hall counselors who hold the baccalaureate degree and are out-of-state students pay tuition fees at the resident rate. All other 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, 8 Temporary North of Mines, University of Minnesota, Minneapolis, Minnesota 55455.

Fellowships and Scholarships

Fellowships Unrestricted as to Field

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

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

***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 1964-65.

John Cowles Foundation Fellowships (10-15) in amounts from $400 to $500, depending on students' needs, are open to nationals of Aden, Afghanistan, Bahrein, Burma, Cambodia, Ceylon, India, Indonesia, Iran, Iraq, Israel, Jordan, Kuwait, Laos, Lebanon, Libya, Malaya, Morocco, Nepal, Oman, Pakistan, Qatar, Saudi Arabia, Singapore, Thailand, Trucial Oman, Tunisia, Turkey, United Arab Republic, South Viet Nam, Yemen, and countries of Africa south of the Sahara 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, Minnesota 55455.

***Minneapolis Woman's Club Fellowship** at $1,800 available in alternate years to a woman student meeting scholarship and leadership qualifications. Offered 1964-65.

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

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

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

University Alumni Graduate Fellowships (2) 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.

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

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

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

Graduate School Tuition Scholarships and Graduate School Summer Tuition Scholarships 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 programs under the National Defense Education Act, Title IV and Title VI, are available to graduate students. For many of these, applications are due before November 1 for the next academic year. Information concerning these opportunities may be received from the Graduate School Fellowship Office on the third floor of Johnston Hall, University of Minnesota.

Tozer Foundation Fellowships (20-40 with a maximum of $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, 104 Wesbrook Hall, University of Minnesota.

Fellowships Restricted as to Field

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

7—AGRICULTURAL SCIENCE FIELDS

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

Agricultural Biochemistry

Procter and Gamble Fellowship in Agricultural Biochemistry at $1,800 ($2,200 if student is married). Agency pays fees.

United States Public Health Service Predoctoral Trainee Fellowships (4-7) in Agricultural Biochemistry at $2,400 on calendar year basis. Agency pays fees. Application deadline July 1.

United States Public Health Service Postdoctoral Trainee Fellowships (1-2) in Agricultural Biochemistry at the basic rate of $6,216 on calendar year basis. Agency pays fees. Application deadline July 1.

Dairy Industries

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

Forestry

Charles K. Blandin Foundation Fellowships (3) at $2,904 for work in Forest Genetics in the School of Forestry.

Kimberly-Clark Graduate Research Fellowship at $2,904 for work in Forest Products and Forest Physiology in the School of Forestry.

Mando Graduate Fellowship at $2,904 for work in Forest Management in the School of Forestry.

Northwest Paper Foundation Fellowship at $2,904 for work in Forest Management in the School of Forestry.

Genetics

United States Public Health Service Postdoctoral Trainee Fellowships (2) at $7,200 in Genetics.

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

United States Public Health Service Predoctoral Trainee Fellowships (5) at $3,000 in Genetics.

Radiation Biology (Genetics) Fellowships (8-10) at $3,000 plus allowance of $450 per child for students who will teach at college level in the fields of Biology, Genetics, Botany, Zoology, or Veterinary Medicine.

Home Economics

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

National Institutes of Health Research Assistantships in Nutrition at $2,178 for the academic year.

United States Public Health Traineeship in Nutrition at from $3,000 to $4,800 depending on student's graduate status (dependency allowance of $360). Agency pays fees. Application deadline March 1.

ARTS AND SCIENCE FIELDS

***Albert Howard Fellowship** at $240. Offered when funds suffice; offered 1964-65. Open only to graduates of the University of Minnesota.

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

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

George A. Macpherson Fellowship at $2,000 a year to a student who will enter teaching in any of the natural sciences, social sciences, or humanities.

Radiation Biology (Genetics) Fellowships (8-10) at $3,000 plus allowance of $450 per child for students who will teach at college level in the fields of Biology, Genetics, Botany, Zoology, or Veterinary Medicine.

Anthropology

Walter B. Cline Memorial Fellowship at $300, offered when funds have accumulated, for graduate study of languages and/or cultural history of Asia or the Moslem world. Offered 1964-65.

National Institutes of Health Training Grants (10) in Anthropology, excluding Archaeology, at $2,700 for the calendar year. Agency pays fees.

Art

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

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 $1,400 or more as funds permit, preferably for a student in his final year of work for the Ph.D. in Botany.

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

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

Radiation Biology (Genetics) Fellowships (8-10) at $3,000 plus allowance of $450 per child for students who will teach at college level in the fields of Biology, Genetics, Botany, Zoology, or Veterinary Medicine.

Business Administration

Paul Goldsborough, Jr., Memorial Fellowship. Available when funds permit. Offered 1964-65. Application deadline April 1.

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

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

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

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

Minnesota Chapter, American Marketing Association Fellowship at $1,000 in Business Administration for a student with strong interest in marketing. Application deadline April 1.

New York Life Insurance Company Fellowship at $1,000 in Insurance. Application deadline April 1.

Emmett Salisbury Sales Management Scholarship at $500 in Business Administration for a student with strong interest in sales management. Application deadline April 1.

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

Price Waterhouse Foundation Graduate Fellowship in Accounting at $1,000 for a graduate student who proposes to enter the teaching field.

Arthur Young and Company Foundation, Inc., Fellowship at $750 in Business Administration for a student with strong interest in accounting.

Child Psychology

United States Public Health Service Training Stipends (10 or more) for research in Child Psychology at $1,800 to $3,000 depending on student's year of training. Agency pays tuition. Application deadline March 15.

Classical Languages

John C. Hutchinson Scholarship of $300 awarded every second year to a graduate student in Classical Languages. Offered 1964-65.

Geography

Ames Research Fellowship at $2,500 for a student who will carry out a project in historical cartography.

German

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

Humanities

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

Industrial Relations

Archer-Daniels-Midland Industrial Relations Fellowship at $200. Application deadline December 15.

Industrial Relations Graduate Fellowship at $500. Application deadline December 15.

Journalism

Carroll Binder Memorial Award of approximately $400 for a graduate or undergraduate student who shows promise in the reporting and/or interpreting of international news and who expects to go into newspaper work. Application deadline April 1.

Minneapolis Star and Tribune "World Affairs Program" Teaching Assistantship at $2,178 in Journalism. Application deadline March 1.

David Silverman Memorial Scholarship at $350 in Journalism for a student specializing in news-editorial aspects of journalism. Application deadline April 1.

Stephen L. Wells Scholarship in Public Opinion at $200 for a student in Journalism who plans to work in public relations. Application deadline April 1.

Library Science

John C. Hutchinson Scholarship of $250 awarded every second year to a graduate student in Library Science. Offered 1965-66.

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

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

Minnesota Library Association Scholarship of $600 awarded every second year to a graduate student preparing for college or public librarianship. Offered 1964-65.

Blanche Thompson Scholarship at $500 open to school librarians.

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

Political Science

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

Psychology

Clinical Fellowships (3 at $1,089, and 2 at $2,178) in the Student Counseling Bureau for Psychology or Educational Psychology majors.

Clinical Fellowships (2) at $1,089 in Psychology or Educational Psychology.

Clinical Psychology—Veterans Administration: Approximately 12 work-study stipends at from $2,700 to $4,000 for half-time psychological work under the joint training program of the University and the Veterans Administration open to students who have completed at least 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 18 fellowships at from $1,800 to $3,000 for study for the Ph.D. degree in Clinical Psychology. The amount depends upon whether the student is in his first, second, third, or fourth year of graduate work when appointed. Agency pays tuition and fees.

Counseling Psychology—Veterans Administration: Approximately 10 work-study stipends at from $2,700 to $4,000 for half-time psychological work under the joint training program of the University and the Veterans Administration open to students who have completed at least 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—United States Vocational Rehabilitation Administration: Approximately 28 traineeships in vocational rehabilitation counseling at from $1,800 to $3,400 for the academic year. The amount depends upon the year level of graduate work. Agency pays tuition and fees.

Counseling Psychology—Clinical fellowships (3) at $2,904 for graduate students in Counseling Psychology or Educational Psychology are available in the Student Counseling Bureau.

National Science Foundation (Research) Assistantships (2) at $2,178 in Social Psychology.

Personality Research—United States Public Health Service: Four 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, plus $500 per dependent. 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.

United States Veterans Administration Assistantships (5) at $5,000-$7,000 in Clinical or Counseling Psychology.

Public Administration

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

Public Administration Traineeships (10 or more) at $2,100-$2,500 for the calendar year with state government and municipalities.

Research Fellowship at $3,108 in the Public Administration Center.

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

Social Work

Donald Abbott Miller Memorial Fellowship—pays tuition for a graduate Social Group Work student. Application deadline May 1.

Minnesota Mental Health Association Fellowships (3) for students who will seek employment as social workers in Minnesota. Amount based on need. Application deadline May 1.

United States Vocational Rehabilitation Administration Traineeships (8) at $1,800 (for first graduate year) and $2,000 (for second graduate year) for Social Work students whose career objective is to work in the rehabilitation field. Agency pays tuition. Application deadline May 1.

United States Public Health Service, Mental Health Act, Traineeships (27) 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. Application deadline May 1.

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

Mrs. Archie Walker Scholarship Fund for Social Group Work students. Amount based on student's needs. Application deadline May 1.

Sociology

National Institute of Mental Health Traineeships (9) in Anti-Social Behavior and the Sociology of Mental Health at $1,800 to $3,000, depending on year of graduate work. Basic training for careers in teaching. Agency pays fees.

Speech and Theatre Arts

Oscar W. Firkins Scholarship of $500 in Theatre Arts. Application deadline April 1.

McKnight Foundation Graduate Theatre Fellowships (8 to 15) at $600 to $3,000 in Theatre Arts. Candidate must be nominated by a director of a college theater from which degree was received. Holders devote fall and winter quarters to graduate study and work in the University Theatre and work spring and summer quarters in Tyrone Guthrie Theatre. Application deadline January 1.

National Institutes of Health Fellowships (2) at $2,800 in Speech Pathology, Physics, or Linguistics.

United States Vocational Rehabilitation Administration Traineeships (16) at $2,400 to $3,400 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.

Radiation Biology (Genetics) Fellowships (8-10) at $3,000 plus allowance of $450 per child for students who will teach at college level in the fields of Biology, Genetics, Botany, Zoology, or Veterinary Medicine.

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

EDUCATION FIELDS

Agricultural Education

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

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

Education

United States Office of Education Fellowships for the Training of Teachers of the Deaf (9-12) at $2,000. Agency pays fees. Application deadline end of spring quarter.

United States Public Health Service, National Institute of Mental Health Fellowships for Teachers of Emotionally Disturbed and Socially Maladjusted Children (12) at $2,400 for ex-perienced teachers of the socially and emotionally disturbed. Agency pays fees.

United States Office of Education Fellowships (Mentally Retarded) (4) at $2,000 to $2,800 plus dependency allowance of $400 in Educational Psychology for students who have experience in teaching the mentally retarded. Agency pays fees.

United States Public Health Service Traineeships (6-8) at from $1,800 to $3,000 in School Psychology for students in a Ph.D. program. Agency pays tuition.

ENGINEERING AND PHYSICAL SCIENCE FIELDS

George A. Macpherson Fellowship at $2,000 a year to a student who will enter teaching in any of the natural sciences, social sciences, or humanities.

Chemical Engineering

Allied Chemical and Dye Corporation Fellowship at $1,900 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 $2,000 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 $1,900 for research in Chemical Engineering. Agency pays fees.

Procter and Gamble Fellowship at $1,900 for research in Chemical Engineering. Agency pays fees.

Chemistry

American Oil Foundation Fellowship at $300 per month in Chemistry and Chemical Engineer-ing. Offered in Chemistry 1964-65. 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.

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.

General Mills, Inc., Fellowship at $1,800 in Chemistry. Agency pays fees.

Minnesota Mining and Manufacturing Company Fellowships at $2,000 for research in Chemis-try. Agency pays fees.

Shell Fellowship in Chemistry at $1,800 ($2,100 for married student with children). 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 Organic 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 in Organic Chemistry at $1,800 ($2,100 if student is married) under Professor C. F. Koelsch. Agency pays fees.

Civil Engineering

United States Public Health Service Traineeships (2 at $250 per month for first year; 2 at $333 and $400 for second and third years) for graduate study in Sanitary and Water Resources Engineering. Agency pays tuition and fees. Application deadline April 4.

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) in Electrical Engineering at $500 offered to graduate students interested in medical instrumentation and allied pursuits.

Mayo Engineering Graduate Fellowship open to a major in Electrical Engineering who has completed the course requirements for the M.S. degree. Residence will be Rochester, Minnesota, for thesis work in the Engineering Division of the Mayo 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.

Geology and Geophysics

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

***Thomas F. Andrews Fellowship** at approximately $500-$1,000 in Geology, available at intervals of 2 or 3 years. Offered 1964-65. Application deadline April 15.

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

Edmund J. Longyear Memorial Fund Fellowship in Mineral Engineering, Metallurgical Engineering, Geology, or Geophysics at a variable amount depending on circumstances. Offered 1965-66. Application deadline April 15.

Reserve Mining Company Fellowship at $3,000 for 12 months of study in Geology, Metallurgical Engineering, or Mineral Engineering. Application deadline April 15.

United States Steel Foundation, Inc., Fellowship at $2,400 plus dependency allowance at $600 in Mineral Engineering, Metallurgy, Metallurgical Engineering, or Geology. Application deadline April 15.

Mechanical and Industrial Engineering

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

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

Metallurgy and Metallurgical Engineering

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

Atomic Energy Commission Research Assistantships (4) at $3,500 in Metallurgy. Application deadline April 15.

Jones and Laughlin Steel Corporation Fellowship at $3,000 in Metallurgical Engineering. Application deadline April 15.

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

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

National Science Foundation Research Assistantships (2) at $3,500 in Metallurgy. Application deadline April 15.

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

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

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

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

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

Mineral Engineering

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

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

Reserve Mining Company Fellowship at $3,000 for the calendar year in Metallurgical Engineering, Mineral Engineering, Geology, or Physics. Offered 1965-67.

United States Bureau of Mines Fellowship in Mineral Economics at up to $4,000 annually for 2 years. Open to male United States citizens desiring doctoral degree. Agency pays allowance for travel and expenses. Application deadline April 15.

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

United States 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). Application deadline April 15.

Physics

Reserve Mining Company Fellowship at $3,000 in Metallurgical Engineering, Mineral Engineering, Geology, or Physics.

MEDICAL AND HEALTH SCIENCE FIELDS

Dight Institute

United States Public Health Service Traineeships (2) at from $2,800 to $3,000 in Human Genetics are available to graduate students in the Genetics area and Zoology. Agency pays fees.

Microbiology

United States Public Health Service Predoctoral Fellowships (28) at $2,904 with dependency allowance at $500 in Microbiology.

United States Public Health Service Predoctoral Research Grants (5) at $2,904 with dependency allowance of $500 in Microbiology.

Pharmacology

United States Public Health Service Postdoctoral Traineeships (2) in Pharmacology at $5,000 with a $500 dependency allowance. Application deadline May 1.

United States Public Health Service Predoctoral Traineeships (6) in Pharmacology at $2,600 to $3,400 with a $500 dependency allowance. Agency pays fees. Application deadline May 1.

Physiology

National Institutes of Health Training Grants (about 15) at $2,600. Agency pays fees. Application deadline March 1.

National Institutes of Health Training Grants (4) at $2,600 plus dependency allowance of $500 in Physiology. 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. Application deadline March 15.

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.

School of Public Health

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

United States Health Service Graduate Traineeships (3) at $3,000 plus dependency allowance of $360 for Public Health Engineers. Agency pays fees.

United States Public Health Service Graduate Traineeships in Maternal and Child Health at $4,800 plus dependency allowance of $360. Agency pays fees.

United States Public Health Service Training Fellowships (15) 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 (7) 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.

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 dependency 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 dependency allowance and tuition. Open to graduate students who are graduate nurses preparing for leadership positions.

United States Public Health Service Traineeships (4) in Radiological Health at $250 to $400 per month plus dependency allowance. Renewable. Agency pays tuition.

College of Veterinary Medicine

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

Radiation Biology (Genetics) Fellowships (8-10) at $3,000 plus allowance of $450 per child for students who will teach at college level in the fields of Biology, Genetics, Botany, Zoology, or Veterinary Medicine.

United States Public Health Service Training Grants (11) at $6,216 for students holding their professional degrees for graduate study in the Departments 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 10, Morrill Hall, University of Minnesota, Minneapolis, Minnesota 55455.

Services of the Bureau of Student Loans and Scholarships

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

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

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

Services for Students from Abroad

Counseling and advisory services are provided for students from other countries by the adviser to foreign students. Assistance is given in 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, Minnesota 55455.

Placement of Graduate Students

Aid and counsel to graduate students who wish college, university, or other positions may be had from advisers and departments, the dean of the Graduate School, and the deans of various colleges of the University and through the *Bureau of Recommendations,* which receives reports of vacancies for college teaching in all fields as well as in counseling, administration, and research. For further information, students may address the Director, Bureau of Recommendations, 102 Burton Hall, University of Minnesota, Minneapolis, Minnesota 55455.

HOUSING FACILITIES

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

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

University Residence Halls—Living in a residence hall has many advantages** for the student. The halls, located close to class buildings and to the student unions, offer comfortable living with well-planned, healthful meals, served under the direction of a trained dietitian. Opportunities for counseling, health supervision, student government, social and athletic programs are provided. All residence halls are modern, fireproof brick buildings, constructed in accordance with the highest safety standards. The 1963-64 rates ranged from $3.21 to $3.93 per day for board and room ($245 to $300 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 August 15 or immediately following nonacceptance by the University.

Minneapolis Campus—*Sanford Hall,* accommodating 280 women, is located on University Avenue S.E. near the northwest entrance to the campus.

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

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

Pioneer, Centennial, Territorial, and *Frontier Halls* for men are located in a quadrangle on the southern edge of the campus near the East River Road. These halls accommodate 2,360 men. Special areas for graduate students are available. Many residents can earn part of their board and room by work in the halls. For additional information, contact the Director of Housing, 100 Wesbrook Hall, University of Minnesota, Minneapolis, Minnesota 55455.

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

Other accommodations may be available in *Brewster* 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 362 families in 1- and 2-bedroom units. Present rates are $70 and $80 per month unfurnished except for stove and refrigerator, including utilities. Priority is given to Minnesota residents with children.

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

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

Off-Campus Housing—Rooms or apartments in privately operated residences** must be engaged "on the spot"—no reservations can be made before arrival on

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

campus. Lists of vacancies in approved places of residence may be obtained from the Student Housing Bureau. Single students under 21 years of age must have approval of the Student Housing Bureau to live in an apartment. Vacancies in reasonably priced apartments or housekeeping facilities for married students are limited, but the Student Housing Bureau assists students in locating such units. For additional information regarding off-campus housing facilities, write to the Student Housing Bureau, 209 Eddy Hall, University of Minnesota, Minneapolis, Minnesota 55455.

AIR FORCE ROTC PROGRAM

Students in the Graduate School may pursue the 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.

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 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
Francois N. Frenkiel
Lawrence E. Goodman
Helmut G. Heinrich
William C. Meecham
Robert Plunkett
Patarasp R. Sethna

Associate Professor
Allan A. Blatherwick
Carl N. De Silva
Walter T. Graves
Chih-Chun Hsiao
Thomas S. Lundgren
Theodore J. Mentel
Eugene Stolarik
William H. Warner

Assistant Professor
Gordon S. Beavers
August R. Hanson
Daniel D. Joseph

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. Kinematics of Fluid Flow. Kinematics of fluid field including continuity equation, vorticity, circulation, velocity potential, source, and doublet. Application of Gauss's and Stokes's theorem to fluid flow. Flow about cylinder. (3 cr; prereq Math 26A, MM 27)

101. Potential Flow and Dynamic Equations. 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. Intermediate Boundary Layer Theory. Viscous incompressible flow. Thin airfoil theory. Stress and strain rate. Navier-Stokes's equation. Boundary layer equation and Blasius solution. Von Karman momentum integral. Pohlhausen method. Turbulent boundary layer. (3 cr; prereq 101)

103. Shock Waves and Compressible Fluid Flow. Basic concepts of thermodynamics. One-dimensional steady isentropic flow. Laval nozzle. Normal and oblique shock waves and reflections. Prandtl-Meyer flow. Supersonic thin airfoil theory. (3 cr; prereq 101 or Hydr 101 or Hydr 103 or equiv)

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 101 or equiv)

107. Performance of Aircraft. Analysis of speed, take off, landing, range, and endurance characteristics of propeller and jet propelled aircraft. Vtol and Stol vehicles. (3 cr; prereq 101)

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 101)

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 101, MM 28; offered 1964-65 and alt yrs)

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

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 ¶103, MM 142, MM 193, ¶Engl 85A-B-C)

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

150. Aeroelasticity I. 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 101, MM 28; offered 1965-66 and alt yrs)

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

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

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. Elements of kinetic theory. Velocity distribution function. Surface interactions. Free molecular flow. Slip flow. Application to low density aerodynamics. (3 cr; prereq 103 or ‡) Lundgren

190. Introduction to Magnetohydrodynamics. Fundamental equations and concepts of magnetohydrodynamics. Transport of magnetic field; magnetohydrodynamic channel flow. Alfven waves. (3 cr; prereq 103, Math 147 or ‡)

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

201. Foundations of Fluid Mechanics. Kinematics of deformable media. Thermodynamics of compressible fluids. Derivation of integral and differential forms of the conservation laws. Entropy production. Linear laws. Perfect fluids. Vorticity theorems. (3 cr; prereq 103 and ¶Math 149 or ‡) Joseph, Lundgren, Meecham

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

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

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

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

207. Fluid Dynamic Stability. Orr-Sommerfeld equation. Stability of plane Pouseuille flow; Lin solution. Stability of Couette flow. General stability criteria; Taylor and Rayleigh methods. (3 cr; prereq Math 149 or equiv or ‡) Meecham

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

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

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, Math 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 Math 173-174-175 or ¶Math 173-174-175)

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

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

AGRICULTURAL ECONOMICS

Professor
Elmer W. Learn
Sherwood O. Berg
Marguerite C. Burk
Willard W. Cochrane
Reynold P. Dahl
Selmer A. Engene
Darrell F. Fienup
Carroll V. Hess
Harald R. Jensen
E. Fred Koller
Truman R. Nodland
Philip M. Raup

Associate Professor
W. Burton Sundquist

Assistant Professor
W. Keith Bryant

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

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

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

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

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

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

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

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) Learn

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

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

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

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

131. Market Prices. Nature of demand for farm products; supply considerations; price formulation and structure of markets; price variation and instability; dynamic analysis. (3 cr; prereq 30) 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 1964-65 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 1965-66 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. Course 80 plus a special problem. (3 cr; prereq ‡) Nodland

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

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

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

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

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

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	Associate Professor	Research Fellow
Evan R. Allred	Clarence H. Christopherson	Lee F. Hermsmeier
Andrew Hustrulid	Arnold M. Flikke	
Philip W. Manson	Curtis L. Larson	
Charles K. Otis	John Strait	

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.

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

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.

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; not open to engineers; prereq 23, Soil 1, or 3 or 19) Larson

107. Drainage and Irrigation. General theory, design, economical feasibility, and legal responsibilities of drainage and irrigation practices. (3 cr; not open to engineers; prereq 23, Soil 1 or 3 or 19) 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; not open to engineers; prereq 106 or 107) Manson

114. Special Problems in Farm Buildings. Problems based on work given in the prerequisite courses. (2-4 cr; not open to engineers; prereq 3, 7, and 14) 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, Math 25B 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 ¶AgEd 91) Marvin

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

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

145. Soils Engineering. Mechanical and hydraulic properties of soils, moisture constants, pressure and bearing characteristics for structural and mechanical design. (3 cr; prereq Soil 126, MM 41) 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, Math 26A) Hustrulid

159. Agricultural Engineering Instrumentation. Application of basic electrical instruments to measurement and control. Controls and control circuits. Pyrometry, psychrometry, and pres-

sure measurement and control. Physical measurements relating to soils and crops. Radioactive and tracer instrumentation. (3 cr; prereq EE 43) 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.° Design of Agricultural Machinery. Operating principles and problems. (3 cr; prereq 147, ME 24) Strait

172.° 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)

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) 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 ¶143) Allred, Larson

191-192-193.°‡ 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.°‡ Advanced Problems and Research. (2-6 cr per qtr; prereq 191, 192, or 193) Staff

AGRONOMY AND PLANT GENETICS

Professor	Associate Professor	Assistant Professor
Ernest H. Rinke	Laddie J. Elling	Robert N. Andersen
Richard Behrens	Robert G. Robinson	William M. Clement
Charles R. Burnham	Alois R. Schmid	Verne E. Comstock
Richard S. Caldecott	James C. Sentz	Donald C. Rasmusson
Jean W. Lambert	Horace L. Thomas	Lawrence H. Smith
Will M. Myers		
Leon A. Snyder		

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

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

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) two foreign languages or (b) one 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.

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

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

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

135. Weed Control. Survey of research and regulatory aspects of weed control. Kinds and extent of losses due to weeds. Outline of principles of cultural and chemical weed control. Specific weed control practices in agricultural production. (3 cr; prereq 1 and PlPa 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.* Seminar: Farm Crops. Reviews and discussions of important agronomic literature. (1 cr per qtr; prereq 9 cr in farm crops) Graduate staff

204w. Pasture and Forage Research Techniques. Potentialities and limitations of grazing trials including the animal-plant complex and experimental designs; *in vivo* and laboratory methods for determining forage quality; determination of herbage yield and botanical composition. (3 cr; prereq Biom 100 or equiv, Agro 127 or ‡; offered 1964-65 and alt yrs) Marten

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

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

Plant Genetics

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

131. Principles of Genetics. Physical and chemical bases of heredity including concept of mutation, role of cytoplasmic substances, and relationships of chromosomal abnormalities. Extension of Mendelian principles to include linkage and crossing over, inheritance of quantitative traits, 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 BPhy 170, 171 or equiv and ‡) Loken, Spurrell, Caldecott

240s. Advanced Genetics. An advanced consideration of genetic principles and mechanisms. (3 cr; prereq 131 or equiv and a course in biochemistry or ‡) Snyder

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

242f.* Seminar: Plant Breeding. (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 131 and 132 or equiv) Rasmusson

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 in Plant Breeding. (2 cr; prereq 131, 243, and 244 or equiv or consent of staff) Staff

246w,s. Seminar: Genetics. Contributions to genetic theory and practice. (1 cr) Graduate staff

252w. Cytogenetics. Advanced material on chromosomes in relation to genetics. (4 cr; prereq 240 or ♯, Bot 118) Burnham

253s. Methods in Plant Genetics. Planning and analysis of genetic experiments. (2 cr; prereq 131; offered 1964-65 and alt yrs) Burnham

255f. Special Topics in Genetics. (2 cr [can be taken for cr more than once]; prereq 252 or consent of staff) Graduate staff

256s. 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. 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.
Robert H. Beck
Charles H. Foster
George Hage
Joseph J. Kwiat
Jacob C. Levenson
Johannes Riedel
Arnold M. Rose
Ralph G. Ross
Mulford Q. Sibley
Robert F. Spencer
Gregory Stone
Donald R. Torbert
Dimitri T. Tselos

Associate Professor

Hyman Berman
Clarke A. Chambers
David Cooperman
Paul Murphy
David W. Noble
Timothy Smith
Francis J. Sorauf
Mary C. Turpie

Assistant Professor

Robert Berkhofer

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

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

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

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 four areas: (a) history, (b) literature, (c) philosophy and fine arts, (d) social sciences. All candidates must include AmSt 200-201-202 in their program and must pass a written and an oral examination in American Studies.

Doctor's Degree—Candidates for the Doctor's degree enroll in courses on aspects of American civilization distributed in the four areas named above and in the fifth area of foreign civilization. All candidates must include AmSt 210 and 211-212-213 in their program, write an interdepartmental dissertation, and pass a series of written examinations, the preliminary oral examination, and the final oral examination.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

111A. Human Neuroanatomy. (3 cr; enrollment limited; prereq 104 or Zool 150, ‡) Smithberg, Lindall

131. Biological Electron Microscopy. (Cr and hrs ar; prereq ‡)

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 104, ‡) Carpenter

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

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

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

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, MdBc 100-101, ‡)

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, Lazarow, Sundberg, Wells

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

ANESTHESIOLOGY

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

ANIMAL HUSBANDRY

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

Associate Professor
Eldon G. Hill
Robert M. Jordan
Olaf E. Kolari
William E. Rempel
Joseph V. Scaletti

Assistant Professor
Franklin D. Enfield
Jay C. Meiske
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) two foreign languages (French, German, Russian, or Spanish) or (b) one foreign language and the option of a special research technique or a collateral field of knowledge. When two languages are offered, any combination of the four listed may be approved except French and Spanish.

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

162. Animal Breeding. Applications of 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, 62 or ‡; also offered SSI 1966) Meade

164. Sheep Production. Adaptability, breeding, feeding, care and management of commercial and purebred sheep. (3 cr; prereq 37, 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, 62 or ‡; also offered SSI 1967) 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, BioC 6 or ‡; also offered SSI 1965) 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 Agro 131) 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.* Seminar: Animal Husbandry. Review of literature and discussion of problems in animal breeding, nutrition, management, meats, and related fields. (1 cr per qtr) Hanson

211. Experimental Methods. Theory, plan, and conduct of experimental work in animal 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, BioC 6 or ‡...BioC 216 recommended; offered 1964-65 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, BioC 6 or equiv or ‡...BioC 216 recommended; offered 1964-65 and alt yrs) Meade

224.* Vitamin Nutrition. Principles of vitamin nutrition for rats, poultry, swine, cattle, and sheep, including vitamin characteristics, interrelationships and requirements, and deficiency symptoms. (3 cr; prereq BioC 6 or ‡...BioC 124 recommended; offered 1965-66 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 BioC 6; offered 1965-66 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, BioC 6 or ‡...MicB 121, 123 recommended; offered 1964-65 and alt yrs) Kolari

ANTHROPOLOGY

Professor

E. Adamson Hoebel
Robert F. Spencer

Associate Professor

James L. Gibbs
O. Elden Johnson
Rupert I. Murrill

Assistant Professor

Richard F. W. Adams
Luther P. Gerlach
Ladislav P. Novak
Pertti S. Pelto

Instructor

Milton Altschuler

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

Master's Degree—Offered only under Plan A.

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

Group I—Ethnology

100. **Principles of Anthropology.** Intensive introduction to elements of anthropology. Analysis of primitive societies as to range and variability of human behavior. Principles of cultural dynamics. (3 cr, §1A or §2A) Gerlach

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

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 △; 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) Altschuler

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 △) Adams

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 or 2A or 100) Gibbs, Gerlach

121.* **Peoples and Cultures of the South Seas.** Oceania, Polynesia, Micronesia, and Melanesia. (3 cr; prereq 1A and 2A or 100 or △; 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 △) Gerlach

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

126.* **Peoples and Cultures of Southeast Asia and Indonesia.** Burma, Siam, French Indochina, and Malaysian archipelago. Influences from India on the area. Islamic influences in Indonesia. Modern ethnic, national, and colonial problems. (3 cr; prereq 1A and 2A or 100 or △) 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 △) Gerlach

128. **Islam in Africa.** Influence of Islam upon African people south of the Sahara. How Islam has spread through East and West Africa; why and how it has changed indigenous African cultures. Relationship between Islamization and Westernization. (3 cr; prereq 2A or 100 or △; offered when feasible) Gerlach

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 ‡) Adams

132.* **Archaeology of Mississippi Drainage.** Archaeological record of prehistoric cultures of Mississippi River area, Minnesota to Gulf of Mexico. (3 cr; prereq 90; offered 1964-65 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

134. Pre-Columbian Civilizations of the New World. Archaeological record of prehistoric civilizations of Middle America and Peru. Developmental cultural sequences leading to the Maya, Aztec, and Inca. (3 cr; prereq 90 or △) Adams

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 △) 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.° 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, Gerlach

161.° 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 lifeways 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) Adams

163.° 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) Gerlach

164.° 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, Pelto

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

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

Group IV—Physical Anthropology

170-171. Primate and Human Evolution. Origins and relationships of extinct forms of nonhuman primates and man. (3 cr per qtr; prereq 1A or 100 and △) Murrill, Novak

173-174. Human Biology. Evolutionary processes in differential development of races. Physical characteristics, distribution, and relationships of living races of mankind. Human genetics,

particularly of blood types in racial analysis. Influence of various environments on man. (3 cr per qtr; prereq 1A or △) Murrill

175-176. 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 per qtr; prereq 1A or ♯, or waived for majors in child development) Murrill, Novak

177-178-179. Physical Anthropology. Comparative osteology of man and the anthropoid apes. Variations related to sex, age, and race. Observations and measurements on the skeleton. Anthropometry (measurement of the living). Body size, proportions, and statistical analysis. (4 cr per qtr) Murrill, Novak

Group V—Linguistics

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

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

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

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, Pelto

204, 205, 206.° Seminar: Anthropology. Individually directed research. (3 cr per qtr) Staff

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

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

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

250. Advanced Social Anthropology. (3 cr) Gibbs, Pelto

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

264. Seminar: Social Anthropology. (3 cr) Gibbs

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

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

ARCHITECTURE

Professor
Ralph E. Rapson
Robert G. Cerny
John S. Myers
Walter K. Vivrett

Associate Professor
Howard F. Koeper

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

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

115f. 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)

116w. 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)

126w. Professional Relations. Relations of the architect to clients, contractors, and fellow practitioners. Procedures of architectural practice. (3 cr) Cavin

131f. Planning. History and theory of planning. (3 cr) Einsweiler

132w.* Planning. (Same as Pol 123, Soc 106) Conceptualization of role of individual disciplines in the planning process: architecture, economics, engineering, geography, public administration, public health, and sociology. (3 cr, §104; prereq 131 or ‡) Einsweiler, Vivrett

133s.* Planning. Community facilities and housing. (3 cr, §106) Vivrett

134.* Planning. Tutorial work in community facilities and housing. (3 cr; prereq 133 or 106) Vivrett

201-202-203.* Special Research in Architectural History. (Cr ar; prereq 53 or ‡) Koeper

231-232-233.* Planning. Individual problems and research in planning. (Cr ar; prereq consent of grad adviser in School of Architecture) Peterson, Rapson, Vivrett

251-252-253.* Architectural Design VI. Problems involving individual research in either composition or construction. (Cr ar; prereq 123 or equiv) Cerny, Rapson, Vivrett, Myers

254-255-256.* Theory of Architecture. (2 cr per qtr; prereq ‡) Rapson and visiting lecturers

ART

Professor
Carl D. Sheppard
Allen Downs
Jerome Liebling
Malcolm H. Myers
Walter W. Quirt
Josephine L. Rollins
John Rood
Hylton A. Thomas
Donald Torbert
Dimitri T. Tselos

Associate Professor
Peter Busa
Warren MacKenzie
Marion Nelson
Sidney Simon
Melvin Waldfogel

Assistant Professor
Norman Canedy

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 a selected group of students with a Bachelor's degree from an approved university or college or the equivalent and to those who provide evidence of exceptional promise as creative artists in one or more of the following subfields: painting, sculpture, printmaking, film and photography, and ceramics.

Language Requirement—For the master of fine arts degree, none. For any of the three other Master's degrees, reading knowledge of one foreign language, French or German. For the Ph.D. degree, two foreign languages, preferably German and French.

Master of Arts Degree (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 226 (Museology I), with the 20 additional credits (which comprise the internship program) earned in full-time apprentice work in two 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. He must execute and leave a record of a creative project (production, recital, or exhibition) which will be accompanied by a supporting paper that deals with the planning and/or execution of the creative work. A minimum of 9 credits will be required in history of art or literature and a further minimum of 9 credits in areas of study outside the department. The individual program must be approved by the M.F.A. committee. The candidate will be subject to final written and oral examinations.

For the master of fine arts degree, admission to candidacy is limited to a selected group of students with the Bachelor's degree from an approved university or college or the equivalent and to those who provide evidence of exceptional promise as creative artists in one or more of the following—painting, sculpture, printmaking, film and photography, and ceramics.

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.* **Ancient and Medieval Art I.** Art of prehistoric Europe, ancient Near East, Aegean proto-Greek and classical Greek art. (3 cr) Tselos

101w.* **Ancient and Medieval Art II.** Arts of Hellenistic Greece and the Near East, Etruscan and Roman; Early Christian and Byzantine. (3 cr) Tselos

102s.* **Ancient and Medieval Art III.** The arts of the Merovingian, Anglo-Celtic, Frankish, and Germanic peoples; Carolingian, Ottonian, Romanesque, and Gothic styles in western Europe. (3 cr) Tselos

110. **Art of India.** Development of architecture, painting, sculpture, and the minor arts. (3 cr; prereq**; offered when feasible) Rundorff

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

111. Art of China. Development of painting, sculpture, and minor arts from earliest times to present. (3 cr; prereq **...Hist 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 1965-66 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 1965-66 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, Zurbarán). (3 cr; prereq **; offered 1965-66 and alt yrs) Thomas

126f.* Eighteenth-Century Art in Italy. Late baroque and classicizing trends in architecture. Neoclassic architecture. Roman, Neapolitan, and North Italian sculpture. Canova. Painting in Rome, Naples, Bologna, Genoa, and Venice. Prints. (3 cr) Thomas

127w.* Eighteenth-Century Art in France. Urban architecture; the town house. Provincial centers. Neoclassic architecture. Rococo and neoclassic sculpture. French painting: Watteau, Boucher, Fragonard, Chardin, David; the lesser masters. Prints. (3 cr) Thomas

128s.* Eighteenth-Century Art in England and Germany. The Palladian Revival in architecture. Robert Adam. The English portrait; Reynolds, Gainsborough. Hogarth. English landscape painting. German and Austrian late baroque and rococo architecture, sculpture, and painting. (3 cr) Thomas

129w. History of the Graphic Arts. Origins of woodcut and engraving. Renaissance and baroque master etchers and engravers. Mantegna, Raimondi, Schongauer, Dürer, Holbein, Lucas van Leyden, Callot, Rembrandt. Reproductive and portrait engraving of the 17th and 18th centuries. Lithography, Géricault, Delacroix, Daumier. Twentieth-century printmaking. (3 cr; prereq **; offered 1965-66 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 1964-65 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. Jefferson and his influence. 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. Architectural revivals. Rise of a national style in landscape and realistic genre. Homer, Eakins, Ryder, and their influence. Impressionism and relations with Europe after the Civil War. Beginnings of modern architecture. (3 cr) Torbert

138s.* Art in the United States. Contemporary movements. Armory Show, modern realism, expressionism, and abstraction. Frank Lloyd Wright and later manifestations of 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

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

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

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

147.* Modern European and American Architecture: 1860-1920. Revivalist and progressive directions; the founders of modern architecture: William Morris and Queen Anne style; the Chicago School and its chief exponents: Richardson, Jenney, Sullivan, and early Wright; their European counterparts: Berlage, Behrens, Wagner; middle Wright and beginnings of modern architecture: Gropius, Mies, LeCorbusier, Oud, etc. (3 cr) Tselos

148.* Modern European, American, and International Architecture: 1920-1960. Development of modern architecture in Europe, North and South American continents, Asia, and Africa; later work of the modern pioneers; Wright, LeCorbusier, Gropius, Mies; modern experiments in concrete: Mendelsohn, Nowicki, Saarinen, Nervi, etc.; Japanese, Mexican, and Brazilian architecture; the modern panel style and the new skyscraper; city planning and housing for the nuclear age. (3 cr) Tselos

156f.* Modern European Painting: 1775-1830. Late rococo and beginnings of naturalism; early romantic neoclassicism of David and Ingres; their contemporaries in France, Germany, Spain, and England; early romantic neobaroque, exoticism and naturalism of Géricault, Delacroix, and their German contemporaries. (3 cr) Tselos

157w.* Modern European Painting: 1830-1860. The later careers of Ingres, Delacroix, and their European contemporaries; development of romantic and realistic landscape: Constable and Turner; Corot and the Barbizon school; Courbet and German contemporaries; Millet and Daumier. (3 cr) Tselos

158s.* Modern European Painting: 1860-1900. Rise and development of impressionism: Boudin, Monet, Pissarro, and their analogues in Germany; Manet, Degas, and Renoir; Cezanne and the problem of form; expressionistic impressionism in Toulouse-Lautrec and Van Gogh; anti-impressionist tendencies in the school of Pont-Avent and Gaugin; expressionistic symbolism of Ensor and Munch. (3 cr) Tselos

168.* Modern Sculpture from Rodin to Roszak: 1875-1960. Rise and development of modern sculpture; romantic and revivalist currents; modeling and direct carving; cubist, neoplastic, expressionist, surrealist and neo-Dada tendencies. (3 cr) Tselos

176Xf.* Twentieth-Century Painting. Germany, Austria, Worpswede, The Bridge, Vienna Secession, The Blue Rider, The New Objectivity. Modersohn-Becker, Nolde, Kirchner, Kandinsky, Kokoschka, Klimt, Grosz, Beckmann, Hartung, etc. (3 cr) Waldfogel

177Xw.* Twentieth-Century Painting. France, Italy, Holland, Belgium, Russia, and Spain. Fauvism, cubism, futurism, Dada, surrealism, abstract art, School of Paris. Matisse, Picasso, Braque, Chagall, Leger, Boccioni, Duchamp, Dali, Mondrian, de Stael, etc. (3 cr) Simon

178Xs.* Twentieth-Century Painting. United States, Latin America, and England. Fauvist and representational expressionism, purism, realism and cubism-realism; nostalgic and regional romanticism; social criticism; fantastic and surrealist trends; American variations on cubism and puristic abstraction; abstract expressionism and action painting; expressionist and primitivizing mythmakers; Mexican, Brazilian, and English painting between two world wars and since the last war. (3 cr) Tselos

186f. The Art of the Film. Aesthetics of the film medium. Modern 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 △) Amberg

196f-197w-198s.† Readings in Art History and Criticism. (3 cr per qtr; prereq △) 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 △) 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 △) Simon

236f-237w-238s. Seminar Problems: Art History and Criticism. (Cr ar; prereq △) Graduate staff

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

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

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 △) Downs, Liebling

150f,w,s-151f,w,s-152f,w,s. Problems in Painting. (3 cr per qtr; prereq 72 and △) Quirt

180f,w,s-181f,w,s-182f,w,s. Problems in Sculpture. Advanced work in wood, stone, plaster, metal, and other materials of sculpture. Students work individually on projects. (3 cr per qtr; prereq 82, 82A or △) Rood

190f,w,s-191f,w,s-192f,w,s. Problems in Printmaking. Advanced work in black and white and color in metal, lithograph, and wood block. (3 cr per qtr; prereq 92 or △) Myers

193f,w,s-194f,w,s-195f,w,s. 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. (3 cr per qtr; prereq ♯) Graduate staff

200f,w,s-201f,w,s-202f,w,s. Advanced Problems in Painting. (3 cr per qtr; prereq ♯) Busa, Quirt, Rollins

210f,w,s-211f,w,s-212f,w,s. Advanced Problems in Sculpture. (3 cr per qtr; prereq ♯) Rood

220f,w,s-221f,w,s-222f,w,s. Advanced Problems in Printmaking. (3 cr per qtr; prereq ♯) Myers

240f,w,s-241f,w,s-242f,w,s. Advanced Problems in Ceramics. (3 cr per qtr; prereq ♯) MacKenzie

250S-251S-252S.† Seminar: Independent Creative and Critical Research and Methodology. (No cr; may be required of MFA students; prereq consent of grad adviser) Graduate staff

260f,w,s-261f,w,s-262f,w,s. Advanced Problems in Film or Photography. (3 cr per qtr; prereq ♯) Downs, Liebling

ASTRONOMY

Professor
Willem J. Luyten

The Astronomical Observatory possesses a 10½-inch refracting telescope; a 5-inch star camera; a photographic measuring machine by the Société Génévoise.

Prerequisites—For major work, Ast 51-52-53 and Math 50; for minor work, Math 50 and 3 credits in astronomy.

Language Requirement—Exemption from the language requirement for the Master's degree may be made in individual cases by petition. When a foreign language is offered, French, German, and Russian are acceptable.

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

104. Celestial Mechanics. Central orbit theory. The two-body problem. Computation of an ephemeris. Determination of an orbit from observations. (3 cr; prereq Math 26A or 27 or 106)

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

105. Celestial Mechanics. The restricted three-body problem. Gravitational field of the earth. Numerical methods applicable to computations of special perturbations. First order theories of motion of the moon and of motion of a satellite of an oblate planet. Drag perturbed orbits. (3 cr; prereq 104)

106. Celestial Mechanics. Applications of contact transformations and the Hamilton-Jacobi equation to computation of general perturbations. Delaunay and Hill-Brown theories of motion of the moon. The motion of a satellite of an oblate planet. (3 cr; prereq 105)

121-122-123.* Astrophysics and Stellar Statistics. Introductory course on the motions of the stars. (3 cr per qtr) Luyten

211-212-213.* Seminar. For students who are prepared for advanced work along specific lines. (1, 2, or 3 cr per qtr) Luyten

BIOCHEMISTRY

(Agricultural)

Professor
La Vell M. Henderson
David R. Briggs
Robert Jenness
Samuel Kirkwood
Irvin E. Liener
Walter O. Lundberg
Herman Schlenk
Max O. Schultze
Fred Smith

Associate 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 324. Candidates for the M.S. degree must have completed 3 credits in course 324. 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 on protein structure, function and immunological properties; metabolism of vitamins and amino acids; enzymology, including active site studies; polysaccharide structure; carbohydrate and lipid chemistry; and cereal chemistry.

Minor—Courses 100, 101, 102, 110, 111, 112, 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 two foreign languages, one of which must be German. For the M.S. degree, one foreign language, French, German or Russian. 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, BioC 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) 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 BioC 100-101-102. (2 cr per qtr; prereq ¶100-101-102 except with consent of dept head) Staff

113. Advanced Dairy Chemistry Laboratory. Parallels BioC 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 1 yr organic chemistry 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

129. Physical Biochemistry Laboratory. Preparation, purification, and study of physicochemical properties of inorganic and biocolloid systems. (2 cr; prereq AnCh 57 or equiv, ¶119 or ‡)

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 1964-65 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 1965-66 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 1965-66 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 1964-65 and alt yrs) Liener, Kirkwood

308x. Seminar: Cereal Chemistry. (1 cr per qtr; prereq 108 and ‡) Glass

313x. Seminar: Dairy Chemistry. (1 cr; prereq 103 and ‡) Jenness

316x. Seminar: Nutrition and Enzymes. (1 cr; prereq 102 and ‡) Schultze, Liener

319x. Seminar: Colloid Chemistry. (1 cr; prereq 119 and ‡) Briggs

320x. Seminar: Protein Chemistry. (1 cr; prereq 102 and ‡) Briggs, Jenness

321x. Seminar: Carbohydrate Chemistry. (1 cr; prereq 102 and ‡) Smith, Kirkwood

322x. Seminar: Chemistry of Lipids. (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

BIOCHEMISTRY

(Medical)

Professor

Wallace D. Armstrong, M.D., Ph.D.
Cyrus P. Barnum, Jr., Ph.D.
Ellis S. Benson, M.D.
Ivan Frantz, M.D.
Ralph T. Holman, Ph.D.
Leon Singer, Ph.D.

Associate Professor

Charles W. Carr, Ph.D.
Helmut R. Gutmann, Ph.D.
John F. Van Pilsum, Ph.D.
Richard W. Von Korff, Ph.D.
Donald B. Wetlaufer, Ph.D.
Frank Ungar, Ph.D.
Leslie Zieve, M.D., Ph.D.

Assistant Professor

Curtis H. Carlson, M.D., Ph.D.
Ernest D. Gray, Ph.D.
James F. Koerner, Ph.D.
Bernard Pollara, M.D., Ph.D.
George J. Schroepfer, Jr., M.D., 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) two foreign languages or (b) one foreign language and a collateral field of knowledge.

Master's Degree—Offered only under Plan A.

Doctor's Degree—Candidates for the Doctor's degree with a major in physiological chemistry will be required to present or to develop satisfactory competence in organic, analytical, and physical chemistry and in the biological sciences. The following courses are usually included in the program of graduate study: MdBc 100-101, five of the eight biochemistry courses numbered 206, 207, 208, 211, 214, 215, 217, or 218 and other courses in biochemistry or logically related fields. These are not intended to be interpreted as minimum requirements, however, and each graduate student is expected to work out his full program in consultation with an adviser, with the understanding that needs may differ in individual cases. The department will supply full information on admission and graduate study requirements on request.

If MdBc 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. Biochemistry. (8 cr per qtr; prereq physics, physical and organic chemistry) Armstrong, Barnum, Carr, Ungar, Van Pilsum, Wetlaufer

153f,w,s,su. Problems in Biochemistry. Special work arranged with qualified students. (Cr and hrs ar; may be taken 1 or more qtrs; prereq 101) Armstrong, Barnum, Carr, Singer, Van Pilsum, Von Korff, Ungar, Wetlaufer

200f,w,s,su. Seminar: Biochemistry. (1 cr) Armstrong, Barnum, Benson, Carr, Frantz, Singer, Van Pilsum, Von Korff, Ungar, Wetlaufer

205f,w,s,su. Research in Biochemistry. (Cr and hrs ar) Armstrong, Barnum, Frantz, Carr, Singer, Van Pilsum, Von Korff, Wetlaufer

206f. Advanced Endocrinology and Steroid Chemistry. (3 cr; minimum of 8 students; prereq 101; offered 1965-66 and alt yrs) Ungar

207f. Radiotracers and Mineral Metabolism. (3 cr; minimum of 8 students; prereq 101; offered 1964-65 and alt yrs) Armstrong, Singer

208s. Advanced Laboratory Technique. (3 cr; limited to 10 students; prereq 101 and ‡; offered 1965-66 and alt yrs) Staff

211s. Nucleic Acid and Protein Metabolism. (3 cr; minimum of 8 students; prereq 101; offered 1964-65 and alt yrs) Barnum

213f,w,s. Clinical Biochemistry. (Cr and hrs ar)

214s. Kinetics and Mechanism of Enzymic Reactions. (3 cr, §PCh 214; minimum of 8 students; prereq PCh 103 and ‡; offered 1964-65 and alt yrs) Lumry

215su. Topics in Lipid Metabolism. (3 cr; minimum of 8 students; prereq 101 or ‡; offered 1965 and alt yrs) Frantz

217w. Protein Chemistry. (3 cr; minimum of 8 students; prereq 101 or ‡ and PCh 103 or ‡; offered 1965-66 and alt yrs) Wetlaufer

218s. Physical Methods in Biopolymer Research. (3 cr; minimum of 8 students; prereq 217; offered 1965-66 and alt yrs) Lumry

236f,w,s. Radioisotope Seminar. (1 cr, §Rad 236) Loken, Armstrong, and staff

BIOMETRICS

Courses in Which Graduate Credit May Be Earned

100. Introduction to Statistical Analysis I. Statistical procedures in agricultural research; tests of significance, simple regression and correlation analyses, 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, Ph.D., *chairman*
Kenneth N. Ogle, Ph.D.
A. Glenn Richards, Ph.D.
Otto H. Schmitt, Ph.D.
Carlo A. Terzuolo, M.D.

Assistant Professor

Robert M. Benolken, Ph.D.

Staff:

Professor

Kenneth N. Ogle, Ph.D.
Otto H. Schmitt, Ph.D.
Marvin M. D. Williams, Ph.D.

Associate Professor

Eugene Ackerman, Ph.D.

Assistant Professor

Robert M. Benolken, Ph.D.
Merle K. Loken, Ph.D., M.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 biological and physical sciences, and mathematics with an undergraduate major in one of these areas is required.

Language Requirement—For the Master's degree, either reading knowledge of one language (Russian or German recommended) or substitution of approved course work, choice of approved course work or language to be made by the student's adviser. For the Ph.D. degree, either Russian or German and an additional language chosen from Russian, German, or French. A collateral field may be substituted for the second language.

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

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

Biophysics is a broad field including diverse biological and physical disciplines. Accordingly credit in biophysics is regularly granted for courses drawn from various departments. A wide diversity of appropriate courses is available in addition to those listed. The student's program should include 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: Biophysics and General Physiology. (Cr ar) Staff

Zool 153. Molecular Biology. (3 cr; offered 1965-66 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 physiology recommended; schedule ar) Schmitt

170, 171, 172. Radiation Biophysics. Theoretical and experimental aspects of radiological physics, medical physics, and radiobiology. Consideration of physical properties of various ionizing radiations, interaction of ionizing radiations with biological systems, and the use of radioactive isotopes as tracer elements. (3 cr per qtr; prereq ‡) Loken

204x.* Research in Biophysics and Radiation Biology. (Cr ar) Loken

218x. Seminar: Radiobiology. Discussion of research problems and current literature on the biological effects of ionizing radiations. (1 cr; prereq ‡)

221x*-222x*-223x.* Research in Biophysics. (Cr ar) Staff

Rad 236. Seminar: Radioisotope. (1 cr; prereq ‡) Loken

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

BIOSTATISTICS

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

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

Assistant Professor
Robert L. Evans, Ph.D.
Marion W. Thornton, Ph.D.
Constance van Eeden, Ph.D.

Prerequisites—For major work, completion of the premedical curriculum. Acceptable alternatives include the equivalent of an undergraduate major in one of the following two categories:

1. The biological and/or behavioral sciences
2. The physical sciences and/or mathematics

and the equivalent of a minor in the other category. If the major is in category 2, the candidate should be interested in application in category 1.

Language Requirement—For the M.S. degree, none. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge. Acceptable languages are Chinese, French, German, Italian, Japanese, Russian, Scandinavian languages, and Spanish.

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

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

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 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 exercises. (2 cr) Bearman, Weckwerth

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 nonparametric 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 prin-

ciples and methods covered in 110 and 120. (2 cr per qtr; prereq ¶110 for 111, ¶120 for 121) Briese, Loewenson

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

PubH 124. Medical Statistics II. Selected statistical techniques in continuation of 90, including analysis of data resulting from follow-up studies. (2 cr; prereq 90 or ♯; offered when demand warrants) Staff

PubH 130s.° Biostatistics III. Principles and methods of analysis of components of variance and effects in surveys and experiments; one-way, two-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) Briese, Loewenson

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

PubH 143x. Introductory Topics in Mathematical Biology. Physico-, chemico-mathematical biology (analytical methods) of mechanical and electrochemical problems of colloids, cells, and tissues, and of kinetics of simple reactions and transports. (3 cr; prereq 1-yr sequences in mathematics [incl calculus], physics, chemistry, and a basic biological science with lab work in at least one of them or ♯) Evans

PubH 144w. History of Biostatistics. Development of probability theory and systems for collection of vital statistics; early applications to life tables, medical, and biological problems; biographies of men important in development. (2 cr; prereq 3 cr in statistics) Thornton

PubH 150.° Vital Statistics II. Life table techniques and follow-up studies; survivorship curves; problem of bias and selection connected with retrospective studies. (3 cr; prereq ♯) Staff

PubH 180. Introduction to Biostatistics. Variation; frequency distribution; probability; estimation; significance tests; binomial, normal, Poisson distributions; serial dilutions; most probable number. (6 cr; prereq environmental health students only, others ♯) Staff

PubH 197f°-198w°‡-199s.°‡ Elements of Mathematical Biology. Physico-, chemico-mathematical biology; analytical methods; mechanical (static and dynamic) and electrochemical problems of colloids, cells, and tissues; kinetics of reactions, transport, and their combinations; computers in bio-medicine, analog and digital. (5 cr per qtr; prereq mathematics, incl differential equations, and 1-yr sequences in physics, chemistry, and a basic biological science, with lab work in at least one of them or ♯) Evans

PubH 200x.° Research. Opportunities are offered by the School of Public Health and by various co-operating organizations for qualified students to pursue research work. (Cr ar) Graduate staff

PubH 201x.° Topics in Biometry. Studies in special topics for advanced students. (Cr ar; prereq 120, 130 and ♯) Bearman and staff

PubH 201A. Topics in Biometry (Advanced Topics Vital Statistics). (3 cr; prereq 140 with grade B) Thornton, Bearman

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 design. (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: 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

Offered at the Mayo Foundation

Professor

Joseph Berkson, M.A., M.D., D.Sc., *head*

Graduate work in biometry and medical studies at the Mayo Foundation is offered in the Division of Biometry and Medical Statistics at the Mayo Clinic. This may include studies in clinical as well as laboratory fields.

M 251f,w,s,su. Research Problems in Biometry. Berkson

BOTANY

Professor

Ernst C. Abbe
A. Orville Dahl
Albert W. Frenkel
John W. Hall
Donald B. Lawrence
Thomas Morley
Gerald B. Ownbey

Associate Professor

Alan J. Brook
Eville Gorham

Prerequisites—For major work, general biology (Biol 1-2 or equivalent) and at least 17 additional credits in botany approved by the department; with consent of the major adviser, credits in related subjects may be substituted. For minor work, general biology (Biol 1-2 or equivalent).

Language Requirement—For the Master's degree, reading knowledge of scientific literature in one foreign language, preferably French, German, or Russian. For the Ph.D. degree, two languages, one of which must be German, the other either Russian or French.

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

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

Note—For courses in plant pathology and mycology, see Plant Pathology; for courses in genetics and cytogenetics, see Genetics.

103f. Plant Embryology. Early stages of somatic development with emphasis on vascular plants. (3 cr; prereq 54 or 104 or ‡; offered when feasible) Abbe

104f.* Survey of the Plant Kingdom. A brief consideration of evolutionary relationships throughout the plant kingdom, illustrated by life histories. (5 cr, §54; prereq Biol 2) 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 1964-65 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 1965-66 and alt yrs) Ownbey

110f. Gymnosperms. Taxonomy and phylogeny of gymnosperms; emphasis on living representatives. (3 cr; prereq 52 or ‡; offered 1964-65 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 1965-66 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. (6 cr; prereq 10 cr in biology or ‡; offered only at Itasca Biology Session)

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, cytotaxonomy, 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 ir cytology. (5 cr; prereq 118 or Zool 272; offered 1964-65 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 Biol 2, 118 or 119, and ‡; offered 1964-65 and alt yrs) Dahl

121w.* Developmental Plant Anatomy. Microscopic structure of vascular plants; development in root, stem, and leaf. (5 cr, §53; prereq 10 cr in botany or zoology) Abbe

125f.* Morphogenesis. Development of form and structure in ontogeny and phylogeny; phenomena and genetical factors involved. (5 cr; prereq 10 cr in botany or biology; offered when feasible) Abbe

126f. Pre-Pleistocene Palynology. Survey of pollen and spores primarily from Mesozoic and Tertiary deposits. Techniques of sample preparation; nomenclature and identification of fossil pollen and spores; their use in stratigraphy. (3 cr; prereq 165; offered 1965-66 and alt yrs) Hall

127.* Morphology of Vascular Plants. Vegetative and reproductive structure of living and fossil vascular plants. Their evolutionary relationships based on phylogenetic principles. (5 cr; prereq 54 or 104 or ‡; offered when feasible) Abbe, Hall

128s. Phyletic Paleobotany. Morphology, anatomy, and evolution of fossil plants, especially those occurring in the late Paleozoic. (3 cr; prereq ‡) Hall

129f. Floristic Paleobotany. Fossil floras from the late Paleozoic to the present; macrofossil remains, especially leaves, and their use in stratigraphy, paleoclimatic and paleoecologic interpretations. (3 cr; prereq ‡; offered 1966-67 and alt yrs) 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 ‡; offered when feasible)

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 ‡; offered when feasible) Lawrence

138w. Freshwater and Wetland Ecology. Nature, origin, and development of lake, marsh, swamp, and bog ecosystems with reference to environmental control and productivity. (3 cr; prereq 15 cr in biological subjects, introductory chemistry, or ‡...Bot 50 or Zool 65 recommended) Gorham

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], §Bot 51; prereq elementary course in botany, zoology, or biology, or ‡, and a course in organic chemistry or biochemistry) Frenkel

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 1964-65 and alt yrs) Brook

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 1965-66 and alt yrs) Brook

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 1965-66 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 272 or ‡; offered 1965-66 and alt yrs) Dahl

170f. Water Relations of Plants. Colloidal phenomena. Diffusion, osmosis, and characteristics of living membranes. Cell water relations. Phenomena of absorption, transport, and transpiration of water and translocation of solutes in higher plants. (3 cr; prereq 51 or 140, 20 cr in chemistry or biochemistry; offered 1965-66 and alt yrs)

171w. Mineral Nutrition of Plants. Chemical elements necessary for plant nutrition and their role in normal metabolism. Relationship of nutritional factors to other physiological processes. Deficiency and toxicity of mineral elements. (3 cr; prereq 51 or 140, 20 cr in chemistry or biochemistry; offered 1965-66 and alt yrs)

172s. Plant Growth. Changes in physiological and biochemical activities during plant growth and development. Analysis of changes in enzyme and respiratory activities from germination to seed production. Biochemistry of hormone production and destruction; relation of hormones to metabolic activities. Biochemical and physiological aspects of the genetic control of plant growth and development. (3 cr; prereq 51 or 140, 20 cr in chemistry or biochemistry; offered 1965-66 and alt yrs)

176f. Plant Respiration. Biochemical mechanism of carbohydrate degradation in plants. Nature of biochemical pathways, electron transport, phosphorylation. Utilization of metabolic energy in synthetic processes. Respiratory control mechanisms. (3 cr; prereq 51 or 140, 20 cr in chemistry or biochemistry; offered 1964-65 and alt yrs)

177w. Photosynthesis. Detailed survey of the present state of knowledge of photosynthesis. (3 cr; prereq ‡; offered 1964-65 and alt yrs) Frenkel

178s. Nitrogen Metabolism of Plants. Conversion of inorganic to organic forms of nitrogen. Nitrogen fixation. Interrelation with other metabolic processes of plants. Protein and nucleic acid synthesis in plants. Control mechanism in protein, enzyme and nucleoprotein synthesis. (3 cr; prereq 51 or 140, 20 cr in chemistry or biochemistry; offered 1964-65 and alt yrs)

182f. Advanced Topics in Plant Physiology. (3 cr; prereq 51 or 140 or ‡) 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 1964-65 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) Frenkel

229f,° 230w,° 231s,° 232su.° Research Problems in Cytology. (Cr ar) Dahl

233f,° 234w,° 235s,° 236su.° Research Problems in Phycology. (Cr ar) Brook

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) Frenkel

255f, 256w, 257s. Seminar: Cytology. (1 cr per qtr) Dahl

258f, 259w, 260s. Seminar: Cryptogamic Plants. (1 cr per qtr) Brook

BUSINESS ADMINISTRATION

Professor

Paul V. Grambsch
George W. England
Richard K. Gaumnitz
Robert S. Hancock
Delbert C. Hastings
Herbert G. Heneman, Jr.
Robert J. Holloway
Richard L. Kozelka
Edwin H. Lewis
Reuel I. Lund
Thomas A. Mahoney
John Neter
Edmund A. Nightingale
George Seltzer
Allen R. Solem
Harold W. Stevenson
Albert K. Wickesberg
C. Arthur Williams, Jr.

Associate Professor

Robert G. Berryman
Gordon B. Davis
Ernestine C. Donaldson
Nicholas Glaskowsky
Donald V. Harper
Thomas R. Hoffmann

Assistant Professor

Jack C. Gray
J. Russell Nelson
Cyrus F. Smythe
Raymond E. Willis
Glenn L. Wood

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

Master of Business Administration

1. Purpose—This degree is designed for the individual who desires to build upon a general competence in business administration the ability to analyze and solve problems faced by business managers. To this end, the student's primary orientation is directed in the areas of administrative responsibility and decision-making.

2. Degree Requirements—Participants must complete the requirements outlined in the sections which follow. Requirements in the "Tool Areas and Underlying Disciplines" and "Basic Business Core" (sections a and b below) may be met through appropriate courses taken in the student's undergraduate program. Students lacking any of these courses or their equivalents must take courses necessary to meet the requirements of these two sections. Any deficiencies may be removed while regularly enrolled in the M.B.A. program.

a. *Tool Areas and Underlying Disciplines*—All students must complete two introductory courses in managerial accounting; two introductory courses in the behavioral sciences (psychology, sociology); and one introductory course in each of the following: statistics, quantitative approaches to administrative problems (QA 258), managerial economics, and national income and employment.

b. *Basic Business Core*—Students must also complete:

(1) one introductory course in each of the following: fundamentals of management, business finance, marketing fundamentals, administration of production, and manpower management; and

(2) one introductory course in each of two areas selected from the following three: business law, risk management and insurance, and transportation and business logistics.

All participants in the M.B.A. program are required to complete the requirements outlined in the sections "Advanced Managerial Core" and "Areas of Interest" while enrolled in the M.B.A. program at the University of Minnesota.

c. *Advanced Managerial Core*—The M.B.A. candidate must complete:

(1) all of the following: Executive Leadership (Mgmt 250), Government and Business Enterprise I and II (Mgmt 256-257), Quantitative Approaches to Administrative Problems II (QA 259), and Policy Formulation and Administration (Mgmt 260); plus

(2) three courses to be selected from among the following: Production Management (Prod 100), Risk Management and Insurance II (Ins 163), Transportation II: Traffic Management (Tran 174), Intermediate Labor Marketing and Manpower Management (IR 182C), Marketing Management (Mktg 247), Managerial Cost Accounting (Acct 265A), Financial Management (BFin 257)

d. *Areas of Interest*—For purposes of Graduate School credit requirements, the M.B.A. degree program consists of 45 graduate credits earned under the requirements in sections c and d. In meeting this requirement, each candidate must select at least three elective courses (9 credits). Students with extensive undergraduate background in business may need to elect additional graduate courses to bring their graduate credit total to 45. All elective courses must comply with the requirements in sections d(1) and d(2) which follow. (Up to 12 graduate credits earned under sections a and b may be included in the candidate's formal program to meet the Graduate School's 45-credit minimum).

(1) The following areas in business administration may be used as areas of interest in which the student may take additional course work:

accounting
business finance
industrial relations
management
marketing
production
quantitative analysis
risk management and insurance
transportation and business logistics

(2) Electives selected under this section must be distributed so that no more than two courses beyond those required in sections a, b, and c are selected in any one area as defined in d(1). Courses in business law and office management may be used as electives. A maximum of two courses may be taken outside the Graduate School of Business Administration.

e. *Written Reports*—At least 9 credit hours of the requirements in paragraphs c and d must be earned in courses requiring the preparation of written reports which represent the quality but not the range of a Master's thesis. These "Plan B papers" must be prepared for courses beyond the introductory course of the area in at least two different areas. Courses used to meet this requirement must receive the prior approval of the course instructor and the major adviser.

f. *Examinations*—All candidates will be required to take a final oral or written examination, or both, at the discretion of the examining committee.

g. *Foreign Language*—A foreign language is not required.

Master of Science

1. Purpose—This degree is recommended for those individuals who wish intensive preparation in a functional area of business activity leading to professional status in their chosen area of specialization (e.g., accounting, investment analysis,

market research, traffic, personnel, operations research, production control, and similar areas).

The M.S. is offered either with or without thesis and may be completed in from 1 to 2 years depending on the extent of the person's undergraduate preparation.

2. Degree Requirements—

a. ALL CANDIDATES (Plan A and Plan B) must complete the requirements as outlined in the sections "Tool Areas and Underlying Disciplines" and "Basic Business Core," sections a(1) and a(2). Appropriate courses in the student's undergraduate program may be submitted to meet these requirements. Students lacking any of these courses or their equivalents must take courses necessary to meet the requirements of these two sections. Any deficiencies may be removed while the student is regularly enrolled in the M.S. program.

(1) *Tool Areas and Underlying Disciplines*—All students must complete two introductory courses in managerial accounting; two introductory courses in the behavioral sciences (psychology, sociology); and one introductory course in each of the following: statistics, quantitative approaches to administrative problems (QA 258), managerial economics, and national income and employment.

(2) *Basic Business Core*—All students must complete one introductory course in each of the following: fundamentals of management, business finance, marketing fundamentals, administration of production, and manpower management.

b. DEGREE REQUIREMENTS, PLAN B (WITHOUT THESIS)—In addition to the requirements in paragraph 2a, students seeking the M.S. degree (Plan B) must satisfy the following:

(1) *Major Field of Concentration*—

(a) The major field must be selected from the following areas in business administration:

accounting
business finance
industrial relations
management
marketing
production
quantitative analysis
risk management and insurance
transportation and business logistics

(b) The major field consists of a minimum of 21 quarter credits in graduate courses selected at the adviser's discretion from courses within the major area as identified in b(1)(a) and where appropriate from other areas in the Graduate School of Business Administration and/or other fields of instruction in the Graduate School, subject to the limitations in section b(3).

(2) *Related Fields or Underlying Disciplines*—

(a) A minimum of 18 quarter credits in graduate courses in only two related fields or areas, with a minimum of 6 credits in each, will be offered to meet this requirement. At least one of these fields or areas must be outside the Graduate School of Business Administration. A related field within the Graduate School of Business Administration may be selected from any of the areas listed in section b(1)(a) above, other than the major area. Courses selected under sections a(1), a(2), and b(1) cannot be used to meet this requirement except as permitted under the conditions of section b(3).

(3) *Additional Requirements and Recommendations*—

(a) For purposes of Graduate School credit requirements, the M.S. degree Plan B credit program consists of 45 credits earned under the requirements of sections b(1) and b(2) except that up to 6 graduate credits earned under sections a(1) and a(2) may be included to meet this requirement.

(b) It is highly recommended that some research methodology courses, such as QA 251 and/or QA 191, be incorporated in the degree program, either as part of the major requirement or as a related field.

(4) *Written Reports*—At least 9 credit hours of the requirements in sections b(1) and b(2) must be earned in courses beyond the introductory course of the area requiring the preparation of written reports which represent the quality but not the range of the Master's thesis. Of the 9 credit hours, 6 must be in the major field of study and 3 outside the major field. Courses used to meet this requirement must receive the prior approval of the course instructor and the major adviser.

(5) *Examinations*—All candidates are required to take a final oral or written examination, or both, at the discretion of the examining committee.

(6) *Foreign Language*—A foreign language is not required.

c. Degree Requirements, Plan A (with thesis)—In addition to the requirequirements in paragraph 2(a), students seeking the M.S. (Plan A) must satisfy the following:

(1) *Major Field of Concentration*—

(a) The major field will be selected from the following areas in business administration:

accounting
business finance
industrial relations
management
marketing
production
quantitative analysis
risk management and insurance
transportation and business logistics

(b) The major field consists of 18 quarter credits in graduate courses selected at the adviser's discretion from courses within the major area as identified in c(1)(a) and where appropriate from other areas in the Graduate School of Business Administration and/or other fields of instruction in the Graduate School.

(2) *Related Field or Underlying Discipline*—A single field outside the Graduate School of Business Administration and totaling 9 credits in graduate courses must be selected from among those fields of instruction recognized by the Graduate School.

(3) *Additional Requirements and Recommendations*—

(a) Courses used to meet the requirements in sections a(1) and a(2) cannot be used to fulfill the requirements of sections c(1) and c(2).

(b) It is highly recommended that some research methodology courses be incorporated in the degree program. Courses such as QA 251 and/or QA 191 may be included as part of the major requirement. Research methodology courses from other areas of instruction within the Graduate School may be used as the related field.

(4) *Thesis*

(5) *Examinations*—All candidates are required to take a final oral or written examination, or both, at the discretion of the examining committee.

(6) *Foreign Language*—A foreign language is not required.

Doctor of Philosophy

Candidates for the doctor of philosophy degree must complete the following, subject to the approval of the Graduate School:

1. General Competence—For admission to the doctoral program, each prospective candidate must pass a qualifying examination to demonstrate competence in tool areas, underlying disciplines, and the basic business core as outlined under the requirements for the master of science in business degree plus calculus. The examination covers subject matter typically found in two introductory courses in each of the areas of accounting and the behavioral sciences; one introductory course in each of the following: statistics, quantitative approaches to administrative problems, managerial economics, national income and employment, differential and integral calculus, fundamentals of management, business finance, marketing fundamentals, administration of production, and manpower management.

2. Major Field of Concentration in Business—The prospective candidate must pass a comprehensive written proficiency examination in his major field of concentration to be selected from the following:

accounting
business finance
industrial relations
management
marketing
production
quantitative analysis
risk management and insurance
transportation and business logistics

3. Related Field of Concentration in Business—The prospective candidate must also demonstrate basic competence by passing a written examination in a related field within business administration to be selected from the fields listed in paragraph 2 above.

4. Research Methodology and/or Technique—A minimum of 9 credits in research methodology and/or technique courses numbered 100 or higher must be completed with grades of C or better to give the student technical research competence in his area of specialization. The courses selected to meet this requirement must provide for an integrated development of this research competence, and must be approved by the adviser and by the Program Review Committee of the graduate faculty in business administration.

5. Underlying Discipline—The following fields are identified as underlying disciplines for business administration: economics, mathematics, psychology, and sociology. The prospective candidate must achieve basic competency in one or two of the underlying disciplines by completing either:

a. one of the above underlying disciplines as a minor field; in this case, all of the minor field requirements as set forth by the Graduate School must be met; or

b. 12 graduate credits in one underlying discipline selected from the four listed above plus 12 graduate credits in a related field also outside the area of business administration (this latter related field may be a second underlying discipline from the four listed above); an average of B or better must be earned in the courses used to meet the requirements of this subsection.

6. Foreign Language—Reading knowledge of one foreign language is required.

7. Oral Examination—Within a reasonable time after successful completion of the written examinations in the major and related fields in business, students will take a comprehensive oral examination. This examination may cover any work in the student's approved program with the exception of the thesis. Successful completion of this examination formally admits the student to candidacy for the degree.

8. Thesis and Final Oral—The candidate will complete a doctoral dissertation and final oral examination as prescribed by the Graduate School.

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) Solem

Mgmt 251. Superior-Subordinate Problems. Theory, methods, and skill development in the application of behavior concepts to management problems. Problem solving, role playing, discussion methods, and readings from current literature will be emphasized. (3 cr; prereq 250) Solem

Mgmt 256. Government and Business Enterprise I. Varied interrelations of governmental and business activities in American society. Recent trends and future prospects regarding the scope of such relationships. Government as: (a) a rule-maker for business—in peace and war-time contexts; (b) a direct participant in the economic process—e.g., procurement practices, employment policies, and operation of publicly owned enterprises; and (c) an indirect participant in business activities—e.g., programs regarding small business, urban redevelopment and housing, "distressed" areas, research, plant construction, resource conservation and development. (3 cr) Seltzer

Mgmt 257. Government and Business Enterprise II. Relationship between governmental policy and maintenance of competitive markets. Purpose, substance, and problems of antitrust law and administration. Desirability, feasibility, and effectiveness of antitrust policy. Meaning of "effective competition," "workable competition," and "countervailing power." Considers: (a) relation between business size and efficiency; and (b) compatibility of antitrust and range of other governmental policies. (3 cr; prereq 256) Seltzer

Mgmt 260. 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 340. Seminar: Interpersonal Relations. (3 cr; prereq 251) Solem

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

Production

Prod 100. Problems in Production Management. Current problems and techniques. Builds upon the introductory course in developing maturity and insight into production factors. Similar problem areas. (3 cr; prereq 50 or equiv) Hoffmann

Prod 110. Systems and Procedures Analysis; Work Measurement. Management systems concepts; application and implementation of information and communication networks in the firm, integrated cybernetic systems and work relationships of groups, individuals, machines, and management as evaluated through time and productivity measurements. (3 cr; prereq 50 or equiv) Hoffmann

Prod 150B. Administration of Production. Fundamentals of production from management point of view. Techniques, managerial problems. and decision-making processes in administration of production function. Limited use of case material and/or field study to observe practical difficulties in utilizing operating principles. (3 cr, §50; prereq 150A or ‡) Hoffmann

Prod 220. Production Planning and Control. Production forecasting, process planning and routing, material and tool control, loading, scheduling, dispatching, and mathematical analysis of managerial production control problems. (3 cr; prereq 150B, QA 61, QA 258 or ‡) Hoffmann

Prod 290A. Readings in Production. Intensive research into a particular subject; with preparation of a major term paper normally required. (Cr ar; prereq consent of adviser and ‡, 2nd yr grad standing in requisite introductory courses) Hoffmann

Prod 290B. Graduate Research in Production. Research projects in co-operation with a specific problem in a business firm. (Cr ar; prereq consent of adviser and ‡, 2nd yr grad standing in requisite introductory courses) Hoffmann

Prod 350. Seminar: Production. (3 cr; prereq 100 or equiv) Hoffmann

Quantitative Analysis

QA 150. Mathematics for Business Analysis. Introduction to mathematical concepts and notation as applied to the description and analysis of business operations. Applications of differential and integral calculus to business problems. For graduate students with limited mathematical background. (3 cr, §Math 40, §Math 24A; prereq Math 10 or equiv) Willis, Neter

QA 151. Elements of Statistics. Statistical description, frequency distributions, probability, sampling, introduction to statistical estimation and decision-making. (3 cr, §51; prereq Math 10 or equiv) Kozelka, Hastings, Neter

QA 171. Statistical Methods for Sample Surveys. Introduction to commonly used sampling methods, including stratified sampling, multistage sampling and cluster sampling; methods of estimation, including ratio and regression estimates; design of surveys taking into account various costs; statistical measurement and control of nonsampling errors. (3 cr; prereq 51 or 151 or equiv) Hastings, Neter

QA 181. Quality Control and Industrial Statistics. Acceptance sampling by attributes and variables; construction of single, double, and multiple acceptance sampling plans; statistical control charts and their operation; effectiveness of control charts; modification of control charts for special problems. (3 cr; prereq 51 or 151 or equiv) Hastings, Neter

QA 191A-B. Statistical Methods in Business Administration. Tests on nature of population and population characteristics. Normal, t, chi square, F distributions. Multiple linear and curvilinear regression and correlation. Other measures and tests of association. Introduction to design and analysis of experiments. Nonparametric estimation and tests. Conditions when a particular statistical method is appropriate; illustrations of applications of statistical methods. (3 cr per qtr; prereq 51 or 151 or Econ 121A or ‡, 191A for 191B) Hastings, Neter

QA 193. Statistical Design of Experimental Research in Business. Basic concepts of statistical design and analysis of results. Randomized block, Latin-square, cross-over, factorial designs; confounding, estimation, and comparison of effects; response surfaces; applications in business administration. (3 cr; prereq 191B or equiv or ‡) Hastings, Neter

QA 231. Mathematical Programming for Business Analysis. Introduction to linear and other programming techniques useful in analyzing business operations. For graduate students interested in applying these techniques in functional areas of business operations. (3 cr; prereq Math 10) Willis

QA 236. Stochastic Models for Business Analysis. Use of probabilistic models in problems involving waiting lines, inventories, and service. For graduate students interested in applying mathematics to problems involving uncertainty in functional areas of business operations. (3 cr; prereq 150 or Math 40 or equiv, familiarity with Fortran or ¶Fortran seminar) Willis

QA 251. Business Research Methods and Techniques. Examination of research methods and techniques and their application to individual problems. Introduction to sources of business information. Place of business research in business management. (3 cr; prereq 51 or 151) Hastings

QA 258-259. Quantitative Approaches to Administrative Problems I and II. Uses of probability, statistics, mathematics, economic analysis, and operations research in the solution of business problems at administrative levels. (3 cr per qtr; prereq 151, Acct 155A, Acct 155B, Econ 65 or 165 or equiv) Willis and others

QA 291A. Readings in Quantitative Analysis. Special readings especially useful to student's individual program and objectives, but not available in regular course offerings. (Cr ar; prereq consent of adviser and inst in field covered)

QA 291B. Graduate Research in Quantitative Analysis. (Cr ar)

See also the following courses in economics in the subfield of econometrics and statistics.

Econ 101A—Foundations of Mathematics for Social Scientists

Econ 101B—Introduction to Decision Theory

Econ 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: Statistical Inference and Econometrics

Manpower Economics and Industrial Relations

For descriptions of the following courses see Industrial Relations.

IR 142. Settlement of Industrial Relations Disputes

IR 152. Systems of Industrial Relations: Labor Marketing

IR 152C. Industrial Relations Fundamentals

IR 162. Union Government and Policies

IR 172. Principles of Industrial Relations: Manpower Management

IR 182A. Intermediate Labor Marketing

IR 182B. Intermediate Manpower Management

IR 182C. Intermediate Labor Marketing and Manpower Management

IR 192. Industrial Relations Practices and Techniques

IR 202. Organization and Staffing

IR 212A. Labor Education

IR 212B. Employee Development and Training

IR 222. Compensation Theory

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 Methodology

IR 382. Seminar: Systems of Industrial Relations

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

Econ 182—Economic Security

Risk Management and Insurance

Ins 113. Actuarial Science Principles—Life and Health Insurance. Construction and characteristics of mortality and morbidity tables; computation of life and health insurance premiums and reserves; nonforfeiture values; dividend calculations. (3 cr, §Math 21; prereq 53 or 153 or ‡) Williams

Ins 153. Risk Management and Insurance I. Recognition, measurement, and evaluation of insurable personnel, property, and liability risks of economic units. Tools of risk management including retention, 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, Wood

Ins 163. Risk Management and Insurance II. A more intensive study of concepts presented in Risk Management and Insurance I and application to selected risk management situations. (3 cr; prereq courses in tool areas and underlying disciplines and basic business core including 153) Williams

Ins 173. Senior Topics: Risk Management and Insurance. Individual student reports on topics of special interest and discussion of important current problems in risk management and insurance. (3 cr; prereq 6 cr in insurance) Williams, Wood

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 Health Insurance. Nature and relative importance of insurable risks; analysis of life and health insurance contracts; programming; estate planning; business insurance; pricing, underwriting, and marketing methods. (3 cr, §73; prereq 153) Williams, Wood

Ins 213. Group Insurance. Group life insurance (term and permanent plans); group pensions (fixed and variable annuities); and group health insurance (disability income and medical expense plans). Basic principles, types of benefits, marketing and administration, methods of financing, and methods of funding. (3 cr, §83; prereq 153) Williams, Wood

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, Wood

Ins 233. Advanced Life and Health Insurance. Advanced programming; premiums and reserves; dividends; underwriting and reinsurance; production; claims; the financial statement; insurer organization and capital structure; government regulation; current problems. (3 cr; prereq 203) Williams, Wood

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, Wood

Ins 293A. Readings in Risk Management and Insurance. Readings useful to student's individual program and objectives, but not available in regular course offerings. (Cr ar; prereq consent of adviser and inst in field covered)

Ins 293B. Graduate Research in Risk Management and Insurance. (Cr ar)

Ins 303. Seminar: Life and Health Insurance. Selected current problems in life insurance and health insurance. Oral and written student reports on individual research. (3 cr; prereq 153) Williams, Wood

Ins 313. Seminar: Property and Liability Insurance. Selected current problems. Oral and written student reports on individual research. (3 cr; prereq 153) Williams, Wood

Transportation

Tran 154. Transportation I: Principles and Introduction to Business Logistics. 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 and Physical Distribution Management. Principles of transport control and physical distribution management (business logistics) and their application within the business (noncarrier) organization; carrier traffic management. Principles and problems governing construction, interpretation, and application of rail, highway, water, express, pipeline, freight forwarder, and air freight classifications and tariffs. (3 cr; prereq 54 or 154) Nightingale

Tran 184A. Highway Transportation. Economic aspects; national policy; facilities, including impact of the Interstate and Defense highway system; services, pricing, operations, and management of the motor-carrier industry; federal and state regulatory policies and problems; I.C.C. motor-carrier cost studies; intercity and urban passenger operations and problems; the transit problem of metropolitan areas. (3 cr; prereq 54 or 154) Harper

Tran 184B. International Transportation: Marine and Air. Economic aspects. Overseas trade routes and shipping services. The American Merchant Marine: operation, management, and finance of American shipping. Regulatory policies and problems: the conference system; Federal Maritime Commission and Maritime Administration. International air routes and services; national policy; operation, management and finance of American overseas air carriers. Economic regulation and problems, international competition in the jet age; Civil Aeronautics Board. International agreements and conventions among governments (International Civil Aviation Organization) and among carriers (International Air Transport Association). (3 cr; prereq 54 or 154) Nightingale

Tran 194A-B-C. Topics in Transportation and Traffic (Physical Distribution) Management

194A. Advanced Traffic and Physical Distribution Management I. Transportation rates, transport control practices, physical distribution systems, and their applications within the industrial firm. Problems and cases. (3 cr; prereq 174 or ‡) Nightingale

194B. Advanced Traffic and Physical Distribution Management II. Transportation rates, transport control practices, physical distribution management systems, and their applications within the industrial firm. Problems, cases, 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 and physical distribution 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 inst in field covered) Nightingale, Harper

Tran 294B. Graduate Research in Transportation. (Cr ar) Nightingale, Harper

Tran 304. Seminar: Transportation (National Transportation Policy). 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) Berryman, Purdy

Acct 105B. Intermediate Accounting II. Accounting treatment of cash, receivables, investments, intangible assets, and applications of actuarial mathematics. (3 cr; prereq 105A) Heller, Purdy

Acct 105C. Intermediate Accounting III. Accounting treatment of stockholders' equity, interpretation and analysis of financial statements. (3 cr, §55D; prereq 105A) Lund, Purdy

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) Davis, Gray, Bentley

Acct 115B. Cost Accounting. Analysis of the use of cost information in managerial decision-making. (3 cr, §55C; prereq 115A) Bentley, Gray

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, Berryman

Acct 135. Income Tax Accounting. Consideration of the more common and important provisions of the Federal and State of Minnesota income tax systems. Problems and case research for individuals, partnerships, and corporations are included. (4 cr; prereq 55D or 105A or ‡) Berryman

Acct 145A. Readings in Accounting Literature. Discussion and reports on selected topics in practice and theory as found in current accounting literature. (3 cr; prereq 12 cr Upper Division accounting) Berryman

Acct 145B. Advanced Topics in Accounting. Specialized topics in the field of accounting, changing from quarter to quarter. (3 cr; prereq 12 cr Upper Division accounting) Berryman

Acct 155A-B. Introduction to Managerial Accounting. Elementary course for graduate students only. Use of accounting as a tool of business management. (3 cr per qtr, §24-25-26, §55A-B) Davis

Acct 175A. Advanced Cost Accounting. Analysis of use of cost information for managerial control. (3 cr; prereq 115B) Davis

Acct 175B. Data Processing. 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. Controllership 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) Gray

Acct 175D. Budgetary Control. Fundamentals of establishing and operating a budget. Budgetary control and relationship to break-even analysis. (3 cr; prereq 115B) Gray

Acct 185A. Advanced Accounting. Consolidated statements, fiduciary and fund accounting, partnership accounting. (3 cr; prereq 105C or ¶105C) Lund

Acct 185B. Auditing and Public Accounting. Work of public accountants, including internal controls, fraud, programming, standards of practice, reporting, ethics, legal responsibility, nonaudit work. (3 cr; prereq 125) Berryman

Acct 185C. Governmental Accounting. Government budgets and fund accounting. (2 cr; prereq 105A)

Acct 195A. Internship in Public Accounting. Student will work full time for a public accounting firm and will write a report on his activities. (3 cr; prereq 125 and ‡) Berryman

Acct 195B. Internship in Internal Accounting. Student will work full time for 1 quarter in the accounting department of an industrial organization and will write a report on his activities. (3 cr; prereq 115B and ‡) Bentley

Acct 215. Accounting and Business Policy. Advanced consideration of use and limitations of accounting data as a basis of management policy. (3 cr; prereq 55C or 115B) Purdy

Acct 235A. Taxation and Business Planning. (3 cr; prereq 155B or equiv) Berryman

Acct 235B. Tax Accounting Problems. (3 cr; prereq 135) Berryman

Acct 265A. Managerial Cost Accounting. Use of cost accounting and analysis of its use by management in making decisions, setting policies, and establishing controls over costs. (3 cr, §55C, 115A, B; prereq 26 or equiv) Bentley, Gray

Acct 265B. Corporate Statements. Preparation of corporate statements and analysis from management, investment, and credit viewpoint. (3 cr, §55D, §105C; prereq 26 or equiv) Purdy

Acct 275A. Internal Auditing. Relationships between internal auditor and the accounting and operating departments. Audit of financial and nonfinancial activities. (3 cr; prereq 115A) Berryman

Acct 275B. Case Studies in Specialized Accounting. (3 cr)

Acct 285. Accounting Under Government Regulation. (3 cr)

Acct 295A. Readings in Accounting. Readings especially useful to student's individual program and objectives, but not available in regular course offerings. (Cr ar; prereq consent of adviser and inst in field covered)

Acct 295B. Graduate Research in Accounting. (Cr ar)

Acct 305A. Seminar in Accounting Theory: Valuation and Principles. (3 cr) Berryman

Acct 305B. Seminar in Accounting Theory: Income Determination and Statement Presentation. (3 cr)

Acct 305C. Seminar in Accounting Theory: Financial Statements. (3 cr)

Acct 315. Seminar: Cost Accounting. (3 cr) Purdy

Acct 325. Seminar: Auditing. (3 cr) Berryman

Acct 345A-B. Advanced Accounting Problems. (3 cr per qtr) Berryman

Business Finance

BFin 156. Business Finance Fundamentals. Study of the financial management of firms. Principles governing the planning, raising, and control of short- and long-term funds. Attention directed to capital structures, valuation situations, capital budgeting, dividend policy. Presented through text, problem, and case material. (3 cr, §56; prereq grad, Acct 26 or Acct 155B) Stevenson

BFin 257. Financial Management. Analysis of financial problems of business enterprises, including the planning, raising, and control of short- and long-term funds. Application of principles to case situations, supplemented with readings covering fund flows, debt-equity choices, valuation, capital budgeting, mergers. Discussions and written reports. (3 cr, §76, §old 276; prereq 56 or 156) Stevenson

BFin 258. Topics in Financial Management. Intensive treatment of certain financial management problems such as capital budgeting, investment banking and long-term capital raising, valuation, mergers, refundings, and reorganizations. Presentation through readings, student projects, and case material. (3 cr, §196; prereq old 76 or 257 or ‡) Stevenson

BFin 266. Investment Fundamentals. Introduction to the appraisal of securities and the management of investment funds, essentially from the viewpoint of the individual investor. Stresses principles of value determination and risks associated with various types of securities, including bonds, preferred stocks and common stocks and their use in portfolios. Coverage includes industrials, utilities, financial institution, and government issues. Lectures, readings, and student projects. (3 cr, §old 116; prereq 56 or 156) J R Nelson

BFin 267. Investment Analysis. Development through research projects of the principles of financial analysis. Techniques in collecting, adjusting, and interpreting data affecting the present and future values of common stocks. Selection of senior security issues. Primarily for students with a professional interest in investments. Readings and student projects. (3 cr; prereq old 116 or 266) Stevenson

BFin 268. Investment Management. Development of principles and policies governing security portfolio management for individuals and institutions. Primarily for students with a professional interest in investments. Readings and case material and student projects. (3 cr, §126; prereq old 116 or 266) Stevenson

BFin 276. Capital Markets and Institutions. Study of the characteristics and institutional structure of the money and capital markets; flow of funds analysis; markets for equity and debt securities; the role of institutional and individual investors; regulation of securities markets; price behavior of specific types of securities. (3 cr, §106; prereq 56 or 156) J R Nelson

BFin 277. Problems in Management of Financial Institutions. Considerable attention to the study of loan and investment policies of commercial banks and other lending and savings institutions; liquidity and solvency problems; methods of evaluating the soundness of individual institutions. Primarily for students with a professional interest in the management of financial institutions. Presentation of cases by officers of financial institutions in the Twin Cities area; readings and student projects. (3 cr; prereq old 106 or 276) Stevenson

BFin 286. Real Estate Fundamentals. The nature of real estate values and finance, urban land economics, the structure and growth of cities; land development, zoning and other factors affecting real estate values. Lectures by businessmen, readings, and student projects. (3 cr, §146)

BFin 296A. Readings in Business Finance. Readings useful to students' individual program and objective, but not available in regular course offerings. (Cr ar; prereq consent of adviser and inst in field covered)

BFin 296B. Graduate Research in Business Finance. (Cr ar)

BFin 356. Seminar: Business Finance. (3 cr; prereq 156 or ‡)

BFin 366. Seminar: Investments. (3 cr; prereq old 116 or 266 or ‡) Stevenson

BFin 376. Seminar: Financial Markets. (3 cr; prereq old 106 or 276 or ‡) J R Nelson

Marketing

Mktg 147. Advanced Advertising Procedure. Problems in advertising research, stressing both traditional and more recent techniques such as motivation research. (3 cr; prereq 77 or 207) Longstaff

Mktg 157. Marketing. A study of the basic concepts as reflected by the environment and market forces. Includes the behavioral, economic, legal, and ethical aspects. Cast in this framework direction of the marketing effort and marketing activities include product, pricing, market development, and physical distribution policies. (3 cr, §57; prereq Econ 2 or equiv) Hancock

Mktg 177. 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)

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, Rudelius

Mktg 207. Advertising and Sales Promotion. The marketing program. Sales promotion mix components. Establishing objectives and budgets for sales promotion activities. Advertising and sales strategy. Media decisions. Advertiser-agency relationships. Measuring the effectiveness of sales promotional activities. Social and ethical implications of sales promotion. (3 cr, §77; prereq 57 or 157) Lewis

Mktg 217. Market Analysis and Research. Techniques used in marketing research, marketing information which can aid in the solution of marketing problems; selected nonsurvey and survey research techniques. (3 cr, §97; prereq 51 or 151 and 57 or 157) Holloway, Rudelius

Mktg 217C. Marketing Research II. Intensive coverage of nonsurvey techniques, especially experimentation in marketing. (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 237. Sales Management. Sales policies and planning; sales organization; selection, training, and compensation of salesmen; control of sales performance, sales budgets; cost control. Case materials. (3 cr, §117; prereq 57 or 157) Lewis

Mktg 237C. Marketing Topics. Analysis of marketing costs, channels of distribution, marketing of selected commodities. (3 cr, §117C; prereq 57) 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 287. Price Policy. Managerial problems concerning pricing and price policy. Methods used and factors considered in pricing goods and services in industrial and consumer markets. Topics include administered pricing, price behavior, nonprice competition, government intervention, pricing objectives, organization for pricing, price leadership, and others. (3 cr, §187; prereq 57 or 157) Harper

Mktg 297A. Readings in Marketing. Readings useful to student's individual program and objectives, but not available in regular course offerings. (Cr ar; prereq consent of adviser and inst in field covered)

Mktg 297B. Graduate Research in Marketing. (Cr ar)

Mktg 307. Seminar: Marketing Theory. (3 cr; prereq 157 or equiv and ♯) Lewis

Mktg 317. Seminar: Consumer Behavior. (3 cr; prereq 157 or equiv and ♯) Holloway

Mktg 327. Seminar: Social and Economic Aspects of Marketing. (3 cr; prereq 157 or equiv and ♯) Hancock

Business Law

BLaw 158. Business Law: Contracts. Legal principles governing contracts; examination of the law of contracts. Readings in law, study of representative decisions, written analyses. (3 cr, §58) Wright

BLaw 178. Business Law: Agency, Partnership, and Corporations. Law of agency, and consideration of problems of partnerships and corporations. Based upon readings in law, case histories, written analyses, pertinent decisions. (3 cr, §78; prereq 158 or equiv)

BLaw 188. Business Law: Sales and Negotiable Instruments. Utilizes readings, representative legal cases and decisions, written analyses. (3 cr, §88; prereq 158 or equiv)

BLaw 198. Business Law: Property Rights and Obligations. Legal principles governing transfer of title to, control of, and mortgaging of property, real and personal, including abstract examinations; also related principles of trusts and liquidation. Current statutory developments. Special readings. (3 cr, §98; prereq 158 or equiv) Neville

Office Management

OMgt 109. Fundamentals of Administrative Services. Role of administrative services in the automated office; managerial considerations of electronic computers; integrated data processing; information handling; duplicating; calculating; mailing; communicating; records control; forms control; selection of office equipment and machines; location, layout, and environment of the office; analysis, standardization, and control of procedures and methods; measurement of performance; organization and organizational relationships; selection, motivation, and compensation of office personnel. Lectures, visual aids, cases, and reports. (3 cr, §99) Donaldson

OMgt 119. Business Communications. Oral and written communications as an integrating force; control of internal activities through administrative writing; improvement and cost reduction of communications. (3 cr; prereq 99 or ‡) Donaldson

OMgt 129. Records Administration. Information-handling situations involved in the origin, classification, control, evaluation, protection of vital papers; disposition of records; maintenance of semi-active records depository and archives; information retrieval methods. (3 cr; prereq 36, 99 or ‡)

OMgt 139. Analysis of Office Functions. Fact finding and analysis applied to organization, work distribution, procedure flow, methods, standards, equipment, forms, and layout of an existing office. Management evaluation and redesign of present practices resulting in a proposed and projected plan which will provide the groundwork for increased automation in processing and utilizing information. (3 cr; prereq 99 or ‡) Donaldson

OMgt 149. Practice Course. Peterson

CHEMICAL ENGINEERING**

Professor
Neal R. Amundson
Rutherford Aris
Norman H. Ceaglske
John S. Dahler
Herbert S. Isbin
Edgar L. Piret
William E. Ranz
Henry M. Tsuchiya

Associate Professor
Arnold G. Fredrickson
Arthur J. Madden
George W. Preckshot
L. Edward Scriven II

Assistant Professor
Howard T. Davis

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

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, Russian, or French will be accepted routinely. Another language may be submitted by petition. For the Doctor's degree, two foreign languages, one of which must be German. The second language may be chosen from French, Japanese, or Russian.

Examinations—The written and oral preliminary examinations in chemical engineering for the Doctor's degree will be given at least twice each year, normally during the first 2 weeks of fall and spring quarters.

Master's Degree—Offered only under Plan A.

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

** Professional degrees in engineering 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 equilibriums. (3 cr per qtr; prereq PCh 101)

122-123. Biochemical Engineering. Application of biochemical and microbiological principles to industrial processes. (3 cr; prereq 103, MicB 53 or ‡) 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 multistage or columnar contacting equipment. (3 cr per qtr; prereq 103 and ‡) Ranz, Scriven

208-209-210. Physical Rate Processes and the Transfer Operations. (Continuation of 205-206-207) Advanced treatment of the laws of heat mass and momentum transfer. (3 cr per qtr; prereq 103 and ‡) 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 ‡) Dahler, Davis

214-215-216. Advanced Mathematics for Chemical Engineers and Chemists. Numerical analyses; ordinary and partial differential equations; Fourier series and special functions; finite difference equations; partial differentiation. Theory of heat conduction and diffusional operations. (3 cr per qtr; prereq differential equations; offered 1965-66 [alternates 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, Scriven

264. General Survey of Chemical Engineering. Independent reading under the guidance of the staff. (1 cr; prereq ♯; this course is prereq to candidacy for Ph.D. degree with major or minor in chemical engineering, and an exam must be taken by end of fall qtr of 2nd yr in residence)

301-302-303. Research in Chemical Engineering. Heat and mass transfer, fluid dynamics, chemical kinetics, chemical reactor theory, thermodynamics, process control, microbiology, applied mathematics. (Cr ar) Staff

CHEMICAL PHYSICS

Professor

John E. Wertz
Bryce Crawford, Jr.
Edward L. Hill
Rufus W. Lumry
Alfred O. C. Nier
Stephen Prager
T. Michael Sanders

Associate Professor

John S. Dahler
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 three chemistry and three physics courses numbered 100 and above must be passed with or without taking the courses themselves.) One of the courses in chemistry must be Chemical Thermodynamics.

Language Requirement—Reading proficiency in two of the following: German, French, Russian.

Preliminary Examinations—Four cumulative examinations in physical chemistry must be passed. A grade of A in one of the courses PCh 117, 118, 119, 211, 212, or passing the preliminary written examination in physics, will reduce this requirement to three cumulative examinations. The preliminary oral examination may be taken after three cumulative examinations have been passed and three required course

examinations in Quantum Mechanics have also been passed and the language requirements have been satisfied.

Doctoral Program—The usual Graduate School rules apply. Since there is no minor field of study, all courses on the Ph.D. 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 chemistry curriculum, at least 1 year of college physics, and college mathematics through calculus.

A minor in chemistry can be arranged by consultation with the departmental chairman.

Proficiency Examinations—Students working toward *any* graduate degree in chemistry are required to take a set of four proficiency examinations, one in each of the fields of chemistry: analytical, inorganic, organic, and physical. These examinations are taken on *entrance* and are offered in the fall *during the week preceding the first day of classes* and again during the week following the close of the winter quarter. The results of these examinations are used for orientation and guidance. If an examination is failed, the student must take and pass it the next time it is offered. The following texts are indicative of the material to be considered:

Organic: Any modern textbook used in a 1-year course for chemists—such as Noller, *Chemistry of Organic Compounds;* or Fieser and Fieser, *Textbook of Organic Chemistry.*

Physical: Undergraduate material from an elementary physical chemistry text—preferably *Physical Chemistry* by Moore; or *Principles of Physical Chemistry* (third edition), by Maron and Prutton.

Analytical: A standard textbook such as Kolthoff and Sandell, *Textbook of Quantitative Analysis* (omitting sections in fine print), or Blaedel and Meloche, *Elementary Quantitative Analysis.*

Inorganic: A textbook such as Sienko and Plane, *Chemistry;* also Cotton and Wilkinson, *Advanced Inorganic Chemistry.*

Minor—The choice of the particular courses to be presented in fulfillment of a minor in graduate work will be made after consultation with the student's adviser.

Language Requirement—Candidates for the Master's degree must have a reading knowledge of German. For the Doctor's degree, two foreign languages are required, one of which must be German. Either French or Russian is acceptable as the second language.

Preliminary Examinations—Written and oral preliminary examinations in chemistry for the Doctor's degree will be given twice each year.

Master's Degree—Work for the Master's degree is offered under Plan A. Plan B is occasionally permitted.

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

Analytical Chemistry

Professor
Stanley Bruckenstein
Edward J. Meehan
Ernest B. Sandell

Assistant Professor
Harold S. Swofford

100. Introduction to Analytical Chemistry I. (2 cr; prereq GeCh 26) Meehan

101. Introduction to Analytical Chemistry II. (3 cr; prereq 100) Meehan

102. Introductory Laboratory in Quantitative Analytical Chemistry. (4 cr; prereq 101) Meehan

102A. Introductory Laboratory in Quantitative Analytical Chemistry. (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) Swofford

113. Physicochemical Methods of Analysis. Laboratory. More advanced treatment of material covered in 112. (3 cr; prereq 111) Swofford

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

118. Electrochemical Methods of Analysis. Laboratory course. (3 cr; prereq 117) Swofford

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 1965-66 and alt yrs) Meehan

138. Advanced Volumetric Analysis. (3 cr; prereq 116)

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

211. Physicochemical Methods of Analysis. Lecture. Optical and electrochemical methods and methods of separation. (3 cr; prereq 102 or 102A, PCh 103 or ‡) Bruckenstein, Sandell, Swofford

212. Physicochemical Methods of Analysis. Laboratory course. Quantitative application of electrochemical, optical, and other physical techniques. (3 cr; prereq 211) Bruckenstein

235-236-237.‡ Research Seminar: Analytical Chemistry. Current research, especially that carried on in the department. (Cr ar) Staff

262. General Survey of Analytical Chemistry. Independent reading which is prerequisite to candidacy for the Ph.D. degree. See section under Proficiency Examinations. (1 cr)

301-302-303.°‡ Research in Quantitative Analysis. (Cr ar) Staff

Inorganic Chemistry

Associate Professor
Z Z. Hugus, Jr.

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

Associate Professor
Henry A. Bent
Doyle Britton
Lawrence E. Conroy
Warren L. Reynolds
R. Stuart Tobias

Assistant Professor
Steven T. Spees, Jr.

Prerequisites—For major or minor work, a Bachelor's degree with a major in chemistry including 1 year each of organic and physical chemistry, together with calculus, physics, and German. An average of B or better is required.

Language Requirement—German is required for the Master's and Doctor's degrees. French or Russian is acceptable as the second language for the Ph.D. degree, but another language may be substituted by petition.

Master's Degree—Offered under Plan A only.

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

103.° 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) Conroy

104.° Chemistry of the More Representative Elements. Preparation, reactions, and chemical properties of regular group elements and their compounds. (4 cr; prereq 103 or ‡) Reynolds

106.° Oxidation-Reduction Systematics. Application of tabulated thermodynamic data, including potential diagrams, to prediction of chemical reactions. (3 cr; prereq PCh 101) Hugus

111.° Silicon and Related Elements. Review of current studies on silicon, germanium, tin, and lead, with emphasis on recent silicon chemistry. (3 cr; prereq OrCh 62; offered 1964-65 and alt yrs) Johnson

112.° Radioactivity and Nuclear Chemistry. Properties of nuclei, distintegration, properties of radiation; natural and artificial radioactivity; modern views of nuclear structure. (3 cr; prereq PCh 103; offered 1965-66 and alt yrs) O'Connor

113.° Mechanisms of Inorganic Reactions. Prevalent ideas concerning mechanisms of inorganic oxidation-reduction and substitution reactions. (3 cr; prereq PCh 103; offered 1965-66 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, Tobias, Britton

134-135-136.‡ Seminar: Modern Problems in Inorganic Chemistry. (1 cr per qtr; prereq PCh 103, ‡) Staff

203.° 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) Bent

204. Advanced Inorganic Chemistry. Reactions and properties of the more important nontransition elements and their compounds. (4 cr; prereq 203 or ‡) Brasted

205. Advanced Inorganic Chemistry. Reactions and properties of the transition elements, including the rare earths, and their compounds. Ligand field theory. (4 cr; prereq 203, 204 or ‡) Spees

206. Advanced Inorganic Chemistry. Application of tabulated thermodynamic data, including potential diagrams, to the prediction of chemical reactions. (3 cr; prereq ‡) Hugus

211, 212, 213. Selected Topics in Inorganic Chemistry. (Cr ar; prereq △)

220-221-222.‡ Advanced Inorganic Chemistry Laboratory Methods. Such topics as advanced qualitative analysis, synthetic inorganic chemistry, radiochemical techniques. (Cr ar; prereq ‡)

260. General Survey of Inorganic Chemistry. Independent reading which is prerequisite to candidacy for the Ph.D. degree. See section under Proficiency Examinations. (1 cr)

301-302-303.‡ Research in Inorganic Chemistry. (Cr ar) Hugus, Brasted, Johnson, O'Connor, Britton, Reynolds, Bent, Conroy, Tobias, Spees

Organic Chemistry

Professor
Stuart W. Fenton
Raymond M. Dodson
C. Frederick Koelsch
Edward Leete
Wayland E. Noland
William E. Parham

Associate Professor
Maurice M. Kreevoy

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.

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 ‡) Hammerston

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 1965-66 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 1964-65 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 1964-65 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 ‡) Noland

223f.° **Stereochemistry.** Stereochemistry of carbon compounds and of organic reactions. (3 cr; prereq 220 or ‡) Dodson

224w.° **Theoretical Organic Chemistry.** More quantitative aspects of organic theory including kinetics and equilibrium studies. (3 cr; prereq 220, PCh 103 and calculus, or ‡) Hill

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 △) 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	Associate Professor	Assistant Professor
Robert S. Livingston	J. Doyle Britton	James R. Bolton
Bryce Crawford, Jr.	John S. Dahler	
Edward L. Hill	Z Z. Hugus, Jr.	
Rufus W. Lumry	Maurice M. Kreevoy	
Paul R. O'Connor	Sanford Lipsky	
Stephen Prager	C. Alden Mead	
John E. Wertz	Albert Moscowitz	
	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 △, Math 25A or 44)

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 △, Math 25A or 44) Lumry

104-105-106. **Physical Chemistry Laboratory.** (1 or 2 cr per qtr; prereq 101 or 108 or ¶101 for 104, 102 or 108 or ¶102 for 105, 103 or 108 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 Phys 6 with △, Math 25A or Math 44) 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) Livingston

111. **Thermodynamics.** Application of principles of thermodynamics to chemical phenomena including those occuring 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) Moscowitz

211. Introduction to Statistical Mechanics. (3 cr; prereq 103 or 103H)

212. Statistical Mechanics and Kinetic Theory. (3 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, 117 or equiv, ‡; offered 1964-65 and alt yrs) Lumry

215. Physical Chemistry of Proteins. (3 cr, §MdBc 217; prereq 103 or 103H or equiv; offered 1965-66 and alt yrs) Lumry or Wetlaufer

216. Physical Chemistry of Polymers. (3 cr; prereq 103 or 103H; offered 1964-65 and alt yrs) Prager

221-222-223.† Seminar: Radiation Chemistry. (Cr ar) Lipsky

250-251-252.† Physical Chemistry Seminar. (1 cr per qtr; required of all grad students majoring in physical chemistry) Overend

253-254-255.† Seminar: Molecular Spectroscopy. (Cr ar) Crawford, Overend

256-257-258.† Seminar: Theoretical Chemistry. (Cr ar) Moscowitz

259-260-261.† Seminar: Photochemistry. (Cr ar) Livingston

263. General Survey of Physical Chemistry. Independent reading which is prerequisite to candidacy for the Ph.D. degree. See section under Proficiency Examinations. (1 cr)

265-266-267.† Seminar: Magnetochemistry. (Cr ar) Wertz

268-269-270.† Seminar: Statistical Mechanics. (Cr ar) Prager

271-272-273.† Seminar: Physical Chemistry of Biological Systems. (Cr ar) Lumry

274-275-276.† Seminar: Quantum Mechanics. (Cr ar) Mead

290-291-292.† Selected Topics in Physical Chemistry. When demand exists, advanced seminars are held in subjects such as quantitative theory of valence, advanced thermodynamics, polymers, transport processes, magnetochemistry, structural and related properties of solids, photochemistry, and radiation chemistry. (Cr ar) Bolton, Crawford, Dahler, Lipsky, Livingston, Lumry, Mead, Moscowitz, Overend, Prager, Wertz

301-302-303.† Research in Physical Chemistry. Defects in crystals and solids, electronic structure of molecules, high polymers, infrared and Raman spectroscopy, molecular structure, NMR and EPR spectroscopy, optical activity, photochemistry, protein chemistry, quantum mechanics, radiation chemistry, reaction kinetics, statistical mechanics, transport processes. (Cr ar) Britton, Crawford, Dahler, Hugus, Kreevoy, Lipsky, Livingston, Lumry, Mead, Moscowitz, O'Connor, Overend, Prager, Wertz

CHILD PSYCHOLOGY

Professor	Associate Professor	Assistant Professor
Harold W. Stevenson	Willard W. Hartup	William Charlesworth
Merrill F. Roff	Shirley G. Moore	Frank B. W. Harper
Mildred C. Templin	Herbert L. Pick, Jr.	John P. Hill
Robert D. Wirt	Britton K. Ruebush	Murray K. Reed
	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—French, German, Spanish, or Russian. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge. If two languages are offered any combination of those listed above may be approved.

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

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

125. Experimental Research with Children. Supervised research experience. Design and conduct of experiments on child behavior in controlled laboratory situations. (3 cr; prereq 80, ‡) Wright, Pick, Charlesworth

126. Case Study of Children. Supervised intensive study of intellectual, personality, and social development and functioning of individual normal children. (3 cr; prereq 85, ‡) Harper, Hill

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 ††) Roff

140. Behavior Problems. Types, origin, development, and treatment of behavior difficulties in normal children. (3 cr; prereq 80 or equiv)

142. The Psychology of Handicapped Children. Research related to sensory, speech, language, physical disabilities of children. (3 cr; prereq 80 or equiv) Templin

143. Problems of Mental Deficiency. Diagnosis, care, training; social and vocational problems. (3 cr; prereq 80 or equiv) Pick

144. Psychology of the Gifted Child. Psychology and development of high intellectual ability and of special talents. (3 cr; prereq 80 or equiv) Charlesworth

179. Clinical Procedures with Children. Survey of methods of clinical psychology emphasizing basic concepts and research problems in clinical work with children. Primarily for students not majoring in clinical psychology. (3 cr; prereq 12 cr in psychology, educational psychology, sociology, or child development)

180. Personality Development. Development of personality in children. Psychoanalytic and behavior theory formulations and related research literature. (3 cr; prereq 80) Hartup, Hill

181. Social Development. Family and peer influences; social interaction and social relations; developmental changes. (3 cr; prereq 80) Hartup, Moore

182. Learning in Children. Discussion of theory and experimental literature. (3 cr; prereq 80) Wright

183. Language Development. Development of the structure and function of language, methodological problems; speech and language development; language scales; theories of language development. (3 cr; prereq 80) Templin

184. Sensory and Motor Development. Development of sensory and perceptual processes; simple and complex motor skills. (3 cr; prereq 80) Roff

190. Topics in Child Psychology. Independent reading or research. (Cr ar; prereq ‡) Staff

210-211. Advanced Child Psychology. Discussion and critical evaluation of current theories and research in child psychology. (3 cr; prereq ‡) Graduate staff

212. Research Methods in Child Psychology. Review of principal research methods and designs in child psychology. (3 cr; prereq ‡) Stevenson, Charlesworth

214. Learning in Children. Discussion of experimental literature on theoretically critical issues in children's learning. (4 cr; prereq Psy 129 or ‡) Stevenson, Wright

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

215. Perception in Children. Review and discussion of experimental and theoretical literature on children's perception; change of perception with age and experience. (4 cr; prereq Psy 150 and ‡) Pick

216. Cognitive Development. Development of thinking in children; theories of concept formation, problem solving and reasoning. (4 cr; prereq 12 cr in child development or psychology) Wright, Charlesworth

217. Advanced Personality Development. Critical evaluation of current theory and research in personality development. (4 cr; prereq ‡) Hartup, Ruebush

218. Abnormal Child Psychology. Dynamics of psychopathology in children. Critical evaluation of current theory and research in abnormal child psychology. (4 cr; prereq 217 and ‡) Ruebush

219. Advanced Social Development. Theory and research related to acquisition of social behavior by children, including effects of interaction with social environment. (4 cr; prereq ‡) Moore, Hartup

220, 221, 222. Seminar: Current Issues in Child Psychology I. Problems and issues in professional child psychology for first-year graduate students. (1 cr per qtr; prereq ‡) Graduate staff

223, 224, 225. Seminar: Developmental Psychology. Intensive study of selected topics. (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

233, 234, 235. Seminar: Current Issues in Child Psychology II. Problems and issues in professional child psychology for advanced graduate students. (1 cr per qtr; prereq ‡)

248. Clinical Child Psychology. Theories of psychodiagnosis: case history, prediction, and psychotherapy in clinical work with children. (3 cr; prereq ‡) Wirt

249. Treatment of Disturbed Children. Supervised experience. Restricted to Ph.D. candidates. (3 cr; prereq ‡) Wirt

250, 251. Practicum in Clinical Child Psychology. Supervised experience in psychodiagnostic work with emotionally disturbed children and their families. (5 cr per qtr; prereq ‡) Ruebush

285-286. Theory and Practices in the Preschool. Educational philosophy of the preschool. Intellectual growth and development of communicative skills. Curricular experiences in science, literature, art, and music. Use of free play and play materials with young children. (2 cr per qtr; prereq ‡) Moore

287. Behavior of Preschool Children. Use of group setting for study and guidance of personality and social development of young children. (3 cr; prereq ‡) Moore

291. Psychological Evaluation of Infants and Preschool Children. Discussion and practice in administering and interpreting psychological tests for infants and preschool children. (3 cr; prereq ‡) Clinic staff

292. Practicum in Psychological Appraisal of Children. Supervised experience in administering and interpreting psychological tests for children. (Cr ar; prereq ‡) Clinic staff

295. Seminar: Projective Methods with Children and Adolescents. Demonstrations, critical analysis, and discussion of research tools and clinical devices. (3 cr; prereq ‡) Hill

CIVIL ENGINEERING**

Professor
Paul Andersen
Alvin G. Anderson
Charles E. Bowers
Miles S. Kersten
John F. Ripken
George J. Schroepfer
Edward Silberman

Associate Professor
Walter T. Graves
John T. Hanley
Chieh S. Song
Theodor W. Thomas

Assistant Professor
Walter K. Johnson

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

Language Requirement—For the Master's degree, none. For the Ph.D. degree, two foreign languages, one of which must be German. In special cases a research technique may be substituted for the second language.

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.

Surveying

111. Land Surveying. Study of Minnesota Public Land Survey. Federal and state laws governing resurveys and subdivision surveys. Court decisions and legal principles involving boundary lines. Interpreting and writing deed descriptions. (3 cr; prereq 23 or ‡) Fant

112. Aerial Surveying and Photogrammetry. Theory and methods of making planimetric and topographic maps from aerial and terrestrial photographs. Principles of horizontal and vertical control nets, state co-ordinates, and astronomy as used in large-scale mapping projects. (3 cr; prereq 23 or ‡) Fant

113. Land Planning and Subdivision Design. Study and analysis of land planning and development problems such as street design, lot and block layout, drainage, utilities, etc. Requirements, computations, and preparation of record plats. (3 cr; prereq 23 or 111 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) Staff

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

139f. Structural Dynamics I. Elastic response of lumped and distributed parameter systems to dynamic loading. Problem formulation, and methods of solution for single degree-of-freedom systems, n-degree-of-freedom systems, and infinite degree-of-freedom systems with specific applications in structural engineering. (3 cr; prereq 132, MM 193, Math 147 or ‡) Hanley

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) Staff

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) Staff

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) Staff

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 141) 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 three or four 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

244. Structural Dynamics II. Elastic and plastic response of lumped parameter systems to dynamic loads. Stress propagation in solids and soil-structure interaction. Energy methods and numerical methods of analysis. Leads to formulation and justification of design expressions for structural elements and systems. (3 cr; prereq 139 or ♯) Hanley

245. Structural Design for Dynamic Loads. Design of beams, slabs, frames, and shells subjected to dynamic loading such as earthquakes, wind forces, blast loads, and moving loads. Determination and idealization of loading functions. Determination of idealization of resistance functions. Design philosophy and procedures for both elastic and plastic response. (3 cr; prereq 244 or ♯) Hanley

247f°-248w-249s. Seminar: 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) Bowers

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) Ripken

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 ‡) Bowers, Anderson, Ripken, Silberman

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) Johnson

173f.° Sanitary Engineering Problems: Water. Investigations of problems in water supply. Supplements 170. Collection, distribution, and purification. Economic studies. (3 cr; prereq 170) Schroepfer

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) Schroepfer

175s.° Industrial Waste Disposal. Investigation of various types of industrial wastes and methods of disposal. Economic studies. (3 cr; prereq 174) Schroepfer

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) Schroepfer

261w.° Water Plant Design. Design of water purification works. (3-5 cr; prereq 173) Schroepfer

262s.° Waste Water Plant Design. Design of treatment works. (3-5 cr; prereq 174) Schroepfer

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. (3-5 cr; prereq 172) Johnson

276f.° Advanced Sanitary Engineering (Water). Principles of water collection, distribution, and purification. Inspections and investigations of water works systems. Advanced study of certain phases of purification. (3-5 cr; prereq 173; hrs ar) Schroepfer

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

General

101. Contracts and Specifications. Synopsis of the law of contracts, sales, agency, negotiable instruments, real property, personal property, partnerships, corporations, insurance contracts, workman's compensation, labor law, mechanics liens, government construction contracts, and torts with applications to the performance of engineering and construction contracts. (3 cr) Westin

102. Building and Construction Contracts. Contracts with public authorities; the invitation, bid award; potential problems. Private construction. Legal problems in construction; contract administration. (3 cr; prereq 101 [GE 101]) Westin

124. Railway Engineering. Design, construction, and maintenance of railway roadbed, track, and structures. Economic principles of railway transportation. (3 cr; prereq 23 or ‡) Fant

125. Introduction to Computer Applications in Civil Engineering. Basic instruction in Fortran programming and utilization of digital computers in solution of civil engineering problems. Execution of actual problems in surveying, structures, hydromechanics, etc., in co-operation with the Numerical Analysis Center. (3 cr; prereq 20, 130, 160) Staff

169f. Public Works Engineering. Engineering phases and relationships of public works. Federal, state, and local administration problems. Present trends and practices. Need for adequate public planning, design, and construction. Responsibilities of the engineer. Typical problems. (3 cr; prereq 52) Schroepfer

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

Robert P. Sonkowsky
Roy Arthur 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 one of the two.

Classical Civilization—Major requirement: normally 12-18 graduate 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 95.

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; offered 1965-66) D Swanson

121f-122w-123s.† Advanced Prose Composition. (3 cr per qtr; prereq 24 cr in Greek) McDonald

161f. Plato: Selections. Meets with 61, but advanced independent work in addition to regular class assignments is required. (3 cr; prereq 3 or equiv) McDonald

162w. Greek Tragic Drama. Meets with 62, but advanced independent work in addition to regular class assignments is required. (3 cr; prereq 3 or equiv) Sonkowsky

163. Homer. Meets with 63, but advanced independent work in addition to regular class assignments is required. (3 cr; prereq 3 or equiv) Hainsworth

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 △) Staff

211-212-213.° Seminar: Greek Epic. (3 cr per qtr; offered 1965-66) McDonald

241-242-243.° Seminar: Greek Lyric Poetry. (3 cr per qtr) R Swanson

Latin

Prerequisites—Lat 61-62-63 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

133. Vulgar Latin. Development of Latin into Romance languages. (3 cr; offered 1965-66) D Swanson

135s. Medieval Latin. Survey of Latin literature from 5th to 12th century; Carolingian and 12th-century renaissance. (3 cr; prereq ‡) R Swanson

161, 162, 163. Survey of Latin Literature. Meets with 61-62-63; but advanced independent work in addition to regular class assignments is required. (3 cr per qtr, §61-62-63; prereq △) 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 63 or △) Staff

201f, 202w, 203s.* Seminar: Cicero. (3 cr per qtr; offered when feasible) Sonkowsky

221-222-223.* Seminar: Latin Lyric Poetry. (3 cr per qtr; offered 1964-65) R Swanson

251-252-253.* Seminar: Roman Drama. (3 cr per qtr) 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

180f. Classical Epic in Translation. Meets with 80, but advanced independent work in addition to regular class assignments is required. (3 cr, §80; offered 1964-65) 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 1964-65) 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 1964-65) McDonald

190. Proseminar: Classical Archaeology. (3 cr; prereq Clas 122, 123, or ‡) McDonald

191f, 192w, 193s. Classical Literary Traditions. (3 cr per qtr; prereq 9 cr in English literature, English beyond A-B-C, or foreign literature; offered 1965-66) DeWitt

194f. Proseminar: Introduction to Graduate Studies. Survey of fields of research in classical scholarship, methods and bibliography, textural history and criticism. (3 cr [required of all new grad students]) Sonkowsky

Sanskrit

128f-129w-130s. Readings in Sanskrit. (3 cr per qtr; prereq at least 2 Upper Division courses in early European languages; offered 1965-66 and alt yrs) D Swanson

COMPARATIVE LITERATURE

Committee:

Professor

John D. Hurrell, *chairman* (English)
Alrik Gustafson (Scandinavian)
Walter T. Pattison (Romance Languages)
Roy A. Swanson (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. French, German, Italian, Spanish, Russian, Latin, and Greek are acceptable. 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 one 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, chosen from the same list, 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 146, 191, 192, 193; Engl 127, 129, 134, 180, 184, 185, 186; Ger 190-191-192, 190A-191A-192A; Scan 161, 171, 172; Fren-Ital-Port-Span 114; Arab 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 one 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 one 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 one European language in medieval form recommended) Pattison

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

CONTROL SCIENCES

Professor

Lawrence Markus (Mathematics), *chairman*
Neal R. Amundson (Chemical Engineering)
Rutherford Aris (Chemical Engineering)
Warren S. Loud (Mathematics)
Katsuhiko Ogata (Mechanical Engineering)
Patarasp R. Sethna (Aeronautical Engineering)
Marvin L. Stein (Mathematics and Computation Center)

Associate Professor

Richard P. Halverson (Electrical Engineering)
E. Bruce Lee (Electrical Engineering)
Bernard W. Lindgren (Mathematics and Statistics)
John H. Park, Jr. (Electrical Engineering)

The program in control sciences leads to the Ph.D. degree. No M.S. degree or minor specialization is planned in the field of control sciences.

Prerequisites—Candidates for the Ph.D. program in control sciences will normally have completed an undergraduate degree or an M.S. in one of the related fields of engineering, mathematics, statistics, or physics. Prior to his admission to the program the student must be admitted as a graduate student to one of the relevant departments. Admission to the program must be approved by the Graduate School on recommendation of his department and the subcommittee on control sciences. Any applicant whose scientific and engineering training is adequate to follow the program will be considered.

Approval of Program—The candidate's tentative program will be planned with the aid of an adviser selected from those listed on the faculty of the Center for Control Sciences. This faculty will consider the program and transmit it to the Physical Sciences Group Committee with recommendations. Approval and appointment of a thesis committee will be handled as usual.

Major Program—The course work in the major should normally be selected from those courses in science and engineering that are particularly relevant to the field of control sciences. As it is intended that this program should provide an opportunity for a broad training, it is desirable that at least 9 credits of 200-series courses be selected from each of three of the related major areas. The candidate must prepare for a preliminary examination covering each of the following four basic divisions:

1. Mathematical and physical control models
2. Stability and control of linear and nonlinear deterministic processes
3. Stochastic processes and information theory
4. Numerical and computer techniques and implementation of control concepts in scientific and engineering processes

Normally a student can prepare for the preliminary examination by completing 9 credits of 200-series (or suitably advanced) courses in each of the four divisions. The remaining course work for the Ph.D. will be selected in consultation with an adviser.

Minor Program—There will be no official minor program. Therefore, all courses on the doctoral program must be passed with a grade of B or better. Each candidate is required to attain a high level of mathematical proficiency.

Language Requirement—All candidates must satisfactorily meet the requirement of two foreign languages, usually selected from French, German, or Russian.

DAIRY HUSBANDRY

Professor	Associate Professor	Assistant Professor
Clarence L. Cole	Charles W. Young	Alan G. Hunter
John D. Donker		
Edmund F. Graham		
Jesse B. Williams		

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 (French, Spanish, German, Italian, Russian, and Scandinavian languages are acceptable) is advised although not required for the Master's degree. For the Ph.D. degree, this requirement may be met by (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge. When two languages are offered, any combination of the following may be approved: Russian, French, Spanish, German, and the Scandinavian languages.

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

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

105. Seminar: Dairy Literature. 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 three 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, Hunter

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

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

202.* Research in Dairy Production. 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. Seminar: Dairy Husbandry. (1 cr) Cole

217f.* Dairy Cattle Inheritance. Review of research in dairy cattle breeding and selection. (3 cr; prereq ‡) Young

218w.* 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 ‡; offered only fall qtr in even yrs) Graham

220s.* 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, BioC 6 or ‡...BioC 216 recommended; offered 1964-65 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, BioC 6 or equiv or ‡...BioC 216 recommended; offered 1964-65 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 BioC 6 or ‡...BioC 124 recommended; offered 1965-66 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 BioC 6; offered 1965-66 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 AnHu 37, BioC 6 or ‡...MicB 121, 123 recommended) Kolari

DAIRY INDUSTRIES

Professor
Samuel T. Coulter
James J. Jezeski
Howard A. Morris
Joseph C. Olson, Jr.
Elmer L. Thomas

Prerequisites—Superior students having a B.S. or B.A. degree from an accredited college or university with a major in any physical or biological science oriented field may be considered as having the necessary prerequisites. However, if preparation appears to be inadequate, certain additional courses may be required.

Major and Minor—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 (French, German, Russian, Danish, Swedish) is advised but not required for the Master's degree. For the Ph.D. degree, this requirement may be met by (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge. When two foreign languages are offered, any combination of those listed above may be approved except Danish and Swedish.

Master's Degree—Offered under Plan A. Plan B may be followed with adviser's approval.

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

100. Seminar: Dairy Industries Literature. Selected topics in dairy literature, including preparation of bibliographies. Each student presents papers and reports orally on assigned subjects. (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 quality control of milk and its products. Lectures and laboratory. (3 cr) Jezeski

110. Sanitation Microbiology. Factors influencing destruction of microorganisms by physical and chemical agents. Chemical and microbiological principles in cleaning and sanitizing of dairy and other food processing equipment. Thermal process evaluation. (3 cr; prereq BioC 5 or 6 or 10, two courses in microbiology or ‡)

130. Advanced Dairy Products Judging. Fundamentals of organoleptic examination of dairy products; psychological and physiological factors. (1 cr) Thomas

150. Dairy Microbiology. Lectures and laboratory. Types, sources, and control of microorganisms important in milk and milk products; utilization of microorganisms in milk processing; public health safety of milk and milk products. (3 cr; prereq MicB 53) Olson

151. Advanced Dairy Microbiology. 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 microbiology. (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 Microbiology. 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.*

ECONOMICS

Professor
John G. Turnbull
Francis M. Boddy
O. H. Brownlee
John A. Buttrick
John S. Chipman
Walter W. Heller
James M. Henderson
Hans J. A. Kreyberg (visiting)
Leonid Hurwicz
Jacob Schmookler

Associate Professor
Arthur M. Borak
Edward Coen
Thomas Iwand (visiting)
John H. Kareken
Anne O. Krueger
E. Scott Maynes
Herbert Mohring
Norman J. Simler
Harlan M. Smith

Assistant Professor
Edward M. Foster
Peter Gregory
John C. Hause
George L. Perry
Marcel K. Richter
Larry A. Sjaastad

Lecturer
Ralph H. Hofmeister
Neil Wallace

Prerequisites—Courses in economics are open to all regularly enrolled graduate students who can meet course prerequisites as listed in the *Class Schedule* or who obtain permission of instructor. A student who desires to major or minor in economics shall satisfy the director of graduate studies in economics that he is prepared to undertake graduate work in economics. Normally he shall have had work in economics and some courses in mathematics or statistics as an undergraduate. An undergraduate grade average of B or better is usually required. Detailed information may be obtained from the department office.

Language Requirement—For the Master's degree, none. For the Ph.D. degree, reading knowledge of two foreign languages or of one foreign language and either a collateral field or an approved research technique. French, German, Russian, and Swedish are acceptable, and, when Latin American development is involved, Spanish.

Master's Degree—Work leading to the M.A. degree is offered under Plan A or Plan B. By arrangement with the instructor, a Plan B paper may be written in most of the courses listed below.

Doctor's Degree—Work leading to the Ph.D. degree in economics is offered. Credit in economics may be granted for some courses offered in business administration, agricultural economics, statistics, and history. Consult the director of graduate studies.

General

101A. Foundations of Mathematics for Social Scientists. Sets. Relations. Partially ordered systems. Functional relations. Elements of logical calculus. Groups. Matrices. Applications mostly in economics, decision and game theory, some in statistics. (3 cr; prereq Math 10 or equiv or ♯) Staff

101B. Introduction to Decision Theory. Elements of probability. Basic concepts in statistical decision theory. Relationship to game theory and other types of decision problems. Prediction and inference. Models underlying statistical analysis in economics and certain other fields. (Same as Stat 101) (3 cr; prereq 101A, or Math 40 or 42 or 13, or ♯)

120. Economics of Consumption. Theories and research relating to saving and consumption; concept of saving; consumption function literature; forecasting of consumer spending; role of buying plans. (3 cr; prereq 65 or 165, 66 or 166 or ♯) Maynes

140. Economics of Location. Analysis of location of economic activity in relation to resources and markets. Effects of changes in transport costs. Problems of regulating urban growth. (3 cr; prereq 65 or 165, 66 or 166 or ♯) Mohring

150A,B. 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

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: 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 43 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; application of evaluative techniques to various market phenomena and government policies. (3 cr, §75; prereq 185A) Brownlee, Buttrick, Foster

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 ‡) Brownlee

180A-B. History of Economic Thought. Principal economic writings of the past so that contemporary theory may be seen in perspective. Particular theories are related to problems and policies of the times and to contemporary theories. A: Classical economists, Marx, and beginnings of neoclassical economics. B: Development of neoclassical economics through the 1930's. Origins of macrotheory. (3 cr per qtr; prereq 176A, 175 or ‡) Buttrick, Krueger

185A. Economic Analysis I: Price Theory. Theories of choice as applied to consumers, firms, and resource owners, economic behavior in competitive and monopoly market situations. (3 cr; prereq 165 or equiv) Boddy, Henderson

185B. Advanced Microeconomics. Price and output policies under conditions of imperfect competition. Problems of choice under conditions of uncertainty. (3 cr; prereq 185A or ‡) 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) Boddy, Simler

195A-B-C. Decision Making and Operations Analysis. Applications of various mathematical techniques of maximization and minimization to business problems. Calculus, linear programming, 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 65 or 165, Math 43 or equiv or ‡) Brownlee, Chipman, Henderson

215A-B. Welfare Economics. Basic concepts and propositions; Pareto optimality, social welfare functions; economic efficiency of alternative market structures. Decentralization of resource allocation processes. Applications of concepts for analysis of typical policy issues with emphasis on development of student's skills. (3 cr per qtr; prereq 185B or ‡) Brownlee, Hurwicz

245A-B-C. Mathematical Economics. Mathematical models underlying contemporary economic theory. (3 cr per qtr; prereq 135C or ‡) Chipman, Hurwicz

335. Seminar: Mathematical Economics. (Cr ar; prereq ‡) Hurwicz and others

Econometrics and Statistics

111. Elements of Statistics. Acquaints the nonspecialist with some basic concepts and methods of classical statistics. Problems of hypothesis testing and estimation. (3 cr; prereq Math 10 or ‡) Staff

121A-B-C. Theory of Statistics. (Same as Stat 121, 122, 123) Normal and related univariate and multivariate distributions. Some large sample theory, including the law of large numbers. Likelihood methods in hypothesis testing and estimation; applications to regression and analysis of variance and covariance. Confidence intervals. Distribution-free methods. (3 cr per qtr; prereq Math 40 or ¶Math 40 for 121A, Math 43 for 121B or ‡)

131. Elements of Econometrics. Statistical inference in models arising in economics and certain other fields. Least squares method, regression theory; relationship to simultaneous equation and factor analysis problems. Specification error. Identification. Time series. Problems of aggregation. Examples: production functions, demand functions, factor analysis. (3 cr; prereq 121C or ¶121C or ‡) Chipman, 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 or ‡) 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 distribu-

tion. 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) Buttrick

213A-B. Economic Growth and National Planning. Models of the process of economic growth; exogenous factors to which growth is attributed. Techniques useful in planning, e.g., input-output, national income accounting, programming. Questions of policy. (3 cr per qtr; prereq 175, 176A, plus a course in this section) Buttrick

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

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. Government expenditures and budgeting, fiscal policy, debt management, and taxation in terms of economic effects, fiscal process, and social policy. Expenditure theory; budgetary process, alternative budgetary policies; debt burden; taxing process; taxation, incentives, and markets; tax incidence; technical problems of income, profits, and sales taxation; defense finance. (3 cr per qtr, §68; prereq 65 and 66 or equiv for 178A) Brownlee, Heller, Perry

188. State and Local Taxation. Main problems of state and local finance and proposed solutions; interstate comparisons and co-ordination of practices and policies. (3 cr; prereq 68 or equiv) 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: 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, Hause, Mohring

309A-B. Seminar: Industrial Organization. Research in applied topics in industrial organization and government regulation of market behavior. (3 cr per qtr; prereq 175, 179B or 189B or equiv or ♯) Boddy, Mohring

EDUCATION**

Professor

Robert H. Beck
Emma M. Birkmaier
Clarence H. Boeck
Guy L. Bond
Henry Borow
Marjorie M. Brown
Theodore W. Clymer
Raymond O. Collier
Luvern L. Cunningham
James R. Curtin
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
Cyril J. Hoyt
Eloise M. Jaeger
Donovan A. Johnson
Stanley B. Kegler
Robert J. Keller
Harry W. Kitts
George H. McCune
Keith N. McFarland
Jack C. Merwin
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
Deane E. Richardson
John E. Stecklein
Louise A. Stedman
Gordon I. Swanson
E. Paul Torrance
Edith West
Harold T. Widdowson

Associate Professor

John F. Alexander
Ayers L. Bagley
Bruce E. Balow
Donald H. Blocher
Russell W. Burris
Arnold F. Caswell
Frederick M. Chapman
Naomi C. Chase
Mary E. Corcoran
Jan D. Duker
Gerald R. Firth
Dewey G. Force
Charles J. Glotzbach
Albert B. Hood
Paul S. Ivory
Bjorn Karlsen
William A. Kavanaugh
Theodore E. Kellogg
Robert E. McAdam
R. Paul Marvin
Warren G. Meyer
Jerome Moss, Jr.
R. Norine Odland
Neville P. Pearson
Samuel H. Popper
Alton L. Raygor
Vincent R. Rogers
Helen M. Slocum
Timothy L. Smith
Martin Snoke
W. Wesley Tennyson
Roger E. Wilk
Marjorie U. Wilson
Arnold S. Woestehoff

Assistant Professor

Robert L. Borg
Donald E. Davis
Robert Dykstra
William E. Gardner
Lorraine D. S. Hansen
Wells Hively II
Joe Hogan
Rollie R. Houchins
Ronald T. Lambert
Daniel C. Neale
Robert Orlando
Robert R. Randleman
James E. Stochl
Roman F. Warmke
Frank B. Wilderson

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.

** Advanced work leading to the professional degree of master of education (M.Ed.) 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 and physical sciences, physical education, recreation leadership, and rural education. Students interested in any of these programs should secure a *Bulletin of the College of Education* and consult an adviser.

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

Master's Degree—PLAN A majors may be chosen as follows:

The student, with the approval of his adviser, may select a group of courses in one of the following fields, excluding the field of his minor, centering about his special interest in education:

Agricultural education
Art education
Curriculum and instruction**
Education**
Educational administration**
Educational psychology**
History and philosophy of education
Home economics education
Industrial education
Music education
Physical education

Minors may be chosen as follows:

1. From any of the foregoing groups of courses when such grouping is not included in the major.

2. From any other field of study offered at the University of Minnesota in which satisfactory courses of graduate character are available and which is obviously related to the major field.

3. Students majoring in fields other than education may choose education or any of its subdivisions enumerated above as a minor when it appears that such a minor is appropriately related to the major field.

Under PLAN B the student will select a field of concentration in which he will attain from 21 to 27 credit hours. The field of concentration differs from a major in that it encourages the choice of a somewhat wider range of courses related to the student's interest. As in the case of the major, however, the student will indicate his field of concentration according to the general arrangement of courses required for a major. This arrangement is as follows:

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

Additional Courses—The student may elect the additional courses required to complete the total of 45 credits from areas of education not included in the field of concentration and from any other fields of study offered at the University of Minnesota in which satisfactory courses of graduate character are available and which are obviously related to the student's interest. Teachers should include advanced study in their teaching fields.

Notes to Applicants for Admission to Graduate School—Be sure to indicate the exact major field in which you are interested. Where necessary, state also the main emphasis within the major field, as in the following examples:

Educational administration (specify whether elementary school principal, secondary school principal, or school superintendent)

Educational psychology (specify whether college or high school guidance and counseling, measurement, research, school psychology, special education, learning, or another main interest)

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

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

Under the first of these majors, education, the student's program may emphasize any one of several areas, such as industrial education, history and philosophy of education, agricultural education, art education, home economics education, physical education and health, business and distributive education, as well as the elementary and secondary education fields shown under the curriculum and instruction department. Under this general major, the student works with a doctoral adviser from the area of his own particular interest, he includes in his major program a core of courses from that area, and he plans his research in relation to that special interest.

A minor may be selected from any field of graduate study related to the field of major interest, including any one of the following areas of education not represented in the major:

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

If the student's major is education and the minor is one of the above areas not represented in the major, the minor field is ancillary to the student's principal emphasis in his graduate study, the latter always being included under the major.

Prospective college teachers of communication may apply for a doctoral program with a major in education and a minor in English literature. The major, individually planned, combines pertinent courses from education, journalism, speech, psychology, linguistics, and other areas.

Specialist Certificate Programs

The Graduate School offers 2-year programs in the fields of general educational administration (for superintendents and central office personnel), secondary school administration, elementary school administration, special education, and school psychological services, which lead to the certificate Specialist in Education. These programs require the completion of a minimum of 90 credits. Students will ordinarily complete the requirements for the Master's degree with a major in the field of the specialty as the first year of the program. All first-year students must meet regular admission, candidacy, and examination requirements for the master of arts degree and should specify as their degree objective the Master's degree on the application form. Any decision regarding continuation beyond the Master's degree in a specialist program will be dependent on an evaluation of performance in meeting

the master of arts degree requirements. The specialist certificate programs now available are the following:**

General Educational Administration (for Superintendents and Central Office Personnel)—In the first year, the student completes the requirements for the M.A., majoring in educational administration. The second year's program includes seminars in educational administration; workshops on the improvement of instruction in the elementary and secondary schools, school building planning, and state school administrative problems; advanced courses in educational psychology; field research; and graduate courses dealing with school-community problems and educational philosophy.

School Business Administration—This program includes many of the elements of the general educational administration program. Special emphasis is given to those aspects of administration which relate to the business operation of the school. The program is designed for the school business manager, the assistant superintendent in charge of business affairs, and persons in similar positions.

Intermediate Unit in Educational Administration—This administrative unit provides a supervisory, administrative, or co-ordinating function for local school districts within a geographic area larger than a school district and smaller than a state. Students in this program will follow the same common program as for other areas of school administration with the addition of a differentiated group of courses designed to prepare them for service in the Intermediate Unit in Educational Administration. Persons who have taken Master's level work in other areas of school administration can move to this program.

Secondary School Administration—This program is planned to prepare students to serve as high school principals, assistant principals, directors, or supervisors of secondary education and related positions. Students are admitted to the second year of the program after completion of a related program for the Master's degree in secondary school administration and supervision. The program emphasizes secondary school curriculum and instruction with support in educational psychology and child psychology as well as educational administration. Students who wish to work on this program are urged to plan early on an individual basis with graduate advisers. It is possible to emphasize the junior high school level or curriculum development.

Elementary School Administration—Requirements are arranged by areas of study, including emphasis on curriculum and instruction, as well as on administration in the elementary school. Students admitted to the second year of the program will plan individually with advisers for meeting the 2-year area requirements through supplementation of work presented for the Master's degree.

Counseling—This program is designed for preparation of counselors, supervisors, and directors or co-ordinators of guidance and counseling programs in school systems. Students must satisfy all requirements for the Master's degree either at the University of Minnesota or elsewhere before being admitted to the program. Breadth of liberal studies is expected in the undergraduate background of candidates for this certificate. Persons who lack such foundation courses will be expected to add to their program work in the social, behavioral, and biological sciences.

School Psychological Services—In the first year, the student completes requirements for the M.A. The second year includes additional work in educational

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

psychology, psychology, child psychology, diagnostic and remedial procedures, and special education as well as appropriate practicum experiences.

Special Education—The program is designed for students preparing for administrative, supervisory, and consultant positions in special education. Flexibility allows concentration in a particular field (such as education of the gifted, the mentally retarded, or the blind), but generally students will be expected to develop competencies in several special education areas. Applicants should have had basic preparation and experience in at least one special education area, with certification for public school work.

Admission to the Specialist in Education Program—Approval of the Graduate School upon recommendation of the graduate faculty in the field of specialty is required. A prospective student must complete an application form for admission to the Graduate School to be submitted with official duplicate copies of transcripts of all college work completed to date. As an attachment to the application form the prospective student should indicate the names and addresses of three persons who are able to comment in detail on his qualifications for undertaking this sixth-year program. He will also be asked to take a graduate form of the Miller Analogies Test before his admission request will be reviewed. Students who have taken or contemplate the completion of the M.A. degree at Minnesota will request consideration for admission to the specialist program by filing a Graduate School Change of Status Form, available in the Graduate School office.

After admission to the Graduate School for the specialist program and satisfactory completion of at least 9 credits beyond the Master's degree, the student must file a program for the certificate on the appropriate form available in the Graduate School office. This program form will list all courses completed beyond the Bachelor's degree which will be presented for the Specialist Certificate, as well as those courses which he proposes to complete in fulfillment of the requirements for the award of the certificate.

Qualifying examinations in specified areas may be required by the major adviser and the departmental faculty of students who bring credits from other institutions. Such examinations are designed to aid students and their advisers in planning the programs for the Specialist in Education Certificate, and will be taken preceding the date that the students apply for candidacy and file their approved programs.

All students in the specialist program must earn in residence at the University of Minnesota a minimum of 45 credits distributed as approved by the adviser and the graduate faculty in the area of specialization. At least 30 credits of the second year of the program must be earned at the University of Minnesota.

The 2-year specialist program must be completed within a period of 12 years. Graduate credits earned previous to the 12-year span will be evaluated by the graduate faculty in the area of specialization and may be recommended to the Graduate School for acceptance on a full or partial basis. Persons who have completed a Master's degree prior to September 1, 1956, are exempt from the 12-year completion time, but must complete requirements for the Specialist Certificate (beyond the Master's degree) within 7 years after being admitted to the program.

Agricultural Education

Prerequisites—Preparation in agricultural subjects satisfactory to the Department of Agricultural Education.

101. Young Farmer Education in Agriculture. Developing and organizing a continuing program of educational activities for farm youth not in school and not established in an occupation. Co-ordinating community resources, determining needs, deriving goals and individual plans of procedure for establishment in farming and related occupations. Observation of young farmer programs. (4 cr) Peterson, Nelson

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.* Rural Education and Community Leadership. Role of school in rural community; co-ordination of school with nonschool educational agencies; responsibility for community leadership. (3 cr, §20; prereq ‡) Swanson

121. Enterprise Analysis. Analyzing the farm business as a basis for identifying problems. Planning learning experiences to improve farm management at the high school, young farmer, and adult levels. (3 cr; prereq ‡; 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 or ‡) Staff

145. High School Curriculum in Agriculture. Philosophy, organization, and administration of instruction in agriculture departments in the secondary schools. (3 cr; prereq 10 cr in education) Kitts

156.* Rural Education Through Extension Methods. Role of Agricultural Extension Service in rural education; methods and techniques of instruction in nonschool educational programs. Special problem required. (3 cr, §56; prereq ‡) 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.* Research in Agricultural Education. Selecting problems, preparation of bibliographies, analyzing and interpreting data, and preparing manuscripts. (Cr ar; prereq 15 cr in education) Staff

250x. Supervision of Vocational Agriculture. Objectives, functions, responsibilities of state and local supervision at the secondary level; role in teaching-learning process; 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) Staff

286. Current Issues in Agricultural Education. Problems related to local school programs. (Cr ar; prereq ‡) Staff

291x. Seminar: Agricultural Education. (Cr ar) Staff

Art Education

151-152-153. Curriculum Building in Art Education. Selection, evaluation, and organization of material for teaching units and projects. (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; prereq 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 for equipment, facilities, and materials; in-service training of teachers; problems in schools or industry. (3 cr; prereq 105 or ‡) Pearson

107x. Radio and Television in Education. Production, techniques of classroom use, selection of equipment, teaching appreciation, and administration of radio and television in the schools. (3 cr; prereq 9 cr in education) Pearson

108. Nonprojected Audio-Visual Materials and Equipment Laboratory. Planning and making nonprojected materials for audio-visual education; use of materials and equipment. (3 cr; prereq 105 or ¶105) Pearson

109x. Projected Audio-Visual Materials and Equipment Laboratory. Planning and making materials for audio-visual education; use of machines and equipment. (3 cr; prereq 105 or ¶105) Pearson

115. Introduction to Education of Visually Handicapped Children. Educational programs, services, and resources for blind and partially seeing children; historical background, philosophy, related sociological and psychological problems. (3 cr; prereq ‡) 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

127. Methods of Teaching School Subjects to the Hearing Impaired. Adaptation of material and teaching methods suitable for hearing impaired children in such areas as reading, mathematics, social studies, and science. (3 cr; prereq Spch 127 or equiv or ‡) Houchins

128. Introduction to the Education of Hearing Impaired Children. Educational programs, services, and resources for hearing impaired individuals; historical background; philosophy; sociological and psychological problems. (3 cr; prereq ‡) Houchins

133. Consumer Education in the Schools. Objectives, content, and curriculum organization at elementary and secondary levels. (3 cr) Price

145. Reading Difficulties. Causes, prevention, and correction. Remedial practices useful to classroom teacher, school counselor, and reading specialist. (3 cr; prereq 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, ‡) Birkmaier, Randleman

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, 161, 162, 163) Starr

174A. Clinical Practicum in Speech Correction: Cleft Palate. (1 cr; prereq Spch 151, ‡) 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 ‡) Karlsen, Kenmore

185. Advanced Course in the Teaching of Modern Languages. New curriculums, classroom procedures; use of language laboratory and other media and evaluation techniques. Open to teachers of modern languages and registrants in language institutes. (3 cr) Birkmaier

189. Materials and Curriculum Construction in Modern Languages. Curriculum development, preparation of units, testing techniques; materials for classroom, language laboratory, televised instruction, and programmed learning. (3 cr; prereq 185 and ‡) Birkmaier

201x.* Problems: Teaching Social Studies. Individual research. (Cr ar; prereq 102 or 155 or 168, 204 or ‡) Morse, McCune, West, Rogers, Gardner, Warmke

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 or 108) 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, Bond, Clymer, Curtin, Goossen, D Johnson, Chase, Firth, Odland, Rogers, Gardner

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, Kegler, Balow, Chase, Odland, Raygor

288.* Seminar: Research in Modern Language Learning. Criteria for evaluating major studies with implications for language teachers; needed research, planning and design of individual study. (3 cr; prereq 185 and ‡) Birkmaier

291.* Research in Mathematics Education. Recent issues, problems, and findings; criteria for evaluating research; design and preparation of reports on special problems. (Cr ar; prereq 191) D Johnson

296x.* Problems: Teaching English. For those qualified to undertake individual research. (Cr ar) Kegler, Chase, Dykstra

ELEMENTARY EDUCATION

102. Teaching and Supervision of Social Studies in the Elementary School. Examination of the content and organization of social studies programs; programs of understanding, improving the learning situation, and effective use of materials. (3 cr; prereq Ed 75B or equiv)

103. Teaching Science in Elementary School. Resources, materials and their application in elementary grades. (3 cr; prereq Ed 75B or tchg exper) Goossen

110. Practicum: Laboratory School Teaching (K-6). Experience in teaching and/or research with a class in the University Elementary School. (Cr ar; prereq elementary student tchg or elementary school tchg, consent of adviser, director of elementary school, and co-ordinator 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) Curtin, Goossen

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 ♯) Bond, Clymer, Curtin, Goossen, Chase, Odland, Rogers, Dykstra, 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 △) 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) Firth

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) Firth

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 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

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 federal vocational acts. Basic course for teacher-coordinators and vocational administrators. (3 cr) Meyer

137A. Materials and Methods in Co-operative Part-Time Classes. For co-operative part-time distributive, office, miscellaneous trades, and diversified occupations classes. (3 cr) Meyer

137B. Advanced Materials and Methods in Co-operative Part-Time Classes. Individual and group work on related vocational materials. New methods of teaching co-operative part-time distributive, office, miscellaneous trades, and diversified occupations classes. (3 cr; prereq ‡) Meyer

138. Training Store and Office Supervisors. Conducting short unit courses for store and office supervisors and improving on-the-job training in co-operative part-time programs. (3 cr) Meyer

139. Co-ordination Technique. Problems of co-ordinators in the co-operative part-time program. Guidance and selection; placing of students in work stations; assisting job adjustments; developing the training program. (3 cr) Meyer

141. Co-operative Part-Time Work Experience Programs. Planning, organizing, curriculum building, plant and equipment, promoting and evaluating co-operative part-time distributive, office, miscellaneous trades, and diversified occupations programs. (3 cr) Meyer

142. Business and Distributive Programs for Adults. Selection and training of evening school instructors; planning and promoting evening school distributive and business education classes. (3 cr) Meyer

144. Teaching Reading in Secondary Schools. Procedures, objectives, and materials for teaching reading in subject-matter fields. (3 cr; prereq 9 cr in education) Bond, Clymer, Kegler, Chase

147. Workshop Teaching Display. 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

158. Materials and Methods in Office and Clerical Practice. Recent research and developments in teaching of office practice, clerical practice, and office machines. (3 cr)

159. Materials Laboratory, Secondary School Distributive Education. Development of specific related vocational materials for distributive occupations, co-operative part-time classes. (3 cr; prereq 137A or EdT 90C or ‡) Meyer

160. Materials Laboratory, Occupational Relations. Development of general related vocational materials for all types of co-operative part-time classes. (3 cr; prereq 137A, EdT 90 or ‡) Meyer

161. Curriculum Construction in Business Education. Curriculum problems; organization and preparation of teaching units. (3 cr; prereq 113) Price

167. Economic Education Problems. Conceptual framework of economic education through analyzing its research, objectives, philosophy, scope, and curricular sequence. (3 cr; prereq Econ 2 or equiv or ‡) Warmke

168. Current Developments in the Social Studies. Contemporary literature, curricular trends, and developments in methods. (3 cr; prereq ‡) McCune, Gardner

169. Extracurricular Activities. Aims and values; practices in organizing, administering, and supervising; methods of evaluation. (3 cr; prereq Ed 55B or equiv)

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 ‡) Firth

173B. Organizing Units of Instruction in the Secondary School. Development of principles and procedures for constructing units of instruction. (3 cr; prereq 113 or ‡) Firth

190. Current Developments in Secondary School Science Teaching. Curriculums, methods, materials of instruction, evaluation. (3 cr; prereq EdT 68B, C, or 68M, equiv undergrad courses, or exper in science tchg) Boeck

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

194. New Content and Methods in Mathematics. Trends and experimentation with content; special programs for the gifted and the slow learner; methods in mathematics; program evaluation. (3 cr; prereq exper in mathematics tchg) D Johnson

195. Current Developments and Curriculum Construction in English. Analysis and evaluation of curriculums and trends; emphasis on articulation. (3 cr; prereq EdT 75C or D or equiv) Kegler

199E. Internship. (Cr ar; available for MEd students in recreation; ar) Mork

200. Organization and Supervision of Business Education. Examination of evaluative criteria for business education departments, teacher selection and supervision, and organization of business education in the United States. (3 cr; prereq ‡) Price

204. Social Studies Curriculum. History, techniques, and practices at all grade levels. (3 cr) West, Gardner

222x. Seminar: Current Problems in Techniques of High School Instruction. (Cr ar or no cr; prereq Ed 55B and sr methods) Staff

225x.* Problems: Secondary School Supervision. An individual problems course on improvement of instruction. (Cr ar; prereq ‡) Keller, Firth

237. Seminar: Business and Distributive Education. Primarily for Master's degree candidates. Planning and evaluation of research and of individual projects. (No cr; prereq ‡) Price, Meyer, Warmke

238x.* Problems: Distributive Education. Individual research. (Cr ar; prereq ‡) Meyer

239x.* Problems: Business Education. Investigations in field of student's interest. (Cr ar; prereq ‡) Price, Warmke

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, Firth

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, Tennyson

287.* Research Foundations of Secondary School Science Teaching. Implications for improvement of instruction in junior and senior high schools. (3 cr) Boeck

294x.* Advanced Materials and Methods in Secondary School English. Evaluates present content and method in light of research and recent trends in teaching. (3 cr; prereq EdT 75C or equiv) Kegler

295. Readings in English and Modern Language Education. Readings in high school English or in modern language instruction. (1-3 cr; prereq MA or equiv) Birkmaier, Kegler

HIGHER EDUCATION

184. Supervision of Student Teaching. For persons planning to supervise or administer student teaching and other professional laboratory experiences in elementary and secondary education. (3 cr; prereq 15 cr in education or ‡) Mork

228x.* Problems: Higher Education and Teacher Education. Selected topics on college programs, instruction, organization, and administration. (Cr ar; prereq ‡) Eckert, Mork, Morse

250x. Higher Education in the United States. Development, present status, and outlook for American colleges. Purposes 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, 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, 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) Popper

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) Cunningham

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) Cunningham, Hooker

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) Hooker

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) Cunningham

228x.* Problems: Educational Administration. For superintendents and principals qualified to make intensive studies of administration of a school system. (1-3 cr per qtr) Cunningham, Domian, Hooker, Popper, Davis

230. 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. 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)

239. School Principal's Workshop. Contribution of recent research and theory to effective administration; analysis of administrative behavior in realistic settings that include practical school problems; relation of administration to human behavior. (1-4 cr) Cunningham, Popper

241x. Seminar: Internship in Educational Administration. For interns in elementary, secondary, and general school administration. (1 cr per qtr, max 3 cr) Staff

ELEMENTARY EDUCATION

200. Seminar: Elementary School Administration. For elementary school principals. Problems of administration and organization of instruction. (3 cr) Curtin, Lambert

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, Lambert

270A.* Problems: Elementary Education. (Cr ar; prereq ‡) Bond, Clymer, Curtin, Goossen, Lambert

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) Staff

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) Keller

265. Administering the High School Program. Scheduling, administrative practices affecting learning, the academic program, community relationships, program evaluation. (3 cr) Keller

270B.° Problems: Secondary Education. (Cr ar; prereq ‡) Cunningham, Domian, Hooker, Keller, Firth, Popper, Davis

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) Keller

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)

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 ‡)

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)

125. Group Dynamics in Education. Review of selected literature; practical application of social-psychological concepts to analysis of group behavior. (3 cr) Torrance

126. Analysis of Behavior in Groups. Laboratory experimentation; individual projects with class help. (3 cr; prereq 125) Torrance

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

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

148x. Clinical Diagnosis of Reading Difficulties. 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

152. Introduction to School Psychological Services. Relationship of the psychologist to teachers, administrators, parents, and community. Problems of normal children; diagnosis and treatment of educational and psychological disabilities. (3 cr) Duker, Hall

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) Torrance

182. Education of Exceptional Children. Overview of field of special education. For classroom teachers, counselors, supervisors, and administrators; also the initial course for students working for special class certificates. (3 cr; prereq Ed 55B or 75B) Reynolds, Force, Karlsen

183. Education of Gifted Children. Abilities, characteristics, and education of intellectually gifted children and adults. (3 cr; prereq Ed 55B or 75B or equiv) Reynolds

184. 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

185. Education of the Auditorially Handicapped Child. Group and individual observation of classes for auditorially handicapped children; individual and small group conferences. (3 cr) Houchins

186. 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. (3 cr; 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

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

195. Automated and Programmed Learning. Introduction to principles and techniques of programmed instruction systems. Theoretical concepts and issues; systems and methods of programming; survey of available programs and devices; problems in application, development, evaluation, and research. (3 cr; prereq 193 or 293, ♯)

195A. Automated and Programmed Learning—Laboratory. Application of principles and techniques of programmed instruction in construction, development, use, and evaluation of programmed instruction system components; preparation of sample programs and related material; research designs, procedures, and analysis. (2 cr; prereq 195 or ¶195 or equiv and ♯)

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) 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) Hoyt, Wilk

209. Seminar: Research Planning. For advanced graduate students. A functional approach to planning empirical research projects appropriate for the basis of a Ph.D. thesis. Students develop outlines of projects and present these for critical review of members of the seminar. (1 cr per qtr) Hoyt

210x. Individual Mental Testing. Revised Stanford-Binet and Wechsler Adult or Wechsler Intelligence Scale for Children. Student supplies materials for at least one test. Full day or 2 mornings per week required for practice administration of tests. (3 cr, §142; prereq 110 or 117 or ¶117 with ♯) Duker

211. Advanced Individual Mental Testing. Familiarizes student with a variety of individual assessment devices, supplementing the Binet and Wechsler scales. Exploration of theoretical aspects of intelligence as well as administration and interpretation of specific tests. Limited practicum involved. (3 cr, §143; prereq 210 and ♯) Balow

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) MacEachern

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; prereq 218, ♯) MacEachern

220-221. Advanced Theory of Measurement. Principles of underlying construction and use of psychological and educational measuring instruments and the limitations of tests for purposes of measurement in experimentation and evaluation of students' work. (3 cr per qtr; prereq 117 and 217 or equiv or ♯) 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 one of the following: 133, 250, or Psy 130) Blocher

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) Blocher

233x.° Problems: Guidance and Personnel Work. Independent study. No class meetings. (1-9 cr) Dugan, Edson, Hagenah, Merwin, Blocher, Glotzbach, Hood, Snoke, Tennyson, Wilk

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

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) Collier

244x. 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 ‡) Reynolds, Force, Karlsen, Orlando

248. Seminar: School Psychology. One year of continuous enrollment required of all students in the specialist and Ph.D. programs in school psychology. (1 cr per qtr, total 3; prereq PhD or specialist candidate, ‡) Duker, Hall

253x.° Research Problems. (Cr ar; prereq ‡) Staff

257. Clinical Practice in Educational Diagnosis. Supervised work with children referred to the Psycho-Educational Clinic for diagnosis of learning disabilities and school related problems. Parent and child interviewing, testing, and preparation of case reports. (5 cr f,w,s, 3 cr su, §151; prereq 210 or equiv, EdCI 145, ‡) Balow

259. Personality Theory in Mental Hygiene. Major concepts of five or six 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. Seminar: Educational Psychology. 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 262) Orlando

264. Assessment of the Handicapped. Individual assessment of intelligence, achievement, personality, and vocational aptitudes and interests; limited practicum required. (3 cr; prereq 210) Karlsen

280. Practicum in Group Leadership. Supervised practice in leading a discussion or activity group. (3 cr; prereq ‡) Torrance

287. Practicum in School Psychological Services. (1-3 cr; prereq ‡) Duker, Hall

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, Balow, Force, Karlsen, Houchins, Wilderson, Kenmore, Wood

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 ‡) Neale, Hively

295-296.† Principles and Techniques of Programmed Instruction. Foundations of programmed instruction in experimental psychology. Relation of programmed instruction to problems of experimental control and measurement in study of instruction and human learning. Supervised practice in constructing, administering, analyzing, and revising programs. (3 cr per qtr; prereq ‡) Hively

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 experience in testing, occupational information and beginning counselor duties. (1-3 cr; prereq ‡) Dugan, Tennyson, Blocher

282B. Supervised Practicum in Counseling. Individual assignments in counseling under supervision. (1-3 cr; prereq counselor in service only, ‡) Dugan, Tennyson, Blocher

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 one course in higher education or ¶one course in higher education or ‡)

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)

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

255. Diagnosis and Treatment of College Learning Difficulties. Introduction to principles and practice. Readings in research literature on college learning difficulties, especially reading and study skills. Observation of group and individual work in Reading and Study Skills Center. (3 cr; prereq one course in reading and ‡) Raygor

256. Clinical Practice in Diagnosis and Treatment of College Learning Difficulties. Supervised practice in group and individual work. (3 cr; prereq 255) Raygor

281x. Practice in Personnel Work. Supervised experience in counseling at college and adult levels. Student Counseling Bureau section, 3 consecutive quarters beginning fall; other assignments any quarter. (3 cr per qtr; prereq 225-226, or ‡) 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, Bagley, T Smith

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 139E-140E-141E) T Smith

155. History of Western Educational Thought. Major educational classics of Western civilization: Plato, Cicero, Locke, Rousseau, Dewey, and others. (3 cr) Beck, Bagley

156. History of Ideas in American Education. Readings in American political, economic, and social development; reference to the emerging system of public education. Recommended as background for 170. (3 cr)

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, Bagley, T Smith

242. Seminar: Educational Philosophy. For advanced students; critical study and discussion of special problems. (3 cr; prereq ‡) Beck, Bagley

296-297-298. Seminar: American Social and Educational History. Source materials: historical criticism and analysis applied to study of social and educational forces in history; individual research projects. (3 cr per qtr, §Hist 239E) T Smith

Home Economics Education

160A. Home Economics Curriculum. Examination of research and literature; development of units of study and programs at elementary and secondary level; production and evaluation of materials. (3 cr, §193A; prereq 63, ‡) Horn

160B. Home Economics Curriculum. Examination of research and literature; course and program development in higher education; analysis of current college programs; production and evaluation of curriculum materials. (3 cr, §193B; prereq ‡)

161. Method in Teaching Home Economics: Theory and Technology. Derivation of theory for educational method from relevant research; application to educational objectives of home economics; analysis of technology related to teaching method. (3 cr, §191; prereq 61, 63, or ‡)

162. Evaluation: Theoretical and Technical Aspects. Relation among concepts pertinent to evaluation in teaching; collecting and interpreting evidences related to achievement of objectives emphasizing higher levels of cognition and affective behaviors. (3 cr, §292; prereq 62 and ‡) Brown

163. Practicum: Adult Education. Individual field assignments under supervision. (3 cr; prereq ‡) Ford

164. Adult Education in Home Economics. Planning a community program; teaching procedures; special problems. For teachers and supervisors of adult education. (3 cr, §194B; prereq 64 or ‡) Ford

165. Proseminar: Home Economics Education. Purposes and concepts of professional study; relation of processes and standards of rational thought to professional competence and goals of a graduate program of study. (2 cr; required of all new grad students)

166. Trends in Home Economics Education. Current status; purposes, programs, content emphases, research, problems and issues in the field. (3 cr, §243; prereq 160A or B)

190. Readings in Home Economics Education. Independent study under tutorial guidance. (1-3 cr; prereq ‡) Staff

195. Space, Equipment, Furnishings, and Materials for Home Economics Departments. Remodeling old and planning new departments, and equipping and furnishing them. Review of research; investigation of problems. (3 cr; prereq 61, 63, HE 49; offered when demand warrants)

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 home-making teachers in the vocational program. (3 cr; offered when demand warrants)

200A. Research Methods. Overview of methods of inquiry appropriate for home economics education. Descriptive and causal-comparative methods with some attention to experimentation. (3 cr, §294; prereq 162, ‡) Brown

200B. Research Methods. Historical methods as a means of understanding the meaning of home economics and of studying educational problems in the field. Philosophical method applied to problems of meaning, of validity, of value, and of conceptual structure. (3 cr, §294; prereq 200A and 9 cr in history or philosophy of history and philosophy of education, ‡) Brown

201.* Problems: Home Economics Education. Independent study of current educational problems. (1-9 cr, §293; prereq 200A, ‡) Brown, Ford

260. Seminar: Curriculum Development. Examination of philosophical, descriptive, and experimental research pertinent to development of a theory of curriculum for home economics. (2 cr; prereq 160A or B, 200A)

263. Seminar: Supervision of Student Teaching. Examination of research pertinent to purposes, procedures, evaluation, and interpersonal relations of student teaching. (2 cr; prereq EdCI 184)

264. Seminar: Improvement of Instruction in Adult Education. Examination of research and literature. (2 cr; prereq 164 or ‡) Ford

265. Seminar: Teacher Education. Examination of research related to problems of selection and education of teachers of home economics and family life education, development of a theoretical framework for the field as a goal. (2 cr; prereq 160A, 200A, EdCI 285, 286)

266. Seminar: History and Philosophy of Home Economics Education. Examination of primary and secondary sources of data to trace the meaning of home economics as a field of study. Relation of developments in the field of intellectual forces in society. Critical examination of conceptual foundations upon which the field is based. Emphasis during any 1 quarter may be on any one of these three areas. (2 cr; prereq 166, 200B) Brown

267. Seminar: Administration and Supervision of Home Economics Programs. Application of research and theory of educational administration to clarify the role of educational leadership in home economics. (2 cr; prereq 164, 266 or ‡...EdAd 201 or 238 recommended)

295.* Seminar: Home Economics Education. Discussion and reports. (1 cr per qtr) Staff

Industrial Education

100. Industrial Instruction. Concepts and techniques of instruction in industrial arts, trade and industrial schools and classes, and training-within-industry programs. (3 cr; prereq 40, Ed 55B, ‡) Moss

101. Tests in Industrial Subjects. Application of principles of evaluation to shop and drawing subjects. (3 cr; prereq Ed 55B) Kavanaugh

102. The General Shop. Lectures only. Purpose of general shop organization; types of shops, equipment, instructional materials and procedures, pupil personnel plans. (3 cr) Nelson

103. Instructional Aids. Planning, construction, use. (3 cr; prereq 55 or 100 or equiv) Nelson, Kavanaugh

105. Administration of Industrial Education. General and vocational phases; objectives, programs, and practices; laws, rulings, and standards for aid; significant literature. (3 cr; prereq 35 or ‡) Nelson

106. Industrial Education Workshop. Problems. Areas of concentration vary with each successive offering. (3 or 6 cr; prereq tchg exper, ‡)

107. Co-ordination. Duties and responsibilities of co-ordinators in trade schools, part-time programs, and comprehensive high schools. (3 cr; prereq 35 or 125, or ‡) 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) Moss

155. Critical Issues in Industrial Education. Identification, analysis, and discussion of major current problems. (3 cr) Moss

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, Moss, Randleman

205x. Seminar: Industrial Education. (No cr; required of all candidates for advanced degrees) Nelson and graduate staff

250. Literature of Industrial Education. Professional literature, organizations, leaders, and movements in the field. (3 cr; prereq ‡) Nelson

251. Research in Industrial Education. Critical analysis of existing researches; selection of problems; organization and presentation of research projects. (3 cr; prereq ‡) Moss

Music Education

100. Principles. Philosophy, objectives, trends, content, and evaluation of school music programs. (3 cr) Ivory

103. Psychological Foundations. Implications of developmental and objective psychological data in music theory and acoustics. (3 cr; prereq ‡) Caswell

104. Advanced Topics: Vocal Music. Empirical research and literature on voice development in individual, class, and choral work. Individual surveys of performance practices and organization of school vocal groups; selection of vocal music. (3 cr; prereq ‡) Caswell

105. Advanced Topics: Instrumental Music. Individual selection of topics for intensive study. Bibliographical methods, library resources. (3 cr; prereq ‡) 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) Caswell, Ivory

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) Richardson, McAdam

102. The Physical Education Program for Elementary and Secondary School. Philosophy, objectives, trends, content, and evaluation in relation to the physical education curriculum. (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. Selection and organization of appropriate activities for students with physical disabilities. Planning of physical activity at all 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)

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 elem school age level or ‡)

114. Administration of School Health Education. 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 undergrad 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 in School Health for Secondary Schools. Instructional problems. Individual problems discussed. (3 cr; prereq 83 or ‡) Slocum

121. Principles of Recreation Methods. Leadership methodology in all aspects of recreation. (3 cr; prereq EdT 84) Chapman

123. Advanced Methods of Teaching Physical Education. Teaching procedures and method problems at all levels; research results. (3 cr; prereq ‡)

124. Supervision of School Health and Physical Education. Functions; adaptations of accepted procedures for observation, guidance, and training of teachers; face-to-face techniques. (3 cr; prereq ‡) Jaeger

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 ‡) Jaeger

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 ‡)

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; McAdam (s), for men

136. Introduction to Research in School Health Education, Physical Education, and Recreation. Research methods applied to physical education and recreation; designs for research problems. (3 cr; prereq ♯) McAdam

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 of instructional materials 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: School Health Education, Physical Education, and Recreation. Individual problems in areas of philosophy, methods, curriculum, evaluation and measurement; all levels. (Cr ar; prereq 136 and 135 or EPsy 116 or ♯) Donnelly, Jaeger, Piper, Richardson, Alexander, Chapman, McAdam, Slocum, Wilson

233. Administration of the Physical Education Program in Secondary Schools. Special administrative procedures in promotion of physical education program. (3 cr; prereq 63) Donnelly, Richardson

234. The Curriculum in Physical Education. Application of principles of curriculum construction to physical education. (3 cr; prereq 63, 101 or equiv) Donnelly, Richardson

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, Richardson

240. Legal and Financial Aspects of Recreation. Federal, state, and local recreation laws; sources of funds for public and private recreation agencies; agency liability. (3 cr)

241. Administration of Public Recreation. Basic principles in administration of recreation as a governmental service. (3 cr)

242. Community Organization for Recreation. Nature, scope, pertinent principles and procedures. (3 cr; prereq ♯)

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 136 and ♯) Donnelly, Alexander, McAdam

261Bx. Seminar: Contemporary Problems in Recreation. (Cr ar; prereq consent of adviser) Chapman

ELECTRICAL ENGINEERING**

Associate Professor
Bernard V. Haxby

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

Associate Professor
Donald E. Anderson
LeRoy T. Anderson
Paul A. Cartwright
Keith S. Champlin
Eugene R. Chenette
Jorge R. Fontana
Richard P. Halvorson
James E. Holte
Alfred B. Laponsky, visiting
Sidney C. Larson
E. Bruce Lee
Roy H. Mattson
Allen Nussbaum
John Park, Jr.
Mahmoud Riaz
Karel M. van Vliet

Assistant Professor
Vernon D. Albertson
Shao-Chung Lee
Belle A. Shenoi

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

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

to students who have completed another curriculum in engineering, science, or mathematics, including sufficient pertinent subject matter that would qualify the student to carry forward a graduate program in electrical 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. French, German, Japanese, and Russian are acceptable.

Master's Degree—Offered under Plan A or, with the approval of the Electrical Engineering Graduate Committee, under Plan B. The Plan B candidate is required to complete 45 credits of course work and three written reports representing the quality but not the range of the Master's thesis. Such reports are prepared as an additional part of the work required for advanced courses or seminars, or they may be based on independent work under faculty supervision.

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 6 quarter credits of mathematics at the level of courses Math 147, 148 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. Research programs are established and facilities are available in areas such as circuit theory, magnetism, physical and solid state electronics, control and communications theory, quantum electronics, plasma behavior, and noise phenomena.

The general requirements for the Ph.D. are outlined at the beginning of this bulletin; candidates in this department must pass the written preliminary examination not later than 1 year after receiving the M.S. degree (or, with departmental permission to bypass the M.S. degree, not later than 1 year after initial enrollment as a graduate student).

Courses Acceptable Only in Satisfaction of the Minor Requirement

100A-B-C. Fundamentals of Electronics. Basic concepts of transistors and multielectrode vacuum tubes. Graphical analysis methods, linear equivalent circuits. Piecewise-linear methods. Use of Laplace transforms, introduction to electromechanics. (3 cr per qtr; not open to EE majors; prereq 45)

104-105-106. Electronics. 104: Introduction to physical electronics; semiconductors, junctions, and vacuum devices, including models and equivalent circuits. 105-106: Quasi-linear and nonlinear behavior of vacuum, gas, and semiconductor devices; principles of rectification, amplification, frequency-conversion, oscillation; generic two- and four-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, 73, Math 60A or ¶Math 60A 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 and 113 and 116, or 100C)

138-139-140. Electric Power Systems and Power Control. Circuit analysis applicable to electric power systems. Balanced polyphase systems and analysis of unbalanced systems by use of

balanced symmetrical components. Response characteristics of rotating machines. The complete electric power system; generation, transmission, distribution, and utilization of electric energy. Stability problems of large interconnected power systems. (3 cr per qtr; prereq 113, 116)

143-144-145. Engineering Acoustics. Acoustic equations; dynamical analogies 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 44 or 45 or 63, 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 and 113 and 116, or 100C)

164-165-166. Communications. 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, 113, 116)

Courses Acceptable in Satisfaction of Either Major or Minor Requirements

147-148-149. Applied Electromechanics. Theory and application of translational and rotational electromechanical converters; transducers, sensors, and machines. Formulation of dynamic equations and methods of solution. Properties of materials, consideration of limitations they impose on device performance. Associated laboratory. (3 cr per qtr; prereq 113, 116, or 100C, or ♯) Albertson

150. Dynamical Methods in Electrical Engineering. Lagrangian and Hamiltonian formulations of dynamics, with applications to electromagnetic systems. Lagrange's equations; dissipative forces; normal co-ordinates and small oscillations; Hamilton's equations; variational principles for discrete and continuous systems. (3 cr; prereq MM 29 or equiv, Math 147 or 152, 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 Math 148 or 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. (3 cr; prereq 150, 151 and ♯ [students not meeting these specific course requirements should consult instructor])

160A-B-C. Electrical Energy Conversion. Energy conversion processes applying the general methods of thermodynamics, analytical and statistical mechanics: thermoelectric, thermionic, magnetohydrodynamic, electromechanical, photoelectric, and electrochemical conversion. Kinetic and transport properties of materials; interaction with electric, magnetic, thermal, and mechanical fields. Application to typical converters, including design considerations. (3 cr per qtr; prereq 104, 113, ME 30)

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, ♯)

170-171-172. Linear Network Theory. Descriptions of passive and active linear networks in the time and frequency domains; network models of active devices; properties of two-and three-element-kind networks. Approximation and realization problems in network synthesis. Selected topics in feedback and stability. Active and passive circuit applications. (3 cr per qtr; prereq 106 and 113 or equiv, ♯)

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 Circuit Analysis. Semiconductor, ferromagnetic and ferroelectric devices as switching elements; regenerative switching circuits, digital logic circuits. Free and forced response of nonlinear circuits, amplitude and frequency of oscillatory circuits; phase-plane analysis. (3 cr per qtr; prereq 106, 113, 116, Math 148 or equiv, ♯)

186A-B-C. Communications Theory. Theoretical aspects of the problem of communicating with electrical signals in the presence of noise, practical applications. Representation of random

signals, modulation, information theory, analysis of networks with random inputs, coding, statistical decision-theory. (3 cr per qtr; prereq 106, 113, ‡)

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 ‡)

194-195-196. Control Theory. Analysis and synthesis of linear feedback systems: signal-flow graphs, Nyquist and Bode diagrams, root-locus and pole-zero methods. State space formulation. Design of control systems; specification, identification, compensation. Multivariable and sample-data systems. Introduction to nonlinear and statistical methods. Associated laboratory. (3 cr per qtr; prereq 106, 113, 116, ‡)

200A-B-C. Introduction to the Properties of Solids. Classical statistical theory of matter, thermal properties of solids, crystal structure, ionic crystals, dielectrics, electron theory of metals, band theory of solids, imperfections in crystals, magnetism. (3 cr per qtr; prereq 152 or Phys 125, Phys 109 or Phys 110, ‡)

211-212-213. Advanced Topics in Network Theory. Analysis and synthesis of lumped constant and distributed networks, time-varying networks, and nonlinear networks. Selected topics of current interest. (3 cr per qtr; prereq 172, Math 174 or ‡) Holte

221-222-223. Seminar: Electric Power. Problems in power circuits and machinery. (1-3 cr per qtr; prereq ‡)

227-228-229. Stability of Electric Power Systems. Comprehensive treatment of steady state and transient stability problems of electrical power distribution systems. Power flow between interconnected systems. Computer techniques applied to stability problems. (3 cr per qtr; prereq 140 or ‡) 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: 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. Seminar: Plasma Physics. Current literature; individual assignments. (1-3 cr per qtr; prereq 244 or Phys 275, ‡) Oskam

250A-B-C. Quantum Electronics. Properties of quantum systems: energy levels of atoms, molecules, and magnetic ions in crystals. Interaction of radiation with matter. Stimulated emission. Ammonia masers. Paramagnetic resonance. Three-level solid-state microwave masers, cavity and traveling-wave. Noise properties. Optical masers: resonator properties and pumping methods. Solid-state spectroscopy. Gas optical masers. (3 cr per qtr; prereq 152, 169, Phys 110 or ‡) Fontana or Collins

251A-B-C. Properties of Semiconductors. Application of modern solid-state theory to study of specific semiconductor materials. Influence of band structure and scattering mechanisms upon the electrical, optical, thermal, and thermoelectric properties. Plasma effects in semiconductors at low and high frequency. Mathematical treatments of generation-recombination kinetics, carrier injection, drift and diffusion. Utilization of semiconductor properties in devices, especially devices of current importance. (3 cr per qtr; prereq 200C, ‡) Champlin

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 ‡) Caverley

261-263-265. Problems in Electromagnetism. Static electric and magnetic fields. Antennas, free-space transmission, refraction and diffraction phenomena, wave guides, and circuits. (3 cr per qtr; prereq 169 or equiv, ‡)

262-264-266. Seminar: Communication. Current literature, individual assignments. (1-3 cr per qtr; prereq ‡) Staff

267-268-269. Statistical Theory of Communication. An extension of topics covered in 186A-B-C. Recent advances in statistical decision-theory, information theory and coding. Selected special topics. (3 cr per qtr; prereq 186C or ‡) Park

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: Energy Conversion. Topics relating to physical processes involved in conversion of energy in its several forms to electrical energy and to devices which exploit these processes. (Cr ar; prereq 200C or equiv) Staff

287-288-289. Microwave Generation and Amplification. Electron beams: Brillouin flow, periodic focusing. R-f gaps and electron bunching; klystrons. Cumulative interactions in long beams; traveling-wave tubes. Coupled mode theory. Parametric amplification. Noise in electron beam devices. Principles of microwave masers: stimulated emission, pumping methods, and resonator properties with active media. (3 cr per qtr; prereq 169, ♯) Fontana

291-292-293. Seminar: Electronics. Current literature, individual assignments. (1-3 cr per qtr; prereq ♯) Staff

294-295-296. Advanced Control Topics. Adaptive and learning systems, discrete systems, invariance, optimum control of deterministic and stochastic processes, modeling of physical systems, and stability of dynamical systems. (3 cr per qtr; prereq ♯) Lee

ENGLISH

Professor

John W. Clark
Harold B. Allen
Bernard R. Bowron
Huntington Brown
Charles H. Foster
Joseph J. Kwiat
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

Richard J. Foster
John D. Hurrell
Mary C. Turpie

Assistant Professor

Avrom Fleishman
Charles S. Levy
Lee A. Pederson
James L. Scoggins
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 three of the authors named may be allowed to make up some of those courses concurrently with his graduate program.

For minor work, not less than 18 quarter credits in English literature including a course in Shakespeare.

Candidates will ordinarily find it necessary to supplement their undergraduate work by a considerable amount of independent reading.

Before registering for their first quarter of graduate work, students should consult with the director of graduate work for the department.

Special Regulation Regarding Examinations for the M.A. and the Ph.D. During the Summer Session—Written examinations for both the M.A. and the Ph.D. are given, during the Summer Session, in the first term only. Oral examinations 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 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 must take two courses: Engl 100, Old English, as specified above; Engl 213, Bibliography and Methods of Research.

Candidates who are active schoolteachers or who hold the teaching certificate may, if they plan to take the M.A. as a terminal degree, substitute Engl 166 for Engl 100 and omit Engl 213.

Under both plans, the candidate will be given a 6-hour written examination (see Special Regulation above) which calls for some acquaintance with all periods of the language and literature of the British Isles and the United States from the beginnings to the present. The examination is given in the fall and spring quarters and in the first term of Summer Session. A specimen examination may be consulted in 127 Vincent Hall.

All candidates under Plan A must pass an oral examination, as must all Plan B candidates intending to continue toward the Ph.D. Admission to the oral examination is, however, not automatic for Plan B candidates; the requirement is a grade of I (the examination is graded I, II, III, IV) on the M.A. written examination. For further details, see the director of graduate work for the department.

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

The English Language, including 100 (Old English), 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), and 206 (Studies in the English Language).

Foreign Literature in Translation, including 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—The candidate must pass an examination in a foreign language before taking the M.A. written examination, or satisfy the language requirement by completing at least 15 credits in the language with a grade of A or 20 credits with an average grade of B, at this University, and no longer than 5 years before applying for foreign language certification. There are special programs of course work satisfying the language requirement in French and German. For details consult the director of graduate work in English. Unless special exception is made upon petition the candidate is required to have reading knowledge of one of the following: French, German, Latin, Greek, Italian. No candidate may satisfy this requirement either with English or with his native language.

Requirements for the Degree of Doctor of Philosophy

The program of course work for the Doctor's degree should be filled out by the candidate in consultation with the director of graduate work for the department during the first or second term after he has passed the M.A. written examination with a grade of I. This examination requirement applies not only to students taking the Minnesota M.A. degree, but also to students holding M.A. degrees from other institutions. This examination also serves as the preliminary written examination for the Ph.D. For information concerning the M.A. written examination, see above.

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

1. Old and Middle English Literature
2. The Renaissance to the Restoration
3. The Restoration and the Eighteenth Century
4. British Literature of the Nineteenth Century
5. American Literature Through the Nineteenth Century
6. British and American Literature of the Twentieth Century
7. The English Language

A candidate shall "write off" three of the seven subfields with at least 12 credits of course work in each, except for subfield 7, where the requirement for "writing off" is Engl 100 plus 6 credits in other courses in the English language. Six credits in each of these three subfields must be of A quality. On the subfield in which a candidate is writing his thesis, he will be examined in a 3-hour special written examination; on the three remaining subfields plus the minor (or "the supporting program"), he will be examined in a 2-hour preliminary oral examination. A final oral examination will be given to the candidate on completion of his thesis and certification by his committee that it is ready for defense. The following courses cannot be used in "writing off" any of the subfields: 115, 116, 120-121, 123-124, 127, 129, 176, 181, 184-185-186, 213, 246-247, 268-269, 290-291-292, 297-298-299.

Language Requirement—Unless special exception is made upon petition, the candidate is required to have a reading knowledge of two of the following: French, German, Latin, Greek, Italian. No candidate may satisfy either part of this requirement either with English or with his native language. The candidate must satisfy language requirements before taking the preliminary examinations. See under M.A. for particulars.

The Graduate Minor in English

The candidate for the Master's degree (Plan A) taking a minor in English is expected to present a minimum of 9 credits in one of the seven subfields listed above or in 184-185-186.

A minor sequence in English for the Doctor's degree must include either 9 credits in one of the sequences of courses numbered 100 or above devoted to a historical period or 9 credits in 184-185-186.

Besides satisfying the general requirements established by the Graduate School, the candidate for the Ph.D. offering English as a minor must pass a preliminary oral examination on two of the seven subfields listed above, or on one of the seven and on one specific literary kind such as the drama or the novel.

Comparative Literature—For information on this program, see page 95.

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, Pederson

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 §§) Turpie

106. Whitman and Mark Twain. (3 cr; prereq §§) Kwiat

109-110.‡ Romantic Poets of the Early Nineteenth Century. 109: Wordsworth, Coleridge, Scott, etc. 110: Byron, Shelley, Keats, etc. (3 cr per qtr; prereq §§) Scoggins

111. Henry Adams and Theodore Dreiser. (3 cr; prereq §§) Levenson

113. American Short Story. Historical examination of American short story from 18th century to present. (3 cr; prereq §§) Turpie

114. The Midwest in Literature. (3 cr; prereq §§)

115. The Development of English Prose Style, I. Definition of six broad types of prose style on historical principles. (3 cr; prereq §§) Brown

116. The Development of English Prose Style, II. Styles of selected writers since 1700. (3 cr; prereq §§) Brown

120-121. The Interpretation of Poetry. Certain technical aspects of poetry in relation to poetic meaning. 120: Analysis of a number of short poems. 121: Coleridge, Housman, Frost, and Eliot. (3 cr per qtr; prereq §§) Tate

123-124.‡ The Technique of the Novel. Special studies in novels of the late 19th and 20th centuries, with regard to structure. See also Comp 101-102-103 for the writing of fiction. (3 cr per qtr; prereq §§) Unger

126-127.‡ 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 127) Moore

130. Victorian Poetry I. Early and mid-Victorians: Tennyson, the Brownings, Clough, FitzGerald, Arnold, and others. (3 cr; prereq §§) Montgomery

131. Victorian Poetry II. Pre-Raphaelites and after: the Rossettis, Swinburne, Morris, Wilde, and the poets of the 1890's. (3 cr; prereq §§) Montgomery

134. The Origins of American Naturalism. (3 cr; prereq §§) 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. Critical study of works of major authors and their relation to 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) 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

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

157-158. American Poetry. Critical survey of American poetry from Anne Bradstreet to present, with some attention to historical and intellectual backgrounds; emphasis upon major figures. (3 cr per qtr; prereq §§) Tate

159-160.‡ American Literature: Colonial and Early National Periods. Critical survey with emphasis on principal writers. (3 cr per qtr; prereq §§) C Foster

162x. Milton. The minor poems, *Areopagitica, Paradise Lost,* and *Samson Agonistes.* (3 cr; prereq 21 or 56) Levy, Steinmann, Unger

165. The Structure of Modern English. Introductory study of English phonemics, morphemics, and syntax. (3 cr; prereq §§) Allen, Pederson

166. History of the English Language. Historical influences upon, and changes within, the language as both a popular and a literary medium of communication. (3 cr; prereq §§) Allen, Pederson

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) O'Brien

173. Dr. Johnson and His Circle. Boswell; Johnson's influence on his contemporaries. (3 cr; prereq §§ and △) Moore

174. American English. The developing distinctiveness of the English language in America; its relationships to American cultural patterns; significant regional variations in vocabulary, pronunciation, and grammar; introduction to field methods of American dialect geography; access to unpublished collections of Linguistic Atlas of the Upper Midwest. (3 cr) Allen

175. Chaucer. Reading of *The Canterbury Tales* with introduction dealing with grammar and literary forms of 14th-century English. (4 cr, §75 or equiv; prereq 100)

176. The Structure of Verse. Technical devices, with emphasis on tropes, rhythmic patterns, stanzaic forms. Primarily descriptive, but with some attention to history and theory of various techniques. (3 cr; prereq §§) Youngblood

178. The South in Literature. (3 cr; prereq §§) Tate

180. The Influence of Poe. The French "Symboliste" school; influence of this school on modern literature, chiefly poetry, in English. (3 cr; prereq §§) Tate

181. Modern Literary Criticism. Major texts and movements in modern literary criticism; examination of a few of the more important historical documents from earlier centuries. (3 cr; prereq §§)

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 §§)

183. The Poetry of T. S. Eliot. (3 cr; prereq §§) Unger

184-185-186.‡ Form and Idea in Dramatic Literature. Dramatic types, in chronological sequence; analytical reading of selected representative plays. 184: Tragic and religious drama (classical, medieval, Renaissance, and modern); theories of tragedy. 185: Comedy (classical, Renaissance, and modern); theories of comedy. 186: Experimental and nonrealistic drama. (3 cr per qtr; prereq §§...56 recommended) Hurrell

187-188-189.‡ Eighteenth-Century Literature. Survey of English literature from 1700 to 1790. Parallel readings and critical essays. Graduate students will submit a term paper each quarter. (3 cr per qtr; prereq §§) Monk

193. The Poetry of W. B. Yeats. (3 cr; prereq §§) 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, O'Brien

197-198-199.‡ Seventeenth-Century Literature. 197-198: Prose and nondramatic poetry of the century down to 1660. 199: Dryden and his contemporaries. (3 cr per qtr; prereq §§) Unger, Hurrell

204. Studies in the English Language. Historical development of English phonemic, morphemic, and syntactic patterns. (3 cr; prereq 100) Allen

205. Studies in the English Language. Present-day structure, with attention to the theory of transformations. (3 cr, §165) Allen

206. Studies in the English Language. Research problems. (3 cr; prereq ‡) Allen

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

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)

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) Brown

228-229. Studies in Eighteenth-Century Literature and Culture. (3 cr per qtr) Moore

231-232-233. Shakespeare's Tragic and Comic Art. (3 cr per qtr) Brown

234-235-236. Studies in Medieval English Culture. (3 cr per qtr; prereq 75 or equiv) Clark

240-241-242. The Canterbury Tales. (3 cr per qtr; prereq 75 or equiv) Clark

243-244-245. Nondramatic Literature of the Sixteenth Century. Renaissance prose and poetry; Spenser and his contemporaries. (3 cr per qtr) Brown

246-247. English Literary Criticism. Basic historical texts; principles and issues which have relevance for modern criticism. (3 cr per qtr)

250-251. Studies in Modern Literature. Problems and issues in 20th-century British and American literature. (3 cr per qtr; prereq ♯)

253-254-255. American Renaissance I: Emerson, Whitman, Emily Dickinson. (3 cr per qtr) C Foster

256-257-258. Spenser and Milton. (3 cr per qtr) 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, Melville. (3 cr per qtr) C Foster

268-269. Studies in Aesthetics. Analysis and clarification of both practical and theoretical texts in aesthetics (major emphasis on literary criticism). (3 cr per qtr; prereq grad students in English and philosophy, others ♯) Steinmann

271-272. The Rise and Development of the English Novel. 271: Defoe, Richardson, Fielding, and others. 272: Smollett, Sterne, Goldsmith, and others. (3 cr per qtr) Montgomery

274-275-276. Studies in Early Eighteenth-Century Literature. Literature of first half of 18th century in the light of critical theories and currents of thought. (3 cr per qtr) Monk

277-278-279. American Realism. Howells and his contemporaries; Henry James; Mark Twain. (3 cr per qtr; prereq ♯) Bowron

281-282-283. Studies in the English Romantic Movement. (3 cr per qtr)

284-285-286. Dryden and His Age. (3 cr per qtr) Monk

287-288-289. Studies in Victorian Literature. (3 cr per qtr) Stange

290-291-292. Studies in Critical Theory. Intensive study, from the point of view of the philosophy of criticism, of the works of certain great critics. (3 cr per qtr) Tate

297-298-299. Independent Reading. (3 cr per qtr; prereq MA degree or equiv) Graduate staff

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)

200-201-202. Graduate Seminar: Writing. (3 cr per qtr; prereq ♯) Tate

American Studies—Students interested in major work in this program see index.

ENTOMOLOGY, FISHERIES, AND WILDLIFE

Professor
Alexander C. Hodson
Huai C. Chiang
Laurence K. Cutkomp
Mykola H. Haydak
Frederick G. Holdaway
William H. Marshall
A. Glenn Richards
Lloyd L. Smith, Jr.

Associate Professor
James R. Beer
Marion A. Brooks
Edwin F. Cook
Allan G. Peterson
Franklin G. Wallace
Thomas F. Waters

Assistant Professor
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 of fishery and wildlife.

Master's Degree—Offered under Plan A. In exceptional cases Plan B may be followed by petition approved by the major advisers of the department.

Doctor's Degree—Candidates for the Ph.D. degree should earn the Master's degree under Plan A.

Course 200 is required of all majors while in residence with the exception that students who have passed their oral preliminary examination may be exempt on approval of their adviser.

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 94 or ♯...Bot 50 or 130 or equiv recommended; offered 1965-66 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 15 cr in zoology incl Biol 2 or equiv; offered Itasca Biology Session only) Underhill

124. Biology of Immature Insects. Habits, habitats, life history, and identification of immature insects; aquatic forms. (6 cr; prereq 9 cr in general biology and 74 or equiv or △; offered Itasca Biology Session) Cook

125. Insect Morphology. Comparative studies of external and internal anatomy and histology of insects; phylogeny and function. (4 cr; prereq 74, ♯) Cook

126. Embryology and Development of Insects. 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, ♯...BioC 106 or MdBc 101 recommended) Richards

128. Aquatic Entomology. Identification and biology of aquatic and littoral insects in all stages. (2 cr; prereq 74 or equiv; offered 1965-66 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, ♯; offered 1964-65 and alt yrs) 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, ♯; offered when demand warrants) Richards

141. Insects in Relation to Plant Diseases. (Same as PlPa 141) Insect transmission and dissemination of plant pathogens; development of plant-insect relationships; habits of principal insect vectors—practical methods of control. (3 cr; prereq 5 cr in entomology, 5 cr in plant pathology or equiv, or ♯) Peterson, Wilcoxson

144. Medical Entomology. Principal arthropods noxious to man and animals. Emphasis on those that serve as vectors of pathogenic organisms of man and animals. (3 cr; prereq 15 cr incl 74 or equiv, ♯) Price

145. Parasitic Protozoa. Structure, life histories, and economic relations of protozoal parasites of man and animals. (3 cr; prereq 15 cr in zoology incl Biol 2 or equiv, ♯) Wallace

146. Helminthology. Worm parasites of man and animals, their structure, life histories, and biological relationships. (3 cr; prereq 15 cr in zoology incl Biol 2 or equiv, ♯) Wallace

175.* Principles of Economic Entomology. Methods and principles of insect control. (4 cr; prereq 15 cr incl 50 or equiv, or ♯; offered 1964-65 and alt yrs) Cutkomp

178. Special Lectures in Entomology. Lectures in special fields of entomological research given by a visiting professor. (Cr ar; offered when feasible)

193-194-195.*‡ Advanced Work in Entomology. Library and laboratory research in various lines of entomology. (1 or more cr per qtr; prereq △)

196.* Special Problems in Entomology and Vertebrate Ecology. Advanced work in entomology and ecology and ample opportunity for individual research, especially in various faunistic studies. (Cr ar; prereq ♯; offered Itasca Biology Session) Marshall, Cook, Tester

200x. Seminar. Assigned topics dealing with some special fields of work of the department. (1 cr per qtr)

201.* Experimental Ecology Laboratory. Companion course of 118. (2 cr; prereq 118 or ¶118) Chiang

202.* Insect Ecology. Dispersal, distribution, abundance, natural control, and related problems. (3 cr; prereq 118 or ♯) Chiang

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. (5 cr; prereq 127, ♯) Brooks

205.* Insecticides and Their Action. Chemistry, physiological action, toxicology of insecticides. (3 cr; prereq 15 cr incl 50 or equiv or ♯, inorganic and organic chemistry; offered 1965-66 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 1965-66 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 1964-65 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 1965-66 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 1964-65 and alt yrs) Underhill

240-241-242-243.° Research in Entomology. (Cr ar) Chiang, Cutkomp, Haydak, Hodson, Holdaway, Richards, Brooks, Cook, Peterson, Price

Fisheries and Wildlife

103-104-105x.‡ 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 15 cr in zoology incl Biol 2 or equiv; offered Itasca Biology Session only) Underhill

121. Ichthyology. Taxonomy and habits of North American fishes, especially those of upper Mississippi drainage. (3 cr; prereq 15 cr in zoology incl Biol 2 or equiv) Eddy

128. Aquatic Entomology. Identification and biology of aquatic and littoral insects in all stages. (2 cr; prereq 74 or equiv; offered 1965-66 and alt yrs) Cook

162.° Vertebrate Ecology. Field work on populations and their relationships to local environments; habitat analysis and ecological research methods. Individual and team research projects, field trips, and lectures. (6 cr; prereq Bot 50 and Zool 94; offered Itasca Biology Session) Marshall, Tester

165.° Techniques of Fishery Biology. Basic methods used in fishery research and management; lake and stream survey methods, mapping, chemical and biological sampling; methods of fish collection, use of nets and traps, fish toxicants, electro-fishing; tagging and marking; methods of creel census. (3 cr; prereq 65, 119, 121 or ‡) Waters

166.° Techniques of Wildlife Biology. Lectures, laboratory, and field work on wildlife research and management techniques. (3 cr; prereq 65, 77, Zool 76, Bot 50, or ‡) Beer

179. Special Lectures in Fisheries and Wildlife. Lectures in special fields of research given by a visiting professor. (Cr ar; offered when feasible)

193-194-195.°‡ Advanced Work in Fishery Biology or Advanced Work in Wildlife Biology. Library and laboratory research in various lines of fishery biology or wildlife biology. (1 or more cr per qtr; prereq ‡) Marshall, Smith, Beer, Waters, Tester

196.° Special Problems in Entomology and Vertebrate Ecology. Advanced work in entomology and ecology and ample opportunity for individual research, especially in various faunistic studies. (Cr ar; prereq ‡; offered Itasca Biology Session) Marshall, Cook, Tester

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 65, 77, Zool 116 and Bot 50 or ‡; offered 1965-66 and alt yrs) Beer

274.° Wildlife Management: Upland Game. Survey of upland game bird management problems in North America. (3 cr; prereq 65, Zool 75, 116 and Bot 50 or ‡; offered 1964-65 and alt yrs) Beer

275.° Wildlife Management: Waterfowl. Life histories, ecology, and management of North American waterfowl. (3 cr; prereq 65, Zool 75, 116 and Bot 50 or ‡; offered 1964-65 and alt yrs) Tester

276.° Wildlife Management: Big Game. Background basic to and methods used in managing big game herds in North America. (3 cr; prereq 65, 77, Zool 116 and Bot 50 or ‡; offered 1964-65 and alt yrs) Marshall

277-278-279-280.° Research in Wildlife Biology. (Cr ar) Marshall, Beer, Tester

ENVIRONMENTAL HEALTH

Professor

Richard G. Bond, M.S., M.P.H.
George S. Michaelsen, M.S.
Theodore A. Olson, M.A., Ph.D.

Associate Professor

John O. Buxell, M.S., M.P.H.
Harry Foreman, M.D., Ph.D.
Harold J. Paulus, M.S., Ph.D.

Language Requirement—For the Master's degree, knowledge of a foreign language may be waived on recommendation of the adviser. For the Ph.D. degree, reading knowledge of two foreign languages or one foreign language and option of a special research technique or a collateral field of knowledge. Acceptable languages are Finnish, French, German, Japanese, Norwegian, Russian, Spanish, or Swedish.

Minor—For the Master's degree, PubH 100A, B, and C and courses in statistics and either epidemiology or public health administration.

For the Ph.D. degree, PubH 100A, B, and C and 20 additional credits selected on the basis of the candidate's field of major study.

Master's Degree—Offered under both Plan A and Plan B. All candidates for this degree must take PubH 100A, B, and C.

Doctor's Degree—Applicants for the degree in environmental health will present a Bachelor's degree in a physical or biological science or some field of engineering and will minor in a fundamental discipline appropriate to their previous training.

For descriptions of the following courses, see under Public Health.

102. Environmental Sanitation. (3 cr; prereq 100A or ¶100A and ‡) Bond, Olson

112.* Public Health Engineering—Plan Examinations. (1 cr per qtr, §114; prereq engineering degree and 102, and ‡) Bond, Buxell

113.* Public Health Engineering—Field Investigations. (2 cr per qtr, §114; prereq engineering degree and ‡ and 102) Bond, Buxell

115.* Food Sanitation. (3 cr; prereq 100A and ‡) Olson

115A. Institutional Food Protection Programs. (2 cr; prereq ‡) Bond, Stauffer

116.* Public Health Engineering Administration. (2 cr, §114; prereq ‡) Bond

117-118-119.* Sanitary Biology. (3 cr per qtr; prereq 100A or ¶100A or ‡) Olson

123.* Topics in Public Health. (Cr ar; prereq ‡) Staff

145. Low Level Radioactivity and Radiation Measurements. (3 cr; prereq ‡) Foreman

146. Radiological Health II. (3 cr; prereq ‡) Foreman

147. Environmental Radioactivity. (3 cr; prereq ‡) Foreman

149. Public Health Aspects of Housing and the Residential Environment. (3 cr; prereq ‡) Buxell

151. Health Aspects of Air Control in Hospitals. (2 cr; prereq ‡) Michaelsen

152.* Industrial Hygiene Engineering. (3 cr; prereq ‡) Michaelsen

154.* Radiological Health I. (Cr ar; prereq ‡) Foreman

155.* Introduction to Air Pollution Problems. (3 cr; prereq ‡) Paulus

156.* Air Pollution Surveys. (2 cr; prereq 155 and ‡) Paulus

157. Radiation Protection Criteria for Hospital Design and Operation. (2 cr; prereq ‡) Michaelsen

158. Hospital Safety. (3 cr; prereq ‡) Michaelsen, Scheffler

159. Chemical Laboratory Safety. (1 cr; prereq ‡) Scheffler

200. Research. (Cr ar) Staff

210. Seminar: Public Health. (Cr ar)

212.* Seminar: Public Health Engineering and Sanitation. (Cr ar; prereq ‡) Bond

230. Field Practice in Environmental Sanitation. (Cr ar; prereq ‡) Bond

231. Ground Water Supplies. Ground water as a source of supply for communities in economically underdeveloped areas of the world. Special reference to public health problems involved. (Cr ar; prereq grad engineer and ‡) Bond, staff, visiting lecturers

232. Field Work in Ground Water Development. (Cr ar; prereq grad engineer, 231) Bond, staff, visiting lecturers

EPIDEMIOLOGY

Professor

Gaylord W. Anderson, M.D., Dr.P.H.
Leonard M. Schuman, M.D., M.S.

Language Requirement—For the Master's degree, knowledge of a foreign language may be waived on recommendation of the adviser. For the Ph.D. degree, reading knowledge of two foreign languages or of one foreign language and option of a special research technique or a collateral field of knowledge. Acceptable languages are: Danish, French, German, Japanese, Norwegian, Russian, Spanish, or Swedish.

Minor—For the Master's degree, PubH 100A, B, and C and courses in statistics and public health administration.

For the Ph.D. degree, PubH 100A, B, and C, and 20 additional credits selected by the minor adviser on the basis of the candidate's field of major study.

Master's Degree—Offered under both Plan A and Plan B. All candidates for this degree must take PubH 100A, B, and C.

Doctor's Degree—Applicants for the degree in epidemiology will usually present a degree in medicine, dentistry, or veterinary medicine; others with adequate background in the biological or physical sciences or with demonstrated competence in investigative work may be accepted. Students majoring in epidemiology will offer a minor in a related field.

For descriptions of the following courses, see under Public Health.

100A. Elements of Public Health I. (3 cr; prereq 3, 3A or 50 and a course in bacteriology) G Anderson, Thomson, Schuman

100B. Elements of Public Health II. (1 cr; prereq 100A) G Anderson, Thomson, Schuman

100C. Elements of Public Health III. (1 cr; prereq 100B) G Anderson, Thomson, Schuman

103. Public Health Bacteriology. (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

110. Biostatistics I. (3 cr; prereq ¶111, Math 10 or ‡) Brown

111. Biostatistics Laboratory I. (2 cr per qtr; prereq ¶110)

123.* Topics in Public Health. (Cr ar; prereq ‡) Staff

140. Vital Statistics I. (3 cr) Bearman, Thornton

191.* Science of Human Nutrition. (3 cr; prereq ‡) J Anderson, Keys

195. Public Health Aspects of Cardiovascular Disease. (3 cr; prereq ‡) Keys, Grande, and staff

200. Research. (Cr ar)

213. Seminar: Epidemiology. (Cr ar; prereq ‡) Schuman

241.* Epidemiology of Noncommunicable Diseases. Application of basic epidemiologic principles to noncommunicable diseases and to trauma; selected disease examples. (3 cr; prereq 104) Schuman

FLUID MECHANICS

Subcommittee:

Professor

Ernst R. G. Eckert, *chairman* (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)

Associate Professor

Arnold G. Fredrickson (Chemical Engineering)

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

Professor

Neal R. Amundson (Chemical Engineering)
Rutherford Aris (Chemical Engineering)
Francois N. Frenkiel (Aeronautical Engineering)
Edward L. Hill (Physics)
Stephen Prager (Physical Chemistry)
William E. Ranz (Chemical Engineering)
Paul C. Rosenbloom (Mathematics)

Associate Professor

Richard J. Goldstein (Mechanical Engineering)
Thomas S. Lundgren (Aeronautical Engineering)
L. E. Scriven (Chemical 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 three of the several graduate majors listed.

Minor Program—The minor should ordinarily be taken in mathematics. However, under special circumstances the subcommittee may consider the substitution of a basic science such as physics or chemistry. The minor must be planned so that it effectively brings in a related but distinct area and does not merely supplement the major.

Language Requirement—All candidates must satisfactorily meet the requirements for 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 biochemistry (agricultural), 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

Associate Professor
John G. Haygreen
Frank D. Irving
Merle P. Meyer
Richard A. Skok

Assistant Professor
Egolfs V. Bakuzis
Bruce A. Brown
Edward I. Sucoff
Kenneth E. Winsness

Prerequisites—The prerequisites for entering on the master of forestry program may be either an undergraduate degree program in forestry or completion of a 4-year undergraduate college degree including college level courses in algebra, inorganic chemistry, physics, and two college courses in biology. Applicants for admission to study for the master of science degree or the Ph.D. degree are expected to have completed a Bachelor's or advanced degree in forestry or in related sciences as dictated by the major field of specialization. Consideration will be given to students who have included in their undergraduate college curriculum sufficient pertinent subject matter to qualify them to undertake graduate work with specialization in the forest sciences or in forest products engineering.

Language Requirement—For the master of forestry degree and the master of science Plan B—none. One language is required for the master of science, Plan A. This may be waived by petition in individual cases. For the Ph.D. degree, either (a) two foreign languages selected in consultation with the student's adviser and the director of the school or (b) one foreign language and the option of a special research technique or a collateral field of knowledge—selection to be made in consultation with the student's adviser and the director of the school.

Master of Forestry Degree—Students will fulfill the general requirements for the master of science degree under Plan B. This program is designed to meet the needs for professional study by qualified students primarily interested in administration and technical work in forest resources management. For completion of the M.F. degree, the following courses or their equivalents must have been completed in the undergraduate program or during the student's graduate training.

For 4—Dendrology (4)
For 2—Forest Ecology (4)
(or) Bot 130 and 130A, Plant Ecology (5)
Ent 56—Forest Entomology (4)
Ent 64—Fish and Wildlife Populations (3)
PlPa 51—Forest Pathology (4)
For 52—Forest Mensuration (3)
For 77—Forest Products (2)
For 100—Forest Fire (2)
For 109—Forest Aerial Photography (3)
For 111—Statistical Methods in Forestry (4)
For 123—Forest Economics (5)
For 129—Regional Silviculture (3)
For 131—Forest Policy (3)
For 139—Timber Management (3)
For 143—Management of Recreational Lands (3)
For 147—Forest Administration (3)
For 148—Watershed Management (3)
1 quarter of forestry field camp experience
Graduate seminar (3 qtrs) (3)

Doctor's Degree—Work leading to the Ph.D. degree is offered under the general requirements for that degree. A program of study may be developed to include either a specific minor subject or a coherent supporting subject program.

Research Facilities—The Cloquet Forest Research Center, the Forestry and Biological Station at Lake Itasca, and the Forest Products and Forest Science laboratories on the St. Paul Campus are available to students for the development of requisite problem and thesis research.

100. Forest Fire. Fire behavior, effects, control and use. (2 cr; prereq 4, 53) Irving

105. Range Management. Range management for sustained production of livestock forage. (2 cr, §104; prereq 53 or ♯ for nonforestry majors, Biol 2) Meyer

109. Forest Aerial Photogrammetry. Use of aerial photographs, preparation of planimetric and vegetative type maps. Photo interpretation and application to resource management. Lectures and laboratory. (3 cr, §59; prereq 52 or ♯) Meyer

111. Statistical Methods in Forestry. Sampling, decision-making using statistical tests, application of statistics to forest survey, inventory, and volume table selection. Lectures and laboratory. (4 cr, §8, §111; prereq 52, ¶109, Math 10, or ♯) R M Brown, John

122. Forest Business Practices. Survey of timber sales procedures, forest tax procedures, forest finance, and government regulations and business analysis techniques applied to forestry operations. Lectures, reports, and problems. (3 cr; prereq AgEc 3 or ¶AgEc 3) Skok

123. Forest Economics. United States and world forest resource supply and consumption relationships; forest products industries and wood products users characteristics; aggregate and firm capital use theory for long period production processes; market systems for principal forest products; macro problems of forest economy; and decision-making in micro forest economic situations. Lectures and problems. (5 cr, §47; prereq 77, 122, and Cloquet or ♯) Skok

125. Silviculture I. (Formerly 127) Introduction to silvicultural systems, intermediate cuttings, and related practices. Forest regeneration problems and techniques. (2 cr; prereq 4 and 5; given at Cloquet) B A Brown

128. Silviculture II. Lectures and field work in relation to timber stand improvement projects, stand examinations and prescriptions, seeding and planting, and related silvicultural practices. (4 cr; prereq ¶125; given at Cloquet) B A Brown

129. Regional Silviculture. Silvicultural consideration of important forest species and types selected to represent a range of ecological, economic, and logging conditions throughout the U.S. Lectures and reports. (3 cr; prereq 128 or ♯) Hansen

131. Forest Policy. Public and private forest policies in the U.S. Forest policies of other nations. Analysis of current policy issues. Lectures and reports. (3 cr) Irving, Skok

133. Forest Management and Utilization. Observation and analysis of state, federal, and private forestry operations with field trips and assigned reading; techniques of fire control and use; timber utilization and processing including trips through selected forest products processing plants. (4 cr; prereq 100, AgEc 3; given at Cloquet) B A Brown

134. Forest Inventory and Photographic Interpretation. Type delineation, area measurement, map construction, cruise design, and timber measurement using aerial photos. (4 cr; prereq 111; given at Cloquet) Meyer

136. Advanced Forest Economics. Economics of forest resource development and forest products. (3 cr; prereq 123 or ♯) Skok

139. Timber Management. (Formerly 124) Inventory, regulation, and continuous production of timber crops. Economic analysis of specific production problems. Lectures and problems. (3 cr; prereq 111, 123, 125, 133, or ♯) Irving

141. Principles of Forest Ecology. Review and discussion of modern ecological concepts and principles. Their application to forest ecosystems and to silvicultural manipulation. (3 cr; prereq 5, 128, or ♯) Hansen

143. Management of Recreational Lands. Recreational use of the forest and associated land and water. Policy problems arising from recreational demands. (3 cr) Duncan

145. Advanced Silviculture. Synthesis of silviculture knowledge through review of classical as well as recent contributions to silvicultural literature. Topical presentations, reports. (3 cr; prereq 129 or ♯) Hansen

146. Advanced Forest Aerial Photogrammetry. Photogrammetric systems, flight planning, contracting, contract inspection; advanced photo interpretation, mapping, and measurement problems. Laboratory. (3 cr; prereq 109 or ♯) Meyer

147. Forest Administration. Organization and administration of forestry enterprises. (3 cr; prereq 123, 133, or ♯) Irving

148. Watershed Management. Principles of managing forested watershed including effects of woody vegetation upon soil moisture, stream flow, and erosion. (2 cr, §104; prereq 5, 53, or ♯ for nonforestry majors, Soil 3, Geo 1 or ♯) Duncan

149. Advanced Forest Mensuration. Applications of statistical and advanced mensurational methods in analysis and interpretation of forestry data and forest survey sampling methods. Lectures and laboratory. (3 cr; prereq 111 or ♯) R M Brown, John

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. Behavior of trees including energy balance, mineral nutrition, water relations, and growth regulation. Application to practical forestry problems emphasized. (3 cr; prereq Biol 2, MeAg 25, BioC 1A or OrCh 42) Sucoff

153. Advanced Forest Management. Advanced economic, administrative, and biologic problems of forest land management. Current techniques. Problems of increasing intensity of management. (3 cr, §140; prereq 139, 147, or ‡) Irving

154. Advanced Watershed Management. Recent literature relating to management of the forested watershed. Methods of analyzing research data. (3 cr; prereq 148 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 74 and organic chemistry) Hossfeld

176. Design of Wood Structures. Fabrication and use of the timber truss and laminated arches and beams in building construction. Timber connector, nailed, bolted, and nail-glued wood joints. (4 cr; prereq 79, Math 44, Phys 9 or ‡) Haygreen

177. Wood Chemistry. Chemical composition, reaction, and analyses of wood components and derivatives. Chemical technology of wood and wood products. (3 cr; prereq 74 or ‡, organic chemistry) Hossfeld

178. Woody Tissue Microtechnique. Sliding and rotary microtomes, maceration; differential staining, and special techniques in preparation of woody tissue for microscopic study. (2 cr; prereq 74 or ‡) Hossfeld

181. Moisture Relations in Wood. Moisture movement in wood related to the micro-physical and chemical structure and its influence on 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) Kaufert

183. Wood Finishing. Laboratory. Industrial applications of wood finishes. (2 cr) Hossfeld

184. Advanced Wood Chemistry. Laboratory problems in analysis of wood constituents and in the technique for their isolation and purification. (2 cr; prereq 177, AnCh 57 or equiv) Hossfeld

185. Principles of Adhesion in Manufactured Wood Products. Theory of adhesion as applied to wood and to combinations of wood with other materials. (3 cr; prereq 86, 177)

186. Mechanical Behavior of Wood. Orthotropic nature of wood; elastic and inelastic behavior; effect of moisture, temperature, and time. Some consideration of plywood, particleboard, and fiberboard properties. (3 cr; prereq 79 or ‡) Haygreen

187. Advanced Building Materials Merchandising. Lecture and seminar presentations in the areas of retailing, wholesaling, market analysis, and research. (3 cr; prereq 87, Mktg 197; offered when feasible) 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) 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) Skok

207x.* Research Problems: Forest Products Engineering. (Cr ar) Hossfeld, Haygreen, Kaufert

213x.* Research Problems: Forest Utilization. (Cr ar) Hossfeld, Haygreen, Kaufert

215. Research Problems: Forest-Tree Physiology. (Cr ar) Sucoff

218x.* Research Problems: Forest Measurements and Photogrammetry. (Cr ar) R M Brown, Meyer

219x.* Research Problems: Forest Recreation. (Cr ar) Duncan

220x.* Research Problems: Forest-Tree Genetics. (Cr ar) Pauley

221x.* Research Problems: Forest Influences. (Cr ar) Duncan

222x.* Research Problems: Forest Policy. (Cr ar) Skok, Kaufert, Irving, Winsness

223x. Seminar. Current forestry research problems and current forestry literature. (1 cr) Graduate staff

224Ax. Seminar: Forest Biology. Topics in forest biology. (1 cr) Graduate staff

224Bx. Seminar: Forest Management. Topics in forest management. (1 cr) Graduate staff

224Cx. Seminar: Forest Products. Topics in forest products engineering and technology. (1 cr) Graduate staff

225x. Seminar. Current forestry research problems and current forestry literature. (1 cr) Graduate staff

226-227.* Statistical Methods in Forestry. (1 cr per qtr; prereq 6 cr in statistics or #) John

230. Forest Synecology. Structure, dynamics, and productivity of forest ecosystems. Models and classification of ecosystems, theory and application. (3 cr) Bakuzis

GENETICS

Professor
Ralph E. Comstock (Animal Husbandry)
S. Gaylen Bradley (Microbiology)
Charles R. Burnham (Agronomy and Plant Genetics)
Richard S. Caldecott (Agronomy and Plant Genetics)
Troy M. Currence (Horticultural Science)
A. Orville Dahl (Botany)
Joseph G. Gall (Zoology)
Jean W. Lambert (Agronomy and Plant Genetics)
David J. Merrell (Zoology)
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 Science)
Leon A. Snyder (Agronomy and Plant Genetics)
John C. Spizizen (Microbiology)

Associate Professor
V. Elving Anderson (Zoology)
Laddie J. Elling (Agronomy and Plant Genetics)
Charles E. Gates (Agricultural Experiment Station)
William E. Rempel (Animal Husbandry)
James C. Sentz (Agronomy and Plant Genetics)
Francis A. Spurrell (Veterinary Medicine)
Horace L. Thomas (Agronomy and Plant Genetics)
Charles W. Young (Dairy Husbandry)

Assistant Professor
William M. Clement (Agronomy and Plant Genetics)
Verne E. Comstock (Agronomy and Plant Genetics)
Frank D. Enfield (Animal Husbandry)
Florian I. Lauer (Horticultural Science)
Donald C. Rasmusson (Agronomy and Plant Genetics)

Research Associate
Richard L. Cooper (Agronomy and Plant Genetics)

A program of study in genetics, leading to the Master's and Ph.D. degrees, may be elected as a major. The major adviser may be selected from among qualified members of the graduate faculty in this field. All programs of students electing genetics as a major must be approved by the Subcommittee on Genetics of the Graduate School. Genetics may also be selected as a minor area by students with majors in other appropriate areas. Approval of minor programs in genetics will also be the responsibility of the Subcommittee 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 at least two of the special subfields of genetics. All major students will be expected to attain competence in statistics including the design of experiments and the statistical analysis of the data. Dependent upon the subfields of genetics in which the student has special interest, he will be expected to have suitable competence in one or more related areas of science such as chemistry, biology, or mathematics. For students with a genetics minor, general competence in genetics will be required.

Language Requirements—For the Master's degree, none. For the Ph.D. degree, (a) two foreign languages or (b) one foreign language plus a special research technique or collateral field.

Agro 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 BPhy 170 and 171 or ‡) Caldecott, Loken, Spurrell

Agro 240. Advanced Genetics. (3 cr; prereq 131 or equiv and a course in biochemistry or ‡) Snyder

Agro 241. Research in Plant Genetics. (Cr ar) Staff

Agro 242. Seminar: Plant Breeding. (1 cr per qtr) Staff

Agro 243. Methods in Plant Breeding. (3 cr; prereq 131 and 132 or equiv) Rasmusson

Agro 244. Laboratory Methods in Plant Breeding. (Cr ar; prereq 132 or equiv) Staff

Agro 245. Topics: Plant Breeding. (2 cr; prereq 131, 243, and 244 or equiv or ‡) Plant Genetics staff

Agro 246. Seminar: Genetics. (1 cr per qtr) Staff

Agro 252. Cytogenetics. (4 cr; prereq 240 or ‡, Bot 118) Burnham

Agro 253. Methods in Plant Genetics. (2 cr; prereq 131; offered 1964-65 and alt yrs)

Agro 255. Topics in Genetics. (2 cr [can be taken for cr more than once]; prereq 240 and 252 or ‡) 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, PlPa 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 Biom 101) 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 1964-65 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 1964-65 and alt yrs) Dahl, Hansen

Bot 229, 230, 231, 232. Research Problems in Cytology. (Cr ar) Dahl

Bot 255, 256, 257. Seminar: 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)

Hort 248. Truck Crop Breeding. (3 cr; prereq 110 or Agro 132) Currence

Hort 249. Research in Horticultural Crop Breeding. (Cr ar) Currence, Hutchins

MdBc 211. Nucleic Acid and Protein Metabolism. (3 cr; minimum 8 students; prereq 100-101; offered 1964-65 and alt yrs) Barnum

MicB 110. Microbial Genetics. (3 cr; prereq 53 or ‡; offered 1964-65 and alt yrs) Bradley

MicB 111. Advanced Laboratory. (3 cr; prereq 53 or ‡) Bradley

PlPa 215. Genetics of Plant Pathogens. (3 cr; prereq 1 or 51, 156 or equiv, and Agro 131)

Poul 102. Poultry Breeding. (4 cr; prereq 1, Agro 30; offered 1965-66 and alt yrs) Shoffner

Poul 216. Research in Poultry Breeding. (Cr ar; prereq 9 cr 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

Professor
Eugene C. Mather
John R. Borchert
Jan O. M. Broek

Associate Professor
Fred E. Lukermann

Assistant Professor
Russell B. Adams
Ward J. Barrett
Philip W. Porter
John W. Webb

Instructor
Robert C. Lucas

Research Associate
Mei Ling Hsu

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 seven 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, knowledge and use of one foreign language as demonstrated by examination and a graduate paper. For the Doctor's degree either (a) knowledge of two foreign languages (as demonstrated by examination and use in graduate papers or thesis) or (b) one foreign language and a research technique. Proficiency in the latter will be certified by completion of course work, and demonstrated use in graduate papers or thesis will be required. Adequate reading knowledge of one of the two languages must be demonstrated not later than the close of the second quarter in which the student is registered for an advanced degree.

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

Doctor's Degree—Consult the chairman of the department for suggested program of work leading to the Ph.D. degree.

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 5 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 5 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 5 cr or ‡)

105f.* Mediterranean Region. Physical and human geography of lands adjacent to the Mediterranean Sea: Greece, Italy, Spain, Portugal, and Southern France. (3 cr; prereq 5 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) Borchert

109s.* Middle America. Physical and human geography of the West Indies and the mainland from Mexico to Colombia. (3 cr; offered 1965-66 and alt yrs) Barrett

110w.* South America. Regional survey of physical resources, population, agriculture, manufacturing, and transportation in South America. (3 cr; offered 1964-65 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) Mather

113w.* Eastern United States. Regional analysis of physical and human resources east of the Great Plains. (3 cr) 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) Lukermann

114Af.* Historical Geography of North America—Field Course. Sequential analysis of settlement and economy in the changing environment and resource patterns of Minnesota and contiguous states. (2 cr; prereq ¶114 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) 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 5 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 ♯; offered 1964-65) Broek

122w. East Asia. Physical and human geography of China, Korea, and Japan; geographic aspects of population pressure, development of resources and international relations. (3 cr; prereq 5 cr or ♯) Hsu

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; offered 1964-65 and alt yrs) Barrett

130s.* Geography of Outdoor Recreation. Changing perception, use and management of amenities of landscape, particularly rural landscape of North America since European settlement. (3 cr; prereq ♯) Lucas

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, Hsu

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

150f.* Rural Geography. Geographic components and assemblages of rural settlement. World regional occupance and production patterns and the geographic problems of rural settlement and agricultural production on the American scene. (3 cr) 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 or ♯) Wolter

167w-168s.* American Cities—Location and Geographic Design. Changing regional and local patterns of urban growth in the United States; methods and results of projection of future geographic patterns, and their relation to urban planning. (3 cr per qtr; prereq ♯ for 167, 167 and ♯ for 168) Borchert

169s.* Urban Field Study. Directed field study of urban land use problems in the Twin Cities and vicinity. Excursion to another selected Midwestern metropolitan area. (3 cr; prereq 168 or ¶168) Borchert

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) Webb

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

214.* Seminar: Historical Field. (5 cr; prereq ♯) Lukermann

251-252-253.* Seminar: Physical Geography. (3 cr per qtr; prereq ♯) Barrett

256-257-258.* Seminar: Land Use Planning. (3 cr per qtr; prereq ♯) Borchert

261-262-263.* Seminar: Development of Geographic Thought—Cultural Geography. (3 cr per qtr; prereq ♯) Broek

266-267-268.* Seminar: Eastern Europe. (3 cr per qtr; prereq ♯)

271-272-273.* Seminar: Historical Economic Geography. (3 cr per qtr; prereq ♯) Lukermann

276-277-278.* Seminar: Agricultural Geography. (3 cr per qtr; prereq ♯) Mather

281-282-283.* Seminar: 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: Readings in Ancient and Medieval Geography. (3 cr per qtr; prereq ♯) Lukermann

296-297-298.* Seminar. (3 cr per qtr; prereq ♯) Staff

301x.* Research Problems in Geography. (Cr ar) Staff

GEOLOGY AND GEOPHYSICS
(School of Earth Sciences)

Associate Professor
Tibor Zoltai

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

Associate Professor
Campbell Craddock
Paul W. Gast
Harold M. Mooney
William D. Munro
William C. Phinney
Robert E. Sloan

Assistant Professor
Kenneth S. Deffeyes

Prerequisites—For candidates for advanced degrees, a Bachelor's degree in geology, geophysics, or related earth science, with mathematics through differential equations, 1 year of college chemistry, and at least 1 year of college physics. A Bachelor's degree in other fields, such as chemistry, physics, 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 and geophysics are established on an individual basis by consultation with a faculty member and approved by the chairman of the Graduate Program Committee.

Language Requirement—For the Master's degree, reading knowledge of German, Russian, or French. For the Ph.D. degree, German and either Russian or French; other languages may be considered on petition. Candidates for advanced degrees must either complete or show substantial progress toward completion of at least one language requirement in their first year of residence.

Master's Degree—The Master's degree, which is not a necessary prerequisite for candidacy for the Ph.D. degree, is offered under Plan A and Plan B. Under Plan B, within the general Graduate School requirements, a minimum of 9 credit hours will be in one research course in which a written report will be prepared and reviewed by at least two members of the faculty.

Doctor's Degree—Admission to candidacy for the Ph.D. degree is contingent upon completing the minor, passing qualifying written and oral examinations, and completion of both language requirements. (The Ph.D. is not offered in geophysics at present.)

General Geology

100-101. Field Geology. Measurement of stratigraphic sections; fossils and igneous, sedimentary, and metamorphic rocks. Geological surveying on aerial photographs and topographic maps and by the plane table method. Preparation of geologic maps and cross sections. Structural and geomorphic features and geologic setting of mineral deposits. (Cr ar; by special or co-operative arrangement; prereq 120 or ‡)

103.* Problems in Geology and Geophysics. Individual research in laboratory or field problems at Upper Division or graduate levels. (1-6 cr; prereq ‡) Staff

104.* Advanced General Geology. Considers central problems in modern and classical geology through seminar-type discussion, evaluation of professional publications, and special projects. (3 cr; open to science majors in any field with supplemental reading by nongeologists; prereq ‡; offered on demand) Cloud, James, and staff

105. Introduction to Paleontology. Introduction to morphology and classification of major fossil groups. (5 cr; prereq 2 or 22 or ‡) Sloan

106.* Invertebrate Paleontology. Detailed studies of morphology, classification, and ecology of selected groups of invertebrate fossils. (5 cr; prereq 105) Sloan

107.* Vertebrate Paleontology. Morphologic and stratigraphic aspects of fossil vertebrates. (5 cr; prereq 105 or Zool 56 or ‡) Sloan

110. Sedimentology and Stratigraphy. Sedimentary processes and products with particular reference to modern sedimentary environments; principles of physical stratigraphy, correlation, facies, tectonic control, classification of stratigraphic units. (4 cr; prereq 62) Deffeyes, Swain

111.* Stratigraphy. Analysis of stratigraphy of typical and unique sequences of (a) Pre-Cambrian and Paleozoic rocks or (b) Mesozoic and Cenozoic rocks; methods of presentation of stratigraphic data; term paper required. (3 cr; prereq 110) Swain

112.* Micropaleontology. Biology and paleontology of microorganisms of geologic importance including Foraminifera, Radiolaria, flagellate Protista, Diatomaceae, Characea, Ostracoda, and conodonts. (3 cr; prereq 105) Swain

115.* Geomorphology. Origin and evolution of landforms in temperate, arctic, desert, and tropical regions in different geologic settings. Effects of structural history and climatic change on landform development. Relations of geomorphic processes to soil formation and engineering problems. Field trips; term paper or field project. (4 cr; prereq 2 or 22) Wright

116.* Glacial Geology. Physics of modern glaciers. Glacial erosion and deposition. Stratigraphy and chronology of the Pleistocene in glaciated and nonglaciated areas. (3 cr; prereq 2 or 22) Wright

117.* Pleistocene Geology. Problems in Pleistocene history of glaciated and nonglaciated areas, particularly North America, Europe, and the Mediterranean. Relation of Pleistocene climatic changes to soils, biogeography, and archaeology. Pollen analysis. (3 cr; prereq 116; offered 1965-66 and alt yrs) Wright

118.* Advanced Geomorphology. Detailed study of selected geomorphic processes, especially those of arctic and desert regions. (3 cr; prereq 115; offered 1964-65 and alt yrs) Wright

120. Structural Geology. Primary and secondary structures of rocks, mechanics and modes of deformation, and structural techniques. Laboratory exercises in three-dimensional representation and solution of selected structural problems. (4 cr; prereq 62 or 162 or ‡) Craddock

121.* Advanced Structural Geology. Fundamental problems and genesis of secondary structural features; detailed analysis of typical examples. Comprehensive term paper required for graduate credit. (3 cr; prereq 120) Craddock

125. Principles of Sedimentology. Sedimentary processes and environment, tectonic framework, and resultant rock types. (3 cr; prereq 62 or ‡) Deffeyes

126. Diagenesis in Sediments. Processes by which sediments are altered and converted into rocks. (3 cr; prereq 125, PCh 108 or ‡) Deffeyes

200.* Seminar: Paleoecology. Major features of paleoecology developed through evaluation of current and classical publications and special projects. (3 cr; prereq ‡; offered 1965-66 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

202. Seminar: Marine Geology. (Cr ar; prereq ‡) Cloud

203. Advanced Invertebrate Paleontology. (Cr ar; prereq 106 and ‡...200 advisable) Cloud

205.* Research in Paleontology. (Cr ar; prereq ‡) Sloan

206.* Seminar: Paleontology. (Cr ar; prereq ‡) Sloan

210.* Research in Stratigraphy. (3 cr; prereq 111) Swain

211.* Seminar: Stratigraphy. (Cr ar; prereq ‡) Swain

215.* Research in Geomorphology and Pleistocene Geology. (Cr ar; prereq 116, 117) Wright

216.* Seminar: Geomorphology and Pleistocene Geology. (Cr ar; prereq 116, 117) Wright

220.* Geotectonics. Basic problems of structure and evolution of the earth's crust. (3 cr; prereq 120 or ‡; offered 1964-65 and alt yrs) Craddock

221.* Research in Structural Geology. (Cr ar; prereq 121) Craddock

222.* Seminar: Structural Geology. (3 cr; prereq 120 or ‡; offered 1964-65 and alt yrs) Craddock

225. Research in Sedimentology. (Cr ar; prereq ‡) Deffeyes

226. Seminar: Sedimentology. (Cr ar; prereq ‡) Deffeyes

Mineralogy and Petrology

140.* Mineral Systems I. Basic and compound symmetry elements. Derivation and study of point groups, co-ordinate systems, crystal forms, lattices, plane groups and space groups. Introduction to X-ray diffraction. Introduction to crystal chemistry and crystal structures. (4 cr; prereq 62 or ‡, trigonometry, a yr of college physics and chemistry) Zoltai

141.* Mineral Systems II. Survey of mineral structures and crystal growth. Optical mineralogy; behavior of light and of isotropic and anisotropic media in polarized light. Correlation of geometric and electromagnetic theories of optical mineralogy. Laboratory includes study of

structure models, thin and polished sections; immersion techniques. (4 cr; prereq 140) Phinney, Zoltai

141A.° Mineral Systems IIA. Optical mineralogy portion of Geo 140. (3 cr; prereq 140) Phinney

142.° Mineral Systems III. Application of basic physical sciences to geologic problems. Discussion of rocks as chemical systems. Laboratory macroscopic and microscopic study of rocks and minerals. (4 cr, §145 or §150; prereq 141, PCh 102 or 108, Math 26B) Phinney, Gast

144. Principles of Petrology. Igneous and metamorphic mineral assemblages and textures discussed with reference to phase diagrams and physical processes. Summary of important petrologic problems. (3 cr; prereq 62; offered 1965-66 and alt yrs) Phinney

145.° Phase Equilibrium in Mineral Systems. Graphical and mathematical treatment of 1-, 2-, 3-, and 4-component systems. Includes the phase rule, open *vs.* closed systems and effects of disequilibrium. (3 cr; prereq 141, PCh 108 or 103; offered 1964-65 and alt yrs) Phinney

146.° Igneous Petrology. Fractional crystallization, disequilibrium, nucleation, assimilation, volatiles, granites, serpentines, and other problems in light of modern experimental data and theory. (3 cr; prereq 145; offered 1964-65 and alt yrs) Phinney

147.° Metamorphic Petrology. Solid state phase equilibrium, reaction rates, partial fusion, metasomatism, methods of graphical projection for several component systems, geologic thermometers, and the effect of nonhydrostatic stress. (3 cr; prereq 146; offered 1964-65 and alt yrs) Phinney

150. Principles of Geochemistry. Application of principles of thermodynamics to systems of geologic interest, with emphasis on aqueous solutions. (3 cr; prereq PCh 102 or 108 or ‡) Gast

151.° 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 142, PCh 103 or ‡; offered 1965-66 and alt yrs) Gast

152.° Problems in Geochemistry. Selected topics in geochemistry. (2 cr; prereq 151 or ‡; offered 1964-65 and alt yrs) Gast

155-156.° Mineral Deposits. Nature and distribution of mineral deposits, and analysis of processes by which elements are concentrated in magmatic, hydrothermal, sedimentary, and surface environments. (3 cr per qtr; prereq 120, 142, or ‡) James

157. Mineral Fuel Deposits. Origin and distribution of petroleum and coal deposits: source materials, reservoir rocks and structures, stratigraphic distribution of important deposits. (3 cr; prereq 110, 120 or ‡) Swain

160.° X-ray Mineralogy. Physics of X rays. Diffraction of X rays by crystalline material. Description of X-ray powder instruments. Use of powder pattern for mineral identification and for mineralogical and crystallographical research. (3 cr; prereq 140 or ‡) Zoltai

161.° Single Crystal X-ray Diffraction. Introduction to principles and practice of single crystal X-ray diffraction. Lattice and space group determination. Introduction to crystal structure determination. (2 cr; prereq 160 or ‡) Zoltai

162. Soil Mineralogy. Introduction to crystallography, crystal chemistry, and mineralogy. Descriptive and determinative mineralogy. Classification of rocks. Textural, structural, and mineralogical variations of rocks and some ores. Term paper. (4 cr; not open to geology, mining, and metallurgy majors; prereq 1 or 11 or ‡, a term of college chemistry) Zoltai, Phinney

245.° Research in Petrology. (Cr ar; prereq ‡) Phinney

246.° Seminar: Petrology. (Cr ar; prereq 145; offered when feasible) Phinney

250.° Research in Geochemistry. (Cr ar; prereq ‡) Gast

251.° Seminar: Geochemistry. (Cr ar; prereq ‡) Gast

255.° Advanced Mineral Deposits I. Ore genesis. Ore-forming processes considered in relation to major crustal units in space and time; geothermometry; physical and chemical nature of ore-forming solutions; additional or alternative topics when appropriate. (3 cr; prereq 156; offered 1965-66 and alt yrs) James

256.° Advanced Mineral Deposits II. Metalliferous districts. Interpretation of paragenetic relationships of ore minerals, using mineralographic, petrographic, and X-ray methods. (3 cr; prereq 156 or ‡) Sims, James

257.° Research in Mineral Deposits. (Cr ar; prereq ‡) James

258.° Seminar: Mineral Deposits. (Cr ar; prereq ‡) James

260.° X-ray Crystallography. Introduction to geometrical and mathematical principles of crystal structure determination. Principles and techniques of various methods. (3 cr; prereq 161 or ‡; offered on demand) Zoltai

261.* **Research in Mineralogy and Crystallography.** (Cr ar; prereq ‡) Zoltai

262.* **Seminar: Mineralogy and Crystallography.** (Cr ar; prereq ‡) Zoltai

Geophysics

170. Introduction to Earth Physics. Physics of the solid earth; evidence and data on origin, age, size and shape, internal constitution, thermal history, gravity, and magnetic fields. (3 cr; prereq 2 or 22, Phys 9 or 14)

171. Introduction to Earthquake Seismology. Physics and geology of earthquakes; causes, effects distribution, seismic waves. (3 cr; prereq 120 or ‡)

172. Introduction to Exploration Geophysics. Principles of exploration by gravity, magnetic, seismic, and electrical measurements. (3 cr; prereq 2 or 22, Phys 9 or 14)

175. Principles of Gravity and Magnetic Exploration. Instrumentation, surveying techniques, reduction of data, interpretation, case histories. (3 cr; prereq 1 or 11, Phys 9 or 14, Math 25B)

176. Principles of Seismic Exploration. Reflection and refraction seismology; theory, interpretation, instruments. (3 cr; prereq 2 or 22, Phys 9 or 14, Math 25B)

177. Principles of Electrical Exploration. Resistivity, electromagnetic, and other methods; theory, interpretation, instruments. (2 cr; prereq 2 or 22, Phys 9 or 14, Math 25B)

270-271. Theory of Elastic Wave Propagation. Theoretical seismology, solutions of wave equations, normal mode propagation. (3 cr per qtr; prereq MM 180...Math 174 recommended but not required) Mooney

275-276-277. Seminar: Geophysics. (Cr ar; prereq ‡) Staff

GERMAN

Professor
Edwin F. Menze
Herman Ramras
Frank H. Wood

Associate Professor
Frank D. Hirschbach
Wolfgang F. Taraba
Gerhard H. Weiss
Cecil Wood

Prerequisites—For major work, 27 Upper Division quarter credits or equivalent of which 15 credits must be in literature courses. For minor work, 18 Upper Division quarter credits or equivalent.

Language Requirement—A candidate for the Master's degree must have a reading knowledge of at least one foreign language other than German, preferably French.

A candidate for the Doctor's degree in German must have a knowledge of Latin equivalent to at least 2 years of high school Latin; a reading knowledge of French and one other modern foreign language.

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

Doctor's Degree—Normally candidates are expected to offer 18 credits in linguistics and philology.

A minor in linguistics and philology will require at least 27 credits. Majors in German literature may, however, offer a combined minor by offering 18 credits in linguistics and philology and 12 or more in one of the following: classics, English literature, fine arts, foreign literature, comparative literature, history, philosophy. In any case, it is strongly recommended that candidates in German literature supplement their major by courses chosen from one or more of these fields.

Comparative Literature—For information on this program see page 95.

Composition and Bibliography

103-104-105.‡ German Syntax and Composition. Required of all graduate majors. (1 cr per qtr: prereq 66 or equiv)

133f. Bibliography and Research Methods. Required of all graduate majors. (3 cr; prereq 11 cr above 69)

Literature

Courses in literature, as well as linguistics and philology, for which no specific years are indicated are offered more flexibly to meet the needs of the students in the program and are listed in the quarterly *Class Schedule.*

116-117.‡ 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) Menze

143-144-145.°‡ The German Novelle: From Goethe to Kafka. (3 cr per qtr) Taraba

146-147-148.°‡ Studies in the Literature of the Nineteenth Century. Literature, literary movements and influences represented in drama, lyric and shorter prose forms. (3 cr per qtr)

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.°‡ Klopstock, Wieland, Herder. (3 cr per qtr) Ramras

162A-B.° Lessing. (3 cr per qtr) Hirschbach

163-164-165.°‡ Goethe. (3 cr per qtr) Ramras

166-167-168.°‡ Schiller. (3 cr per qtr) Ramras

170-171-172.°‡ Romanticism. (3 cr per qtr) Menze

173-174-175.°‡ The Nineteenth-Century Novel. (3 cr per qtr) Menze

176-177-178.°‡ The Nineteenth-Century Drama. (3 cr per qtr) 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 pr 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) 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) C Wood

112. History of the German Language. (3 cr; prereq 111) C Wood

157-158-159.† Old Norse Language and Literature. (3 cr per qtr; prereq knowledge of one Germanic language other than modern English) C Wood

Germanic Linguistics

107-108-109.† The Structure of Modern German. Linguistic approach to study of structure of present-day German. (3 cr per qtr) C Wood

113. Gothic. (3 cr; prereq 80 and 11 cr in courses 70 and above or equiv) C Wood

114-115.† Methods of Comparative Germanic Linguistics. (3 cr per qtr; prereq 113) C Wood

119. Old High German. (3 cr; prereq 112 or 115) C Wood

120. Old Saxon. (3 cr; prereq 119) C Wood

121. The Hildebrandslied. (3 cr; prereq 119 and 120) C Wood

HISTORY

Professor
Harold C. Deutsch, *chairman*
Clarke A. Chambers
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
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.
Erle V. Leichty
Darrett B. Rutman
Theofanis G. Stavrou
Romeyn 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 two or three of the following areas or periods: Ancient, European, English, American, and Asian; (b) a minimum of two full-year advanced or Upper Division courses (or their equivalent) in two of these areas or periods, including (c) at least one course in which intensive work has been done.

A student who minors in history must have completed approximately the same amount of 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. Reading knowledge of one foreign language is required before admittance to the Master's examination and of two languages before admittance to the preliminary examinations for the Ph.D. The languages must be relevant to the degree and must be ones in which there is a substantial historical literature.

Adviser—A candidate for the M.A. or Ph.D. degree is free to choose his adviser from among the members of the graduate faculty of the department. A candidate unfamiliar with the department or uncertain of his interests should consult 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 one subfield and an associated subarea or two subareas comparable to those required for the Ph.D. (A list of subareas may be obtained from the History Department office.) He will also present a thesis. A minimum of 24 credits in the major and 9 credits in the minor are required. There shall be a final written examination covering the two subareas selected plus an oral examination covering the thesis, the major, and the minor.

PLAN B—The student's program of study shall be planned in consultation with his adviser. The student is expected to register for courses that will eventuate in a balanced training both in the general field of history and in supporting fields. One of the courses in history carrying at least 9 credits shall be a seminar or proseminar.

Doctor's Degree in History

The student working toward the Ph.D. degree in the field of history (with the exception of the student in ancient history as noted below) must be prepared to 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 three of these subareas will fall within the subfield of the student's concentration (in which he will also write his dissertation) and two subareas in two other subfields. The student's program of study and the selection and definition of his subfield and subareas must be arranged in consultation with his adviser.

A student specializing in ancient history shall present the three subareas of the Old Orient, Greece, and Rome, as well as the subfield of medieval history with one subarea.

Preliminary Examination—The preliminary examination shall cover the subfield, the subareas in history, and the minor. The written examinations may be taken the first week in November, the first week in February, and the first week in May. At the discretion of the adviser, who will consult with the appropriate members of the faculty, a student may be excused from the written examination in one subarea within the subfield of concentration. The oral examination must follow immediately after the written examination. In both the written and oral examinations the student will be required to demonstrate a general knowledge of the subfield and a detailed knowledge of the subareas for which he is responsible.

Final Examination—The final oral examination shall cover the dissertation and its relationship to the subfield of history in which it falls.

Minor in History—The candidate for the M.A. degree with a minor in history (Plan A) must take a minimum of 9 credits and be examined in one subarea of history.

The candidate for the Ph.D. degree with a minor in history must be prepared for written and oral examinations in either (a) one subfield of history and an associated subarea, or (b) two subareas. The number of course credits required for a minor in history is flexible (18-24) and will depend upon the needs and the previous training of the candidate.

All minor programs must be approved by a member of the graduate faculty of the department.

SPECIAL COURSES

100Bf-101Bw-102Bs. Directed Study. Qualified senior and graduate students may register for 1 or more quarters with consent of instructor for work and training on a tutorial basis. (3 cr per qtr; prereq #) Staff

LECTURE COURSES

103Af-104Aw-105As.‡ The Ancient Near East. (3 cr per qtr) Leichty

103Bf-104Bw-105Bs.‡ Greece to 200 B.C. (3 cr per qtr; offered 1965-66 and alt yrs) Jones

103Cf-104Cw-105Cs.‡ History of Rome. (3 cr per qtr; offered 1964-65 and alt yrs) Jones

106Af-107Aw-108As.‡ Europe in the Early Middle Ages. 106A: Reforms of Diocletian to first sack of Rome (410). 107A: Age of the Fathers to Carolingian Empire. 108A: Germanic Empire to end of Investiture Controversy. (3 cr per qtr) Morrison

106Bf-107Bw-108Bs.‡ Europe in the High Middle Ages. 106B: Twelfth-century revival. 107B: Medieval civilization. 108B: Rise of Western monarchies, decline of papacy and empire. (3 cr per qtr) Hoyt

106Cf-107Cw-108Cs.‡ Europe in the Late Middle Ages, Renaissance and Reformation. 106C: Later Middle Ages and early Italian Renaissance (1300-1450). 107C: High Renaissance (1450-1515). 108C: Reformation (1515-1560). (3 cr per qtr) Giesey

109Af-110Aw-111As.‡ Byzantine History. 109A: Later Roman Empire from accession of Diocletian to death of Justinian in A.D. 565. 110A: Rise of Byzantium to its zenith at the accession of Basil II in 976. 111A: From reign of Basil II to fall of Constantinople in 1453. (3 cr per qtr; offered when feasible)

112Af-113Aw-114As.‡ English Constitutional History to 1485. 112A: Anglo-Saxon and Anglo-Norman England. 113A: From Henry II to Edward I. 114A: England in the later Middle Ages. (3 cr per qtr) Hoyt

115Af-116Aw-117As.‡ Early Modern Europe. 115A: Reformation and religious wars. 116A: 17th century. 117A: 18th century. (3 cr per qtr) Wolf

115Bf-116Bw-117Bs.‡ French Revolution and Napoleon. 115B: Background and emergence of the Revolution. 116B: The Revolution and revolutionary wars, and the emergence of the Napoleonic Empire (1789-1806). 117B: Struggle to stabilize the Empire and its disintegration under nationalist assaults. (3 cr per qtr; offered when feasible) Bamford

115Cw-116Cs.‡ Europe in the Nineteenth Century. 115C: Reaction and Revolution (1815-1852). 116C: National unification, industrialization, and imperialism (1852-1900). (3 cr per qtr) Pflanze

115Df-116Dw-117Ds.‡ Europe in the Twentieth Century. 115D: 1890-1918. 116D: 1918-1938. 117D: 1938 to the 1950's. (3 cr per qtr) Munholland

115Ef-116Ew-117Es.‡ World War II. 115E: Origins and background. 116E: War period, 1939-1942. 117E: Period 1943-1945. (3 cr per qtr) Deutsch

118Af-119Aw.‡ Modern France. 118A: Political, social, and economic history of France from Vienna settlement to establishment of Third Republic. 119A: Struggle of Third and Fourth Republics to meet challenge of 20th century. (3 cr per qtr; prereq 9 cr, or 15 cr in social science, or major in French; offered when feasible)

118Bf-119Bw-120Bs.‡ Modern History of Spain. Spain and Portugal in the modern period: politics, diplomacy, social, economic, and cultural problems. 118B: 1400-1700. 119B: 1700-1898. 120B: The 20th century. (3 cr per qtr; offered when feasible)

118Cf-119Cw-120Cs.‡ History of Germany. 118C: From 911 to 1648. 119C: 1648-1871. 120C: Since 1871. (3 cr per qtr) Pflanze

118Df-119Dw-120Ds.‡ Central Europe. Poland, Hungary, Czechoslovakia. 118D: Bohemia, Poland, and Hungary to the 18th century. 119D: 18th century to 1867. 120D: 1867 to the present. (3 cr per qtr; prereq 3) Wright

118Ef-119Ew-120Es.‡ Russia. 118E: Origins of the Slavs, the eastward movement, and the rise of Russia through the death of Peter the Great. 119E: The Empire after Peter the Great to the 19th century. 120E: 19th century to the end of the Empire. (3 cr per qtr) Uroff

118Ff-119Fw-120Fs.‡ Modern Russia. 118F: The 19th-century background, reign of Nicholas II to 1914. 119F: 1914-1929, World War I, revolutions, civil war, new economic policy. 120F: The Soviet regime from 1929 to the present. (3 cr per qtr) Stavrou

118Gf-119Gw-120Gs.‡ The Modern Near East: The Balkans and the Arab World. 118G: From the fall of Constantinople (1453) to the Treaty of Jassy (1792). 119G: From the Treaty of

Jassy to the Congress of Berlin (1878). 120G: From the Congress of Berlin to the present. (3 cr per qtr) Stavrou

121Af-122Aw-123As.‡ Economic History of Europe. 121A: Economic life in medieval times. 122A: Economic developments in the early modern world. 123A: Economic developments since 1750. (3 cr per qtr) Bamford

121Bf-122Bw-123Bs.‡ European Overseas Expansion. 121B: Voyages of discovery and overseas expansion, 1400-1600. 122B: Colonial development, 1600-1815. 123B: Imperialism since 1850. (3 cr per qtr; offered when feasible) Stein

121Cf-122Cw-123Cs.‡ Intellectual and Cultural History of Modern Europe. 121C: The 18th century and its background. 122C: The early 19th century, romanticism and liberalism. 123C: The late 19th and early 20th centuries, the breakdown of the intellectual unity of Europe. (3 cr per qtr; offered 1964-65 and alt yrs) Altholz

124Af-125Aw-126As.‡ Modern England: Tudor and Stuart Periods. 124A: 1485-1588, from Henry VII to defeat of Spanish Armada. 125A: 1588-1642, from Spanish Armada to English civil wars. 126A: 1642-1714, from civil wars to death of Queen Anne. (3 cr per qtr; offered 1964-65 and alt yrs) Willson

124Cf-125Cw-126Cs.‡ Modern England: 1783 to the Present. 124C: 1783-1846, triumph of the middle class. 125C: 1846-1901, Victorian era. 126C: 1901-1951, war and social change. (3 cr per qtr; offered 1965-66 and alt yrs) Altholz

127Af-128Aw-129As.‡ Modern England: Social History. 127A: Age of Queen Elizabeth I. 128A: The 18th century. 129A: Age of Queen Victoria. (3 cr per qtr; offered 1965-66 and alt yrs) Willson

130Af-131Aw-132As.‡ History of the British Empire and Commonwealth. 130A: First empire to 1783. 131A: Second empire, 1783-1914. 132A: Development of the Commonwealth. (3 cr per qtr; offered when feasible) Stein

133Cf-134Cw-135Cs.‡ The Early National Period in United States History. 133C: 1783-1815. 134C: 1815-1835. 135C: 1835-1850. (3 cr per qtr) Jordan

133Ef-134Ew-135Es.‡ American History, 1850-1900. 133E: Compromise of 1850 to Appomattox. 134E: 1865-1880. 135E: 1880-1900. (3 cr per qtr) Loehr

136Af-137Aw-138As.‡ History of the South. 136A: 1607-1840. 137A: 1840-1890. 138A: Since 1890. (3 cr per qtr) Noble

139Af. Current Interpretation and the Problem of Synthesis in American History. Acquaints students with current scholarship in the field and its implications for general interpretation of American history. (3 cr; prereq ‡; offered when feasible) Berkhofer

139Cf-140Cw-141Cs.‡ Intellectual History of the United States. (3 cr per qtr) Noble

139Df-140Dw-141Ds.‡ 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. 139D: Colonial period. 140D: The 19th century. 141D: The 20th century. (3 cr per qtr; prereq 20, 21, 22 or ‡) T Smith

139Ef-140Ew-141Es.‡ Social History of American Education. (See HEd 149-150-151) Impact of education on social and institutional developments, colonial period to present. "Education" is defined to include not only work of schools but family, community, and popular press. (3 cr per qtr; prereq 20, 21, 22 or ‡) T Smith

139Ff-140Fw-141Fs.‡ American Constitutional History. 139F: English and colonial background through the Age of Jefferson. 140F: Slavery controversy, sectionalism, Civil War and Reconstruction. 141F: Constitutional developments in an industrial age. (3 cr per qtr) Murphy

139Gf-140Gw-141Gs.‡ History of Civil Liberties and Civil Rights in the United States. 139G: From Magna Charta through colonial and national experience. 140G: Civil liberties and the challenge of industrialism, 1865-1918. 141G: Civil liberties and civil rights issues in modern context. (3 cr per qtr) Murphy

142Af-143Aw-144As.‡ American Economic History. 142A: Colonial life. 143A: From American Revolution to 1860. 144A: Developments since 1860. (3 cr per qtr) Loehr

142Bs. American Agricultural History. Colonial times to present. (3 cr) Loehr

142Cf-143Cw-144Cs.‡ History of American Labor. Role in development of United States from colonial period to present. 142C: 1607-1873. 143C: 1873-1917. 144C: 1917 to present. (3 cr per qtr) Berman

145Af-146Aw-147As.‡ Survey of Latin-American History. 145A: Colonial period. 146A: Latin-American republics. 147A: Recent Latin-American history. (3 cr per qtr) Beatty

148Af-149Aw-150As.‡ History of South Asia, Especially India. 148A: Ancient India to A.D. 1000. 149A: Medieval India, A.D. 1000-1757. 150A: Modern India, 1757-1947. (3 cr per qtr) Stein

148Bf-149Bw-150Bs.‡ History of China, Prehistoric Times to Present. 148B: To 221 B.C. 149B: 221 B.C. to A.D. 1279. 150B: A.D. 1279-1949. (3 cr per qtr) Taylor

148Cf-149Cw-150Cs.‡ 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. 148C: 1851-1911. 149C: 1911-1927. 150C: 1927-1949. (3 cr per qtr; offered when feasible) Taylor

151Af-152Aw.‡ Cultural History of China. 151A: Prehistoric times to A.D. 600. 152A: A.D. 600 to the present. (3 cr per qtr; prereq ¶Art 111 recommended; offered when feasible)

PROSEMINARS IN ANCIENT AND EUROPEAN HISTORY

160Af-161Aw-162As.† Ancient History. (3 cr per qtr) Jones

160Bf-161Bw-162Bs.† Ancient History. (3 cr per qtr) Leichty

163Af-164Aw-165As.† Medieval History. (3 cr per qtr) Hoyt

163Cf-164Cw-165Cs.† Renaissance History. (3 cr per qtr) Giesey

166Af-167Aw-168As.† Medieval English History. (3 cr per qtr) Hoyt

169Cf-170Cw-171Cs.† Europe in the Eighteenth Century. (3 cr per qtr) Wright

169Ef-170Ew-171Es.† Recent European History. (3 cr per qtr; prereq lect course in 20th-century Europe or World War II, or #) Deutsch

172Af-173Aw-174As.† Seventeenth-Century France. (3 cr per qtr; prereq reading knowledge of French) Wolf

172Cf-173Cw-174Cs.† French Revolution and Napoleon. (3 cr per qtr) Bamford

172Df-173Dw-174Ds.† Nineteenth-Century Germany. (3 cr per qtr; prereq reading knowledge of German, #) Pflanze

172Ff-173Fw-174Fs.† Russian History. (3 cr per qtr; prereq 120E and reading knowledge of Russian, German, or French, or #) Stavrou

175Af-176Aw-177As.† European Economic History Since 1500. (3 cr per qtr) Bamford

175Bf-176Bw-177Bs.† History of European Commerce. (3 cr per qtr) Bamford

175Ff-176Fw-177Fs.† Religious History of Modern Europe. (3 cr per qtr; offered 1965-66 and alt yrs) Altholz

178Af-179Aw-180As.† English History: Tudor and Stuart Periods. (3 cr per qtr) Willson

178Cf-179Cw-180Cs.† Modern England: 1783 to the Present. (3 cr per qtr; offered 1964-65 and alt yrs) Altholz

PROSEMINARS IN THE HISTORY OF THE AMERICAS

181Af-182Aw-183As.† Seventeenth- and Eighteenth-Century American History. (3 cr per qtr) Rutman

181Df-182Dw-183Ds.† Nineteenth-Century American History. (3 cr per qtr) Jordan

181Ff-182Fw-183Fs.† American History, 1850-1900. (3 cr per qtr; offered 1965-66 and alt yrs) Loehr

181Jf-182Jw-183Js.† Twentieth-Century American History. (3 cr per qtr) Chambers

184Af-185Aw-186As.† The West in American History. (3 cr per qtr; offered 1965-66 and alt yrs) Berkhofer

187Af-188Aw-189As.‡ American Political and Constitutional History. (3 cr per qtr; prereq 139F-140F-141F or #) Murphy

187Bf-188Bw-189Bs.† American Diplomatic History. (3 cr per qtr; offered 1965-66 and alt yrs) Beatty

187Df-188Dw-189Ds.† Intellectual History of United States in Nineteenth, Twentieth Centuries. (3 cr per qtr) Noble

187Ff-188Fw-189Fs.† American Labor History. (3 cr per qtr) Berman

187Gf-188Gw-189Gs.† American Economic History. (3 cr per qtr; offered 1964-65 and alt yrs) Loehr

190Af-191Aw-192As.† Latin-American History. (3 cr per qtr; prereq reading knowledge of Spanish; offered when feasible) Beatty

PROSEMINARS IN ASIAN HISTORY

193Bf-194Bw-195Bs.† History of India. (3 cr per qtr) Stein

193Cf-194Cw-195Cs.† Chinese History. (3 cr per qtr; prereq 2 yrs 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

200f. Historical Bibliography and Criticism. (3 cr)

203f-204w-205s.‡ Readings in the Works of Great Historians. (2 cr per qtr) Giesey, Rutman, Staff

210Af-211Aw-212As.† Ancient History. (3 cr per qtr) Jones

213Af-214Aw-215As.† Medieval History. (3 cr per qtr) Hoyt

213Cf-214Cw-215Cs.† Renaissance History. (3 cr per qtr) Giesey

216Af-217Aw-218As.† Medieval English History. (3 cr per qtr) Hoyt

219Ef-220Ew-221Es.† Recent European History. (3 cr per qtr) Deutsch

222Af-223Aw-224As.† Seventeenth-Century France. (3 cr per qtr) Wolf

222Df-223Dw-224Ds.† Nineteenth-Century Germany. (3 cr per qtr) Pflanze

222Ff-223Fw-224Fs.† Russian History. (3 cr per qtr) Stavrou

225Af-226Aw-227As.† European Economic History. (3 cr per qtr) Bamford

228Af-229Aw-230As.† English History, Tudor-Stuart Period. (3 cr per qtr) Willson

231Af-232Aw-233As.† Seventeenth-Century American History. (3 cr per qtr) Rutman

231Df-232Dw-233Ds.† Nineteenth-Century American History. (3 cr per qtr) Jordan

231Ff-232Fw-233Fs.† American History, 1850-1900. (3 cr per qtr) Loehr

231Jf-232Jw-233Js.† Twentieth-Century American History. (3 cr per qtr) Chambers

234Af-235Aw-236As.† The West in American History. (3 cr per qtr) Berkhofer

237Af-238Aw-239As.† American Political and Constitutional History. (3 cr per qtr) Murphy

237Bf-238Bw-239Bs.† American Diplomatic History. (3 cr per qtr) Beatty

237Df-238Dw-239Ds.† Intellectual History of the United States in the Nineteenth and Twentieth Centuries. (3 cr per qtr) Noble

237Ef-238Ew-239Es.† American Social and Educational History. (See HEd 296-297-298) (3 cr per qtr) T Smith

237Ff-238Fw-239Fs.† American Economic History. (3 cr per qtr) Loehr

237Gf-238Gw-239Gs.† American Labor History. (3 cr per qtr) Berman

240Af-241Aw-242As.† Latin-American History. (3 cr per qtr) Beatty

243Bf-244Bw-245Bs.† History of India. (3 cr per qtr) Stein

HOME ECONOMICS

Professor

Louise A. Stedman
Marjorie M. Brown
Marguerite C. Burk
Suzanne Davison
Florence A. Ehrenkranz
Gertrude Esteros
Roxana R. Ford
Isabel T. Noble
Robert J. Sirny
Murray A. Straus

Associate Professor

Margaret D. Doyle
Lura M. Morse

Assistant Professor

Irving Tallman

Graduate programs are planned individually with students. The major work may be in one particular field of concentration within home economics or of a more generalized nature. Minor work may be taken in any of a number of other disciplines within the University.

Prerequisites—Students desiring to major in home economics must present undergraduate credits in social sciences, physical sciences, biological sciences, art, and education as shall be satisfactory to the adviser under whose direction the major work is to be done. In addition the student must have adequate undergraduate training in that subfield of home economics in which she wishes to specialize.

Major and Minor—Students majoring in home economics for a Master's or a Doctor's degree and those minoring in this field for the Doctor's degree must include one of the following: 209, 229, 249, 279, 289, 290.

Language Requirement—Candidates for the Master's degree under Plan B are exempted from the foreign language requirement. Under Plan A, one language is recommended but not required (French or German is acceptable). Another language might be offered by petition. Candidates for the Ph.D. degree may submit (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge.

Master's Degree—Offered under both Plan A and Plan B. The M.A. as well as the M.S. may be earned in home economics.

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

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, BioC 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, BioC 1A or OrCh 42, GeCh 6, 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. Lectures by instructor and practicing professional artists, field trips, selected readings. Areas from which selection will be made for class discussion and individual study: architecture (including interior design—homes and public buildings), gardens, painting, sculpture, ceramics, music, theater, costume, and food. (2-3 cr) Esteros

120x.* Art History. Egyptian period to the present. Painting, sculpture, and architecture of the past studied for influences on contemporary period. Field trips. (3 cr) 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 media; color schemes planned with fabrics. Intensive study of color and fabrics. Studies and reports on trends in interior design, contemporary designers and their contributions to the home furnishings field, other topics of practical and historic interest. Field trips to shops, buildings, and homes. (3 cr; prereq 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 water color techniques, studies and reports on selected topics. (3 cr; prereq 3, 22, or ‡) Esteros

126x.* Special Problems in Crafts. Advanced study in an area of crafts; weaving, enameling, leatherwork, metalwork, or other. One area may be studied or a combination of two or more. (2-3 cr per qtr, max 6 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 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, ‡) Ehrenkranz

134. Consumer Selection Guides for Household Equipment. Important construction and operating components of current models of selected appliances. Suitability of appliances for kitchen and laundry plans that meet research-based recommendations. (3 cr; prereq 49 or equiv, 86 or equiv, 3 cr in related art, and 1 yr exper in tchg, extension, or business or ‡)

137. Modern Food Preparation Principles and Practices. Experimental bases of principles underlying present-day food preparation practices; development of experiences illustrative of such principles in high school teaching, dietetics, and foods in business. (3 cr; prereq 15 cr in food and nutrition, organic chemistry) Noble

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...73 recommended) Noble

141. Current Literature in Foods. Lecture and discussion. (3 cr; prereq 40 or equiv) Lund

142x. Experimental Cookery. Intensive study of food problems and food preparation; individual laboratory problems. (3 cr; prereq 40, BioC 1A) Noble

144x. Topics in Experimental Foods. Assigned readings, reports, and discussions. (2-3 cr per qtr, max 6 cr; prereq OrCh 42 or equiv, 15 cr in food and nutrition) Noble

146. Special Food Problems. (3 cr; prereq 142) 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

153. Recent Developments in Clothing Construction. (Workshop) Discussion, demonstration, and laboratory work emphasizing management of time and materials and newer construction techniques. (3 cr; prereq 53 or ‡) 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

164. Design and Layout of Food Services. Problems related to remodeled and new food services. (4 cr; prereq 41, 49, 63, or equiv, general physics course, ‡) Hitchcock

166. Development in Quantity Food Production. Recent trends in quantity food products and production from management viewpoints; quality, yield, and related costs. (3 cr; prereq 67, 63, ‡) Hitchcock

167. Food Service Organization and Management. Management techniques applied to food services. Methods of analysis and control. (3 cr; prereq 63, 3 cr elementary statistics, 6 cr economics) Hitchcock

169. Special Problems in Food Service Administration. Readings, discussion, field work. (3 cr; prereq 67 and ‡) Hitchcock

170x. Nutritional Principles. Application in promotion of optimal health. (3 cr; prereq 31, 40, BioC 1A, Phsl 51) 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, BioC 1A, Phsl 51 or ‡) Sirny

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, GeCh 6, AnCh 57) Morse

176. Advanced Nutrition. Quantitative methods applicable to investigation relating to digestion and metabolism. (4 cr; prereq 35 or ¶35, GeCh 6, AnCh 57) 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. Survey of literature in the field; oral and written reports. (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. Problems of 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 85, or ‡) Burk

187. Readings in Family Relationships. Independent study in selected areas with faculty conferences. (1-3 cr, max 3 cr; prereq ‡) Straus, Tallman

188. Evaluation of Food Quality. Subjective and objective methods used in measuring quality of food products. (3 cr; prereq BioC 1A, GeCh 6, AnCh 57, HE 142, Biom 90 or 100) Noble

189A. Construction and Use Characteristics of Ranges, Refrigerators, and Freezers. (3 cr per qtr; prereq 131) Ehrenkranz

189B. Construction and Use Characteristics of Washers, Dryers, Water Heaters, Water Softeners. Kitchen and laundry area planning. (3 cr per qtr; prereq 131, 189A, ‡) Ehrenkranz

189C. Construction and Use Characteristics of Selected Electric and Nonelectric Appliances and Housewares. (3 cr per qtr; prereq 131, 189A, 189B, and ‡) 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 psychology, psychology, and/or sociology) Straus

195. Development of Home Economics. Current problems. (2 cr) Stedman

197. Applications of Art Theory in Home Economics. Current theories of art with implications for home and family living. (3-4 cr; prereq 180 or equiv) Esteros

201. Readings in Textiles and Clothing. Independent study—survey of literature in selected areas. Written reports. (1-3 cr; prereq 102, 115, or 116, ‡) Davison

202x. Animal Fibers. Structure, composition, properties, and special problems of manufacture of wool, silk, and other protein and protein-like fibers in relation to use. (2 cr; prereq advanced textiles, ‡; offered when demand warrants) Davison

204x. Plant and Other Cellulosic Fibers. Structure, composition, properties, and special problems of manufacture of cotton, flax, rayon, and certain minor and chemically manufactured fibers in relation to use. (2 cr; prereq botany, advanced textiles, ‡; offered when demand warrants) Davison

208s. Microanalysis of Textile Fibers. Histological and microchemical methods. (Cr ar; prereq botany, zoology, advanced textiles, ‡) Davison

209x.* Seminar: Textiles and Clothing. Reviews and interpretations of the literature of this field, emphasizing recent advances. Individual oral and written reports. (1 cr; prereq ‡) Davison

220x.* Readings in Related Art. Independent study and review of books and periodicals. Written reports. (1-3 cr; prereq ‡) Esteros

221. Special Problems in Textile Design. Advanced study in textile design such as in silk screen, block printing, or batik. (1-3 cr; prereq 121 or ‡) Esteros

227x.* Special Problems in Home Planning and Furnishing. Independent study and reports. (1-3 cr; prereq 180 or ‡...122B recommended) Esteros, Ludwig

229x.* Seminar: Related Art. Review and discussion of recent literature and materials in art significant for home economics; reports on art problems in home economics. (1 cr) Related Art graduate staff, Esteros

246. Developments in Experimental Foods. Scientific basis for generally accepted principles of food preparation, contemporary interpretations of changes produced in food by household practices, food acceptance testing. (3 cr; prereq 20 cr in food and nutrition, 142, organic chemistry, microbiology, ‡) Noble

247. Special Food Problems. Review of recent research in experimental foods. (3 cr; prereq 142, BioC 1, ‡) Noble

249x.* Seminar: Foods. Review and interpretation of the literature. (1 or 2 cr; prereq ‡) Noble

270-271. Principles of Human Nutrition. Digestion, metabolism, excretion, and food requirements under various conditions. (3 cr per qtr; prereq 170, ‡) 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: Nutrition. Review and interpretation of the literature. Recent advances. Individual oral and written reports. (1 cr; prereq ‡) Sirny

289. Seminar: Household Equipment. Reference sources and research reports on recent and current work in home lighting, kitchen and laundry planning, and selected electric and nonelectric appliances. Student becomes familiar with available literature in household equipment and develops judgment in interpreting it in areas not covered in 189. (2 cr; prereq 6 cr in 189) Ehrenkranz

290. Seminar: Home Management and Family Relationships. Review and interpretation of current research in the social sciences bearing on the family. (1-2 cr; prereq 185, statistics) Burk, Straus

295x-296x.* Home Economics Problems. Foods, nutrition, textiles and clothing, home management and family relationships, household equipment, and related art. Independent study and written reports. (1-5 cr per qtr; prereq ‡) Staff

HORTICULTURAL SCIENCE

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

Associate Professor
Emil T. Andersen
Florian I. Lauer
John C. Weiser
Richard E. Widmer

Assistant Professor
Donald B. White
William R. Andersen
Robert Mullin

Prerequisites—For a major in horticultural science a student must have completed a sufficient amount of work in plant sciences to satisfy the adviser that gradu-

ate study in this field may be satisfactorily undertaken. In certain cases further foundation courses may be required without credit.

Major—With the approval of the adviser, courses in closely related fields may be accepted as part of the major work.

Language Requirement—For the Master's degree under Plan A, one foreign language is required (German, French, Spanish, Italian, Japanese, or one of the Scandinavian languages). The graduate committee may, in individual cases, waive the requirement by petition. Under Plan B a foreign language is not generally required. For the Doctor's degree this requirement may be fulfilled, with the approval of the adviser, by (a) two foreign languages or (b) one foreign language and either a special research technique or a collateral field of knowledge. When two languages are offered acceptable combinations are German, Scandinavian, Russian, or Japanese *with* French, Spanish, or Italian.

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

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

104. Frozen Food Processing and Storage. Technology of food preservation by freezing. Changes occurring during handling, freezing, and storage. Application to processing, packaging, distribution, and storage. (3 cr; prereq BioC 5 or 6 or 10, MicB 53, or ‡) Munson

105. Frozen Food Problems. Special problems based on work in 104. (2-4 cr per qtr with 9 cr total; prereq 104 or ‡) Munson

107. Orchard Management. Cultural operations in orchards and berry fields. (3 cr; prereq 6, horticultural science majors or minors, or ‡; offered 1964-65 and alt yrs) E T Andersen

110. Horticultural Crop Breeding. Principles of plant improvement; breeding methods used with vegetables, fruits, and ornamentals. (3 cr; prereq Agro 30) Mullin

111. Systematic Pomology. Fruit varieties. Classification, description, identification, and elements of judging. (3 cr; prereq 6, horticultural science majors or minors or ‡; offered 1965-66 and alt yrs) E T 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 1965-66 and alt yrs) W R Andersen

132. Landscape Materials and Design. (Lecture, laboratory, and field trips) Systematics, identification, and site requirements of common woody landscape plants. Principles of landscape design as applied to urban and rural homes. (3 cr; prereq ‡) Mullin

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 1965-66 and alt yrs) Turnquist

137. Advanced Plant Propagation. Lecture and laboratory. Basic concepts, theory, and techniques involved in propagating plants from seeds, cuttings, grafts, buds, layers, and division. In laboratory, students design and conduct propagation experiments on plants or techniques of special interest. (3 cr, §36; prereq Bot 51 or BioC 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 1964-65 and alt yrs) Nylund

139. Nutrition of Horticultural Plants. Lectures and assigned reading on relation of nutrients, including water, to growth and culture of horticultural plants. (3 cr; prereq 15 cr in plant sciences incl 3 cr in plant physiology; offered 1965-66 and alt yrs) Nylund

140. Plant Growth Regulators. Physiology and agricultural technology of phytohormones and synthetic growth regulators in horticulture. Practical uses of such substances in control of fruit and leaf abscission, parthenocarpy, growth rate, growth habit, plant size, apical dominance, organ initiation, dormancy, germination, flowering, callusing, and others. Optional 1- or 2-credit laboratory. (3-5 cr; prereq 15 cr in plant science incl 3 cr in plant physiology) Weiser

141. Plant Hardiness. Physiological and physical bases of plant injury and survival as related to low temperature, high temperature, and drought. Physiology of fall hardening and low temperature survival. (3 cr; prereq 15 cr in plant science incl 3 cr of 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) White

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 1965-66 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 1965-66 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, Lauer

Agro 242x.* Seminar: Plant Breeding. (1 cr per qtr) Horticultural Science, Agronomy, and Plant Genetics staffs

Agro 246.* Seminar: Genetics. (2 cr) Horticultural Science staff and Genetics group

HOSPITAL ADMINISTRATION**

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

Associate Professor
E. Gartly Jaco, Ph.D.

Assistant Professor
Theodor J. Litman, Ph.D.

Lecturer
Vernon E. Weckwerth, Ph.D.

Prerequisites—Ordinarily the attainment of the professional degree master of hospital administration is an initial step toward acquiring the Ph.D. Students lacking the basic public health courses will be required to complete such courses concurrently with their doctoral program. Graduate work satisfactorily completed prior to entering the doctoral program may be applied where appropriate and in accordance with the regulations of the Graduate School.

Ph.D. Degree—Each student's program of study will be arranged individually with the guidance of his advisers and in accordance with Graduate School requirements. Each program will cover subject matter of the major field in the following three areas: (1) Organization and Administration of Hospitals and Related Health Services; (2) Social, Psychological, Economic, and Political Aspects of Health Services; and (3) Methodology of Hospital and Related Health Services Research.

** Inquiries concerning courses of study leading to the degree of master of hospital administration should be addressed to the School of Public Health, 1325 Mayo Memorial Building, University of Minnesota, Minneapolis, Minnesota 55455.

In addition, the student will achieve competency in social science fields particularly related to the major field. Especially recommended are economics, political science, psychology, and sociology. With the approval of his advisers, the student will complete one of the following requirements: (1) at least 24 credits in a coherent program of courses selected from the related social science fields; (2) all of the minor field requirements in one of the related social science fields or in two fields as a split minor in social science; or (3) a second major in one of the related social science fields. All candidates also will complete a minimum of 9 credits in courses in statistics numbered 100 or higher with the approval of his advisers.

For a more complete statement of admission requirements and related information, see the special bulletin published by the Program in Hospital Administration at the School of Public Health.

Language Requirement—A reading knowledge of two foreign languages or of one foreign language with the option of a research technique or a collateral field of knowledge.

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

PubH 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

PubH 162f. Principles of Organization and Management of Hospitals. Departmental structures and functions; organizational principles and practice. (3 cr) Stephan, Hamilton, Bieter

PubH 163w. Principles of Organization and Management of Hospitals. Departmental structures and functions; organizational principles and practice. (6 cr) Stephan, Hamilton, Bieter

PubH 164. Principles of Organization and Management of Hospitals. Personnel department; legal liability; fiscal management, hospital insurance, research in administration. (6 cr; prereq 162, 163) Stephan, Hamilton, Bieter

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

PubH 264f. Seminar: Medical Care Patterns Abroad. Readings, discussion, guest lecturers on relations between health services and other social institutions in different societies. (3 cr; prereq ‡) Litman

PubH 265s. Seminar: Research Studies on Health Services. Appraisal of design, instruments, field work procedures, and findings of contemporary studies. (3 cr; prereq ‡) Jaco, Litman, Weckwerth, and staff

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

PubH 267f,w. Health and Human Behavior. Social ecology of health; social and personal components of illness; health and the community; social and cultural aspects of health care services. (3 cr; prereq ‡) Jaco

PubH 269w. Political Aspects of Health Services. Analysis of interrelationships between government, politics, and health services; the political-social bases of health legislation and community decision-making in provision and modification of health services. (3 cr; prereq ‡) Litman

PubH 273f,w,s. Contemporary Problems of Hospital and Related Health Services. Current concepts, problems, principles, and future developments in hospital and related health services. (Cr ar; prereq ‡) Hamilton, Stephan, Jaco, and staff

PubH 274f,w,s. Readings in Theory and Principles of Hospital Administration. (Cr ar; prereq ‡) Hamilton, Stephan, and staff

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) 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) 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) 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

184f-185w-186s.° Advanced Hydraulic Problems. (2 cr per qtr; prereq 183 or ¶183 or ♯; offered when demand warrants) Staff

187f,s. Intermediate Fluid Mechanics. One- and two-dimensional flow of an ideal fluid, energy and momentum relations, fluid forces, boundary layer theory, separation and cavitation, hydrofoils. (3 cr; prereq 101 or 103 and 104) Ripken, Silberman, Song

188w. Intermediate Fluid Mechanics. Application of potential flow theory to hydromechanics problems. (3 cr; prereq 187) Silberman, Song

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

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, movable dams, harbors. (3 cr; prereq 183 or ♯) Anderson

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) Staff

287. Fluid Turbulence. Theory of turbulence with applications. (3 cr; prereq 187 or ♯; offered when demand warrants) Silberman, Song

290f-291w-292s. Advanced Fluid Mechanics. (3 cr per qtr; prereq 190 or ♯; offered when demand warrants) Silberman, Anderson

293f. Hydrodynamics. Survey of theory. (3 cr; prereq 187 and Math 151 or ♯) Silberman, Song

294w. Hydrodynamics. Viscous flow, laminar boundary layer, and stability. (3 cr; prereq 293 or ♯) Silberman, Song

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, Song

INDUSTRIAL RELATIONS

Professor
Herbert G. Heneman, Jr.
Marvin D. Dunnette
George W. England
Edward Gross
Lloyd Lofquist
Thomas A. Mahoney
George Seltzer
John G. Turnbull

Associate Professor
Rene Dawis
Jack Flagler
Cyrus Smythe

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. See department for specific requirements.

Language Requirement—There is no language requirement.

Doctor of Philosophy

A. *Admission*

Candidates seeking to major in industrial relations at the Ph.D. level must have a Bachelor's or Master's degree from a recognized college or university, show professional promise, take the Miller Analogies Examination, and offer a minimum of 30 credits of related course work in the social and behavioral sciences with the following minimums:

Economics	9 credits
Equivalent of IR 52 and IR 72	6 credits
9 credits in one of the following: anthropology, history, political science, psychology, or sociology	9 credits
6 additional credits in social or behavioral sciences and/or statistics	6 credits
	30 credits

B. *Requirements for the Ph.D. degree*

1. Although course work and study done in industrial relations will serve as the core of a Ph.D. program, each student will be expected to have a thorough mastery of more than one of the six designated related social or behavioral science disciplines (anthropology, economics, history, political science, psychology, sociology). If a student and his adviser feel that a student does not need a normal minor, then the Ph.D. program would be composed of the following:

Major Field:	Industrial Relations
Supporting Program:	At least 15 credits of course work in each of *two* of the six designated social or behavioral science fields.
Research Technique:	Completion of at least 9 credits in designated course sequences.
Foreign Language:	Reading knowledge of at least *one* foreign language.

a. Specific requirements in the major:

All students must pass written examinations in the following:

(1) Scope and Systems of Industrial Relations

(2) Research Methodology

(3) Choice of two of the following five subfields:

Compensation Theory and Administration
Manpower Resources and Allocation
Staffing, Training, and Development
Collective Bargaining
Organization Theory and Administration

A list of courses providing preparatory study for the examinations can be obtained from the Department of Industrial Relations. Generally one-third of the courses taken to prepare for examinations in the major field would be courses offered by other departments.

b. Supporting Program

A supporting program of study must include at least 15 credits of course work in courses numbered 100 or above in each of *two* of the six designated fields in the social and behavioral sciences (anthropology, economics, history, political science, psychology, and sociology). Course work used to satisfy a part of the major requirement or research technique cannot be used in the supporting program. The supporting program, like the normal minor, must be completed before the student is admitted to the preliminary examination.

c. Special Research Technique

Competence in a research technique is required of all candidates and is demonstrated by completion of a sequence of 9 credits of statistical analysis outside industrial relations, and must be completed before the student is admitted to the preliminary examination. A list of courses for this purpose, and for the research methodology requirement may be obtained from the department.

d. Language Requirement

For the Ph.D. degree, reading knowledge of at least *one* foreign language is required of all students. The foreign language requirement must be completed before a student can be admitted to the preliminary examination. The special research technique will take the place of the second language which is normally required of Ph.D. candidates.

2. If a student wishes to use a normal or traditional minor, he must increase work in one of the designated social or behavioral science fields from 15 credits to a full minor. Another social science field, taken from the six designated, must also be completed with a minimum of 15 credits of course work.

C. *General requirements*

Course work used to satisfy requirements in either the major, supporting program, minor, or special research technique may not be used again to satisfy requirements in any other areas of the student's Ph.D. program. Minimum acceptable grades in each of the areas of the Ph.D. program will be the same as those given in the General Information section of this bulletin; the industrial relations graduate faculty may require higher performance standards than those listed there.

Ph.D. Minor—Industrial relations may be selected as a minor or as part of a supporting program for the Ph.D. where it is associated with a major in one of the following fields: agricultural economics, business administration, economics, history, hospital administration, journalism, political science, psychology, and sociology with the exception that a student writing a dissertation in (a) business administration, subfield industrial relations, or (b) economics, subfield labor economics, may not use industrial relations as the minor for the Ph.D.

The minor program is intended to be flexible and is designed to take into account the student's educational objectives, needs, and background. Courses in the minor program will be selected by the minor adviser in consultation with the student. Additional information can be obtained from the advisers listed above or the Department of Industrial Relations.

142. Settlement of Industrial Relations Disputes. The nature of industrial conflict in employment relations; stresses contributing to conflict and dispute situations; public and private approaches

to the prevention, reduction, and resolution of conflicts. (3 cr; prereq 52 or 152) Flagler, Seltzer, Smythe

152. Systems of Industrial Relations: Labor Marketing. Introductory analysis of employment relationships emphasizing economic analysis. Fundamentals of application and conservation of human resources in employment with consideration of related social and economic problems. Labor marketing, collective bargaining, unions and employer associations, industrial unrest and conflict, employment and unemployment, wage problems. (3 cr, §52; prereq Econ 2 or equiv) Heneman, Mahoney, Seltzer, Smythe

152C. Industrial Relations Fundamentals. Introductory analysis of employment relationships, effective utilization, application, and conservation of human resources within the aggregate economy and individual organizations, union and nonunion. Policy and practice in manpower management—staffing, training, morale, compensation, labor relations, industrial unrest, employment, and unemployment. (3 cr, §52 or §152 or §72 or §172 or equiv; prereq Econ 2 or equiv) England, Heneman, Mahoney, Seltzer, Smythe

162. Union Government and Policies. Internal administration and government of unions; economic and social issues; hours, wages, and other conditions of employment. (3 cr; prereq 52 or 152) Flagler, Seltzer

172. Systems of Industrial Relations: Manpower Management. Introductory analysis of personnel management and labor relations in development and utilization of effective work-teams within firms and agencies. Overview of policy and practice in major manpower management functions of staffing, training, communications, motivation, compensation, and morale maintenance. (3 cr, §72; prereq Econ 2) Dawis, England, Heneman, Mahoney, Smythe

182A. Intermediate Labor Marketing. Advanced discussion and analysis of labor marketing concepts, structures, and processes. Examination of sources of information and different approaches to study, analysis, and resolution of problems in the labor market. (3 cr; prereq 52 or 152) Mahoney, Seltzer, Smythe

182B. Intermediate Manpower Management. Manpower management policy development, application, and evaluation within union and company managements; manpower research and auditing. (3 cr; prereq 72 or 172) Heneman, Mahoney, England

182C. Intermediate Labor Marketing and Manpower Management. An advanced course for line managers who are concerned with their personnel and labor relations functions. Policy, administration, and control of major manpower functions such as recruitment and staffing, training and development, motivation and compensation, labor relations, employee benefits and services, manpower research and auditing; labor marketing and labor legislation. This is a course for the nonspecialist. (3 cr, §182A or §182B or equiv; prereq grad, 152 or 172 or equiv) Heneman, Mahoney, Seltzer, Smythe

192. Industrial Relations Practices and Techniques. Role of quantitative measurement and analysis in formulation, administration, and evaluation of industrial relations practices and programs. (3 cr; prereq 72 or 172, 3 cr statistics) England, Mahoney, Dawis

202. Organization and Staffing. Translation of organization goals and objectives to specific manpower goals and objectives, and staffing to meet an organization's manpower needs. Techniques for recruitment, selection, and assignment of manpower resources for optimal utilization. (3 cr; prereq 72 or 172) Dawis, England

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) Flagler

212B. Employee Development and Training. Determination of goals, implementation and evaluation of programs for improved development and training from the standpoint of professional manpower management. (3 cr; prereq 72 or 172) Dawis, England, Mahoney

222. Compensation Theory. Analysis and evaluation of traditional economic wage theories, research findings in wage and salary determination and compensation levels and relationships, and development of modifications of wage theory appropriate to application in industrial relations. (3 cr; prereq 152 or 172) Mahoney, Seltzer

232. Collective Bargaining Policies and Practices. Analysis of functions and procedures of union-management collective bargaining. Problems of collective bargaining and techniques for preparation and conduct of negotiations. (3 cr; prereq 52 or 152) Heneman, Seltzer, Smythe

242. Management Development. Examination of today's management development movement including management development programs within industry and in universities. Basic policy, current problems, and research findings concerning selection of management trainees, management appraisal and inventory, management motivation and compensation, and methods and techniques of development. (3 cr; prereq 72 or 172) Dawis, Mahoney

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 or 172) Mahoney, Seltzer, Smythe

272. Graduate Topics—Supplementary Compensation. Analysis of nature and role of supplementary compensation—insurance, pensions, unemployment benefits, profit-sharing, bonuses. Examination of problems attacked by supplementary compensation, public and private attempts to meet these problems, and their implications. (3 cr; prereq 152 or 172) Seltzer, Smythe

282. Graduate Topics—Collective Bargaining. Advanced analysis and study of role and nature of collective bargaining in industrial relations. Examination of impact and implications of collective bargaining, alternative approaches to conflict resolution, and evaluation of proposals for improvement. (3 cr; prereq 152 or 172) Heneman, Seltzer, Smythe

292A. Readings in Manpower Economics and Industrial Relations. 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)

292B. Graduate Research in Manpower Economics and Industrial Relations. Individual research projects especially useful to student's objectives and program. (Cr ar; prereq consent of adviser and instructor)

352. Seminar: Labor Marketing. Advanced analysis and study of functions and operations of labor markets, labor market theory and research. (3 cr; prereq 182A) Heneman, Mahoney, Seltzer, Turnbull

362. Seminar: Manpower Management. Advanced analysis and study of manpower management functions and processes within organizations. (3 cr; prereq 182B) England, Heneman, Mahoney

372. Seminar: Industrial Relations Research Methodology. Advanced analysis of research methodology appropriate to study of industrial relations; application of methodology in research projects. (3 cr; prereq 192) Dawis, England, Mahoney

382. Seminar: Systems of Industrial Relations. Advanced analysis and study of industrial relations systems in labor marketing and manpower management—historical development, cultural differences, and relative effectiveness. (3 cr; prereq 152 and 172) England, Gross, Heneman, Mahoney, Seltzer

Plan B papers may be written in all courses.

INFORMATION AND AGRICULTURAL JOURNALISM

Course Carrying Graduate Credit

134. Rural Communication Media and Media Behavior. Mass media behavior in rural communities, theoretical approaches relevant to problems of rural mass media behavior; analysis of research aimed at adult education efforts through mass media. (3 cr; prereq 53, Psy 2, Soc 14, or ♯) Tichenor

INTERDISCIPLINARY PROGRAMS

Courses Carrying Graduate Credit

FS 161. Seminar: Foreign Study I. Directed field study in selected foreign countries, investigating current economic, political, educational, cultural, and religious patterns of life. Each student will study the country carefully before embarking and write a comprehensive report of his findings upon returning. (6 cr [grad students pay for 6 cr but receive 3 cr on their grad records]; prereq approval before December by a faculty selection committee; grad students must also have approval of their faculty advisers) Charnley

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

Hum 131-132-133. Humanities Proseminar. Selected interdisciplinary topics in the humanities. (3 cr per qtr) Berryman, Ross

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 regula-

tions 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)
Roy E. Carter, Jr. (Journalism)
Harold C. Deutsch (History)
Roy G. Francis (Sociology)
Raymond B. Nixon (Journalism)
John E. Turner (Political Science)

Associate Professor

W. Donald Beatty (History)
Edward Coen (Economics)
Robert T. Holt (Political Science)
Harlan M. Smith (Economics)

Prerequisites—Ordinarily an undergraduate major in international relations, an area study, or one of the social sciences is required. Students without such background may be permitted to enter if they have completed courses prerequisite to those in the fields of graduate study proposed and are prepared to undertake any additional study needed to correct deficiencies in their preparation. Preparation in an appropriate language at least through the first Upper Division sequence is also expected.

Language Requirement—For the M.A. degree prerequisite course work plus a test of reading knowledge in either French or German. For the Ph.D. degree a reading knowledge of an additional language, normally French or German. Alternative foreign languages may be authorized upon recommendation of the graduate adviser if appropriate to the candidate's program of study or research.

It is not recommended that candidates for the M.A. or Ph.D. degrees with a major in other subjects attempt to present a minor in international relations unless their previous preparation in this field is such that an intensive and well-integrated program in several departments can be completed within the limited time available for the minor. Consult graduate advisers.

Programs for the M.A. Degree—PLAN A. Students will present a minimum of 27 credits of graduate course work, ordinarily including a subfield of concentration of from 12 to 15 credits in one of the social sciences, the remaining credits to be distributed among related courses in other social sciences or in journalism, art, languages and literature, humanities, and philosophy. At least 6 credits should be in seminars, proseminars, or readings courses. Candidates must receive a grade of B or better in at least two-thirds of their course work and a grade of not lower than C in all other courses offered for the degree.

PLAN B. Students will present a minimum of 45 credits of graduate course work, including a subfield of concentration of from 15 to 18 credits in one of the social sciences, the remaining credits to be distributed among related courses in at least two other social science departments, and in journalism, art, languages and literature, humanities, and philosophy. At least 9 credits should be in seminars, proseminars, or readings courses.

Programs for the Ph.D. Degree—The work leading to the Ph.D. degree in international relations comprises at least 3 full years of graduate study and will vary in amount according to the candidate's individual needs and the extent of his undergraduate preparation. Requirements may be decreased for those who enter with advanced standing. Candidates will prepare for the written and oral examinations

prescribed by the Graduate School in six subfields of study, ordinarily completing a minimum of 12 credits in graduate courses or seminars in each subfield, including in each case at least 3 credits in a seminar or course based upon individually assigned reading or research. The six subfields should be distributed among not less than three social science departments and may include one or two subfields in journalism, art, language and literature, philosophy, or humanities. An area of concentration consisting of two subfields within a single social science department shall be included. Definition of subfields must be made in consultation with a graduate adviser, and the entire program should form a consistent, integrated plan of study. General requirements of the Graduate School must be satisfied, including a substantial dissertation in the area of concentration.

Area Studies

Advisers:

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. Don A. Martindale (Sociology)
Prof. Arnold M. Rose (Sociology)
Prof. Samuel H. Monk (English)
Assoc. Prof. Marion Nelson (Scandinavian)
Prof. Herman Ramras (German)
Assoc. Prof. Armand Renaud (Romance Languages)
Prof. Mulford Q. Sibley (Political Science)
Asst. Prof. John W. Webb (Geography)
Prof. David H. Willson (History)
Assoc. Prof. William E. Wright (History)

Russia

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

East and South Asia

Prof. John E. Turner (Political Science)
Prof. Jan O. M. Broek (Geography)
Asst. Prof. Edward M. Copeland (Slavic and Oriental Languages)
Assoc. Prof. O. Eldon Johnson (Anthropology)
Assoc. Prof. Anne O. Krueger (Sociology)
Assoc. Prof. Richard B. Mather (Slavic and Oriental Languages)
Assoc. Prof. Karl F. Potter (Philosophy)
Prof. Robert F. Spencer (Anthropology)
Assoc. Prof. Burton Stein (History)
Assoc. Prof. Donald C. Swanson (Classics)
Asst. Prof. Romeyn Taylor (History)

Latin America

Assoc. Prof. W. Donald Beatty (History)
Prof. Oswald H. Brownlee (Economics)
Prof. John S. Chipman (Economics)
Assoc. Prof. Rodolfo O. Floripe (Romance Languages)
Assoc. Prof. O. Eldon Johnson (Anthropology)
Assoc. Prof. Eugene C. Mather (Geography)

In addition to these advisers students may consult any other member of a committee whose specialization corresponds with the student's subfield of concentration. For committee lists see the special bulletin, *Programs in International Relations and Area Studies.*

Able students who have adequate preparation will be permitted to plan graduate programs in area studies. Programs leading to the M.A. degree may be arranged in any of the following areas: 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 two or three subfields, including the social sciences, literature, art, humanities, and philosophy. The whole should constitute a coherent, well-balanced program.

PLAN B. Students will obtain a minimum of 45 graduate credits, including at least 9 in the social sciences. The remainder will be distributed among the social sciences, literature, art, humanities, and philosophy.

A minor program under Plan A, or "related courses" under Plan B, may also be elected in an area study intended to support a departmental major. However, this is feasible only when the student has some previous area training.

Programs for the Ph.D. Degree—A Ph.D. degree is not presently offered with a major in area studies, since teaching materials are inadequate for intensive area study at this level in several of the contributing disciplines. Where relevant, area study may be included as part of a major program for the Ph.D. degree in a related graduate major or in international relations. It may also be presented as a minor program, in which case it is recommended that it comprise such aspects of study in the chosen area as are especially relevant to the major field. Major and area advisers should be consulted.

Preparation for the Foreign Service

Advisers:

Professor

Charles H. McLaughlin (Political Science)
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)

This is a program designed to provide basic training in intelligence research at the graduate level. Candidates for the M.A. or Ph.D. degrees may combine this training with a graduate major in area studies or international relations, or one of the social science majors. Certificates of proficiency in intelligence research will be awarded to students who successfully complete the prescribed work. Two years of graduate study are usually required to complete the program in conjunction with an M.A. degree. Foreign language competency, research skill and command of methods, and area specialization are stressed.

Those admitted to the program must be able graduate students with a genuine motivation toward careers in intelligence research or related work. They will be expected to have satisfactory reading knowledge of at least one foreign language and a reasonable familiarity with the cultural area chosen for specialization. They should also have completed undergraduate courses in 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 W. Emery
J. Edward Gerald
Raymond B. Nixon
Willard B. Thompson

Associate Professor
George S. Hage
William A. Mindak

Prerequisites—Courses in journalism are open to regularly enrolled graduate students who meet prerequisites stated in course descriptions. Students seeking the M.A. degree must have a minimum of 15 credits in basic journalism. Prerequisites may be taken while the student is enrolled in the Graduate School.

Degree of Master of Arts

The Master's degree is offered under Plan A and Plan B. Minnesota undergraduate journalism majors who contemplate graduate work in journalism should consult a graduate adviser at the end of the junior year.

For Plan A, course 200 and 18 additional credits in journalism are required, including two seminars numbered above 200. For Plan B, course 200 and at least two seminars numbered above 200 are required.

Minor—Majors in other fields who desire a journalism minor dealing with social and cultural aspects of the mass media of communication, or with specialized communications research techniques, may select courses with the consent of a graduate journalism adviser from among the following: 103, 106, 109, 110, 111, 113, 115, 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 program especially suited to their needs is available.

Language Requirement—For Plan A, reading knowledge of a foreign language is required of all candidates, except those who present additional work in statistics

to support a concentration in research methodology. For Plan B, a foreign language is not required but is recommended for students in international communications.

Degree of Doctor of Philosophy

The program in the School of Journalism leading to the Ph.D. in mass communications is intended for students who plan careers in research, teaching, or specialized journalism areas. The candidate, with the approval of his adviser, shall elect three subfields appropriate to his individual needs and goals. One subfield shall be designated the thesis subfield. The subfields are (a) theory of communication and public opinion, (b) history of communications, (c) communication agencies as social institutions, (d) international communications and comparative foreign journalism, and (e) specialized research methodology. To a varying degree, the subfields include supporting courses in other disciplines. Prospective students should write the director of the School of Journalism for detailed subfield descriptions. 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.

Minor—A candidate for the Ph.D. in other fields may elect a minor in journalism by obtaining the approval of his adviser and the director of the School of Journalism. Specialists in one of the natural or social sciences can establish minors leading to the practice of journalism. Written preliminary examinations are required of all minors.

Language Requirement—Either (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge. Acceptable languages are Arabic, Chinese, French, German, Italian, Japanese, Russian, Spanish, or Portuguese.

101w,s. Reporting of Public Affairs. Reporting court trials, city, county, state, federal, administrative, and legislative agencies; political, business, and labor news. Students attend and report trials, hearings, legislative sessions, and press conferences. (3 cr; prereq 51) Hage

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

111f.* Development of American Broadcasting. Historical and economic development of radio and television; government regulation; self regulation and social controls. The broadcaster as journalist. Contemporary issues. (3 cr; prereq 15 or 18 for journalism majors, 13 or ‡ for others) Charnley, Lindsay

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

115w,s.* Communications Analysis: Content, Audiences, Effects. Analysis of content and audiences of newspapers, magazines, radio, television, and motion pictures. Procedures for study of mass media effects. (3 cr; prereq introductory course in statistics and ‡...Psy 167 recommended) Jones, Carter

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 Western World.** Communications in other democracies as compared with the United States and with totalitarian systems. Great Britain, the Netherlands, the Scandinavian countries, France, and Latin America emphasized; problems of constructing a free press in Germany, Italy, Japan, and newly developing areas. (3 cr; prereq 15 cr in social sciences with an Upper Division course in international relations or comparative government recommended) Nixon

126s.* **Communications in Authoritarian Society.** 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 authoritarian states, including the U.S.S.R. (3 cr; prereq 15 cr in social sciences with an Upper Division course in international relations or comparative government recommended) Nixon

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) 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) 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 ‡) 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. (3 cr; prereq 18, 79, or ‡)

163f,s. Advertising Media Analysis and Strategy. Relation of advertising media to creative strategy; media "mix"; evaluation and use of media and market measurements and data; comparison of rates and relative economy of media; media purchasing, scheduling, and appropriations; cases and campaigns. (3 cr; prereq 18, 161, 162 and ‡) Mindak

164w,s. Current Advertising Developments and Problems. Advertising management as related to contributions of behavioral sciences and communications as well as creative and media research. Discussion and analysis of case studies in advertising-marketing. (3 cr; prereq 164 or ‡) Mindak

177f,s. Contemporary Problems in Freedom of Speech and Press. Anglo-American concept of freedom and responsibility, constitutional development in the United States, areas of present tension. The Bill of Rights and journalism today. (3 cr; prereq 15 cr in social sciences) Gerald

190s. Advanced Problems in Journalistic Writing. Investigation and analysis of problems of superior professional accomplishment in the fields of journalistic writing. Uses of literary and

journalistic forms. Experiments in individual effectiveness in journalistic presentation. (3 cr; prereq demonstration of acceptable writing achievement and ‡) Charnley

200f, 201s. Scope and Methods of Communications Research. 200: Areas of study in mass communications. Introduction to research methods and major sources of data. 201: Field survey, content analysis, and the controlled experiment as applied to mass communications problems. (3 cr per qtr; prereq consent of adviser) Jones and others

209w, 210s.* Seminar: History of Communications. Research in history and development of mass media. Historical bibliography and criticism in the field of journalism. (3 cr; prereq 110 or ‡) Emery

213w.* Seminar: Mass Communication Theory. Intensive examination of research concepts and findings which offer the most promise for development of a general theory of mass communication. Emphasis on empirical studies that throw light on problems of professional journalists in trying to communicate more effectively through mass media. (3 cr; prereq 113 and ‡) Nixon

215w, 216s.* Seminar: Communications Analysis. Research designs; procedures for quantitative studies of media control, content, audiences, and effects; relationships between research and decision making. (3 cr per qtr; prereq 200, 201 or 115, and a course in statistics, or ‡) Jones, Carter

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: International News Communication and Comparative Journalism. Problems in communication of news and opinion between nations and under varying types of political and economic systems. (3 cr per qtr; prereq 124, 125 or 126, and reading knowledge of a foreign language) Nixon

230s.* Seminar: Public Opinion and Propaganda. Theoretical bases of public opinion and propaganda. Developing literature in this field of specialization. (3 cr; prereq 130 and consent of adviser) Carter

264s.* Seminar: Advertising Research. Advertising as persuasive communication. Application of research findings and techniques of related social sciences to the advertising decision-making process. Comparison of "quantitative" and "qualitative" techniques. Survey of new developments in creative, media, and market research. (3 cr; prereq 115 or 215 or ‡) Mindak

277f. Freedom of Press and Communications Law. Agencies of mass communication under the United States Constitution today. (3 cr; prereq 177 or ‡) Gerald

278w-279s.* Government and Mass Communications. Reconciliation of social and individual interest through government actions affecting mass media. (3 cr per qtr; prereq 177, 277 or ‡) Gerald

290f-291w-292s.* Special Problems in Mass Communications. Individual research; for graduate students with major or minor programs in journalism. (3 cr per qtr; prereq ‡) Graduate staff

LAW

Professor
Carl A. Auerbach
John J. Cound
David L. Graven
James F. Hogg
Yale Kamisar
Stanley V. Kinyon
Robert J. Levy
William B. Lockhart
Robert C. McClure
Allan H. McCoid
Maynard E. Pirsig
Thomas L. Waterbury

Associate Professor
Jesse H. Choper
Terrance Sandalow
Stephen B. Scallen

Master of Arts in American Legal Institutions—This degree is available for foreign-trained lawyers. It is designed to give lawyers trained under other legal systems some understanding of the American legal system and its institutions. It requires not less than a full year in residence during which the candidate takes law courses selected to meet his special needs and interests, together with advanced work in other departments of the University, selected to put his studies in the Law School in their proper social, economic, political, or cultural framework. The degree is subject to the regular Plan B credit requirements.

Minor—A minor for either the Master's degree or the Ph.D. degree may be earned in law when this field logically relates to the field in which major work is being pursued.

101. Contracts. (9 cr) Cound, Kinyon

102. Criminal Law and Procedure. (6 cr) Kamisar

103. Legal Process. (4½ cr) Auerbach, Choper, Sandalow

105. Legal Accounting. Same as BA 85. (3 cr) Berryman

107. Property I. (6 cr) Graven, Hogg, Waterbury

108. Torts. (9 cr) Christie, McCoid

109. Introduction to Procedure. (3 cr) Cound, Miller

110. Constitutional Law. (6 cr) Auerbach, Kamisar, Lockhart

120. Banking and Negotiable Instruments. (4½ cr) Kinyon

122. Introduction to Business Associations. (3 cr) Choper

123. Private Corporations. (6 cr) Choper

124. Modern Real Estate Transactions. (6 cr) Graven

125. Remedies. (6 cr) Miller

126. Sales. (4½ cr) McClure

127. Trusts and Estates. (6 cr) Hogg, Waterbury

128. Taxation I. (6 cr) Scallen

129. Evidence. (6 cr) Kamisar

140. Administrative Law. (4½ cr) Auerbach

142. Conflicts. (4½ cr) Cound

143. Creditors' Remedies. (4½ cr) McClure

144. Seminar: Criminal Law. (3 cr) Pirsig

145. Estate Planning. (4½ cr) Hogg, Waterbury

146. Seminar: Estate Planning and Drafting. (3 cr) Waterbury

147. Independent Research. (3 cr) All faculty

150. Insurance. (4½ cr) Hogg

152. Judicial Administration. (3 cr) Pirsig

155. Law of Labor Relations. (4½ cr) McCoid

156. Labor Law Practice. (1½ cr) McCoid

157. Standards of the Legal Profession. (1½ cr) Pirsig

158. Legislation. (3 cr) McClure

159. Local Government Law. (4½ cr) Sandalow

161. Modern Social Legislation. (4½ cr) McCoid

164. Regulated Industries Seminar. (3 cr) Auerbach

165. Trade Regulation. (4½ cr) Levy

167. Securities Regulation. (3 cr) Choper

169. Seminar: Supreme Court. (3 cr) Choper

170. Seminar: Judicial Administration. (3 cr) Pirsig

173. Taxation II. (3 cr) Scallen

175. International Law. (4½ cr) Christie

177. International Commercial Transactions. (4½ cr) Hogg

179. Directed Research. (1½ cr) Ar

180. Federal Jurisdiction. (4½ cr) Sandalow

182. Secured Transactions Seminar. (3 cr) McClure

184. Unfair Competition. (4½ cr) Miller

185. Jurisprudence. (4½ cr) Christie

186. Family Law. (3 cr) Levy

187. Law and Medicine. (3 cr) McCoid

191. Law and Land Economics. (3 cr) McClure

193. Seminar: Criminal Procedure. (3 cr) Kamisar

195. Clinical Seminar: Family Law. (4½ cr) Levy

195A. Seminar: Family Law. (3 cr) Levy

196. Seminar: Trusts and Estates. (3 cr) Hogg

198. Seminar: Multi-party Litigation. (3 cr) Cound

200. Seminar: Problems in Minnesota Public Affairs. (3 cr) Graven

201. Seminar: Equity in Modern Society. (3 cr) Miller

202. Seminar: Land Planning. (3 cr) Sandalow

203. Seminar: Impact of Law on Social Development. (3 cr) Auerbach, Hoebel

LIBRARY SCIENCE

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

Associate Professor
Ralph H. Hopp
John Parker
Raymond H. Shove
Wesley C. Simonton
Frederick Wezeman

Assistant Professor
James Kingsley, Jr.

Instructor
Nancy J. Freeman

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

140. Information Retrieval. Theory, characteristics, systems, data processing, etc., applied to libraries. (3 cr; prereq 83 or #) Simonton

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) McDiarmid

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 of the world, especially those of the United States, Great Britain, France, Germany, and Russia. Use in selection and acquisition of books and in preparation of subject bibliographies. (3 cr; prereq 62) Shove

166. Advanced Reference. Special reference tools and government publications. (3 cr; prereq 62) Wezeman

167. Descriptive Bibliography. Special problems in bibliographical research; bibliographical problems encountered in acquisition, cataloguing, and description of antiquarian books. (3 cr; prereq 83 and 165 or ‡) Parker

168. Research Methods in Librarianship. (3 cr) McDiarmid

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; prereq ‡) 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 nonbook 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, McDiarmid

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
John W. Clark
Thomas B. Irving
Walter T. Pattison
Robert F. Spencer
Harry F. Williams

Associate Professor
Richard B. Mather
William Schmalstieg
Cecil Wood

Assistant Professor
Richard Narvaez

Lecturer
Lee A. Pederson

Students interested in languages and linguistics and who would like to prepare themselves professionally for a career in language teaching, linguistic research, lexicography, dialectology (and other field work), or in historical and cultural studies based on linguistics and philology, are encouraged to consult the program director. Tentative programs can be worked out to suit backgrounds and needs of qualified students.

The aim of the program is to train competent students in the whole spectrum of modern linguistics, students who are at home in both descriptive-structural and historical-comparative fields as well as in use of teaching methods and recording devices and research tools such as simple statistics and the digital computer.

Certain courses in peripheral departments are recommended to the attention of students as possible ingredients in a minor sequence or as a supporting program of study. These are Spch 109 and 275, Phil 154 and 162, Psy 118.

Prerequisites—For major work, not less than 6 quarter credits above 50 in each of two foreign languages, one of which must be German or Latin. For minor work,

not less than 6 quarter credits above 50 in a foreign language. See also requirements for the B.A. degree in this program.

Master's Degree—Offered under Plan B; Plan A may be followed by petition. Reading knowledge of Latin and German and an elementary knowledge of a third foreign language are generally required of all candidates.

Doctor's Degree—The M.A. degree (or an equivalent in course work) is a prerequisite to registration for the Ph.D.

Program—Candidates will work toward competence in several of the following subfields (two for the M.A., four for the Ph.D.):

1. General linguistics
2. Fluency in a modern language and knowledge of its structure and history
3. Linguistic and philological competence in an ancient language (e.g., Old Norse, Greek, Old French, Classical Arabic)
4. A non-Indo-European language, such as Arabic, Chinese, Hebrew, or Japanese; 1 year minimum of serious study
5. English linguistics—history and structure

General

Anth 180-181-182. *For details, see Index for Anthropology*

Clas 106-107. *For details, see Index for Classics*

Ling 151-152-153. Readings Course. (1-3 cr per qtr; open only to majors) 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 100-102-103. Old English

Engl 165-166. Modern English. Introduction; historical backgrounds

Engl 174. American English

Engl 204-205-206. History, Structure, Studies in English
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 107-108-109. Structure of Modern French

Fren 207-208-209. Old Provençal

Fren 241-242-243. Old French Philology

Fren 244-245-246. Readings in Old French Literature

Span 107-108-109. Structure of Modern Spanish

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

SLAVIC

Slav 113-114-115. Old Church Slavic (Old Bulgarian)

Russ 125-126-127. Structure and History of the Russian Language

Slav 161-162-163. Comparative Balto-Slavic Grammar

ARABIC

Arab 105. Structure of Arabic

Arab 161-162-163. Hispano-Arabic Culture

INDIC

Indc 105. Structure of Hindi

CHINESE

Chin 151-152-153. Directed Readings

Chin 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 psychology, educational psychology, home economics, psychology, or sociology. The staff and advisory committee of the Family Study Center exercise an over-all interest and supervision of this graduate program, providing consultation to advisers in the major and aid to graduate students in designing individualized programs of study. All candidates, regardless of major, are expected to receive instruction in four functional categories of training: (a) theory and content, (b) research methods relevant for family study, (c) counseling theory and methods, and (d) teaching methods relevant for functional marriage education.

The designing of the individual student's program takes into account the assets and deficiencies peculiar to the discipline in which he is majoring, broadening his program by supplementation in the minor and collateral fields or in the supporting program of study. This enables the student to complete his graduate study adequately equipped to serve as an educator or researcher in the field of the family.

Special services within this program of training include an apprenticeship in college teaching in the undergraduate marriage preparation classes operated by the Family Study Center and a marriage counseling practicum offered through the facilities of the Student Counseling Bureau.

MATHEMATICS

Professor

James B. Serrin, *head*
Glen E. Baxter
Robert H. Cameron
Elizabeth Carlson
Harry Furstenberg
Steven A. Gaal
Bernard R. Gelbaum
Leon W. Green
Heinrich Guggenheimer
Edward L. Hill
Bjarni Jonsson
Gerhard K. Kalisch
Gopinath Kallianpur
Fulton Koehler
Warren S. Loud
Lawrence Markus
Johannes C. Nitsche
Steven Orey
Edgar Reich
Paul C. Rosenbloom
Marvin L. Stein
Hugh L. Turrittin
Hans F. Weinberger

Associate Professor
Alfred Aeppli
Donald G. Aronson
Erwin Engeler
Bernard W. Lindgren
Walter Littman
Charles A. McCarthy
Chester L. Miracle
William D. Munro
Yatsutaka Sibuya
John M. Slye
David A. Storvick

Assistant Professor
George U. Brauer
Paul C. Fife
E. Gebhard Fuhrken
Jesus Gil de Lamadrid
Laurence R. Harper, Jr.
William A. Harris, Jr.
Jack Indritz
Benton N. Jamison
Howard B. Jenkins
James T. Joichi
Richard K. Juberg
Albert Marden
Norman G. Meyers
William E. Pruitt
J. Ian Richards
Warren B. Stenberg
James E. Thompson

Students majoring in mathematics should consult Mr. Serrin, head of the School of Mathematics.

Prerequisites—For students majoring in mathematics, 15 credits in analytic geometry and calculus and 15 other credits in non–Lower Division courses. Exceptions may be made in unusual circumstances. For students minoring in mathematics, 15 credits in analytic geometry and calculus.

Language Requirement—For the Master's degree, one foreign language from the following list: German, French, Russian, Italian. For the Ph.D. degree, two foreign languages from the above list are required.

Master's Degree—Offered under both Plan A and Plan B. Both written and oral examinations required. Ordinarily the degree program should contain a three-course sequence of 200-level mathematics or its equivalent. The Plan B paper requirement may be met in connection with any course accepted for graduate credit if the instructor's approval is secured.

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 three of the four 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 three-course sequence of 200-level mathematics courses or its equivalent.

For more detailed information about the following courses and for the courses offered in 1964-65, students should consult the program of the School of Mathematics as recorded either in the *Bulletin of the College of Liberal Arts* or the *Bulletin of the Institute of Technology*.

Note—For information on work in statistics, see section on Statistics. Attention is called to several Ph.D. programs of an interdisciplinary nature that rely heavily on mathematics. Interested students should consult the entries in this bulletin under Control Sciences and Fluid Mechanics. Any one of the courses Math 25A or 25B or 44 may be offered as prerequisite where any one of them is listed.

104. Variational Problems. Euler-Lagrange equations, isoperimetric problems, geodesics, Fermat's and Hamilton's principles, vibration and stresses in elastic bodies, methods of Rayleigh-Ritz, Galerkin, Kantorovich, etc., eigenvalues and eigenfunctions. (3 cr; prereq 153 or 148 or 150 or ‡)

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 26A or 26B or 55)

109. Theory of Numbers. Elementary properties of integers; prime and composite numbers; Euclid's algorithm; congruences; the theorems of Fermat and Wilson; primitive roots; indices; Diophantine equations. (3 cr; prereq 25A or 25B or 44)

110x. Tutorial Course in Advanced Mathematics. Qualified students whose needs are not met by courses offered may make special arrangements for obtaining the content of other graduate courses regularly offered by the department. (2 cr per qtr; prereq 25A or 25B or 44)

111A-B. Development of the Number System. Systematic construction of the real number system by extension from natural numbers via rational numbers to irrational numbers; negative numbers; properties of the system; operations with numbers and laws governing the operations. (3 cr per qtr; prereq 25A or 25B or 44)

112. Elementary Set Theory. Basic properties of operations on sets, cardinal numbers, simply ordered sets, well-ordered sets, ordinal numbers, axiom of choice, axiomatics. (3 cr; prereq 25A or 25B or 44)

112A-B-C. Mathematical Logic. Propositional and predicate calculi, models for systems of logic, recursive functions, decision and completeness problems. (3 cr per qtr; prereq 26A or 26B or 55 or Phil 155 or ‡)

115A-B-C. Differential Geometry. Curves in the plane and in space; Frenet formulas, foundations of calculus of variations. Theory of surfaces; fundamental forms, curves on surfaces. Surfaces of constant curvature, non-Euclidean geometry and trigonometry. Minimal surfaces. Deformations; introduction to theory of continuous transformation groups. Differential geometry of n-dimensions; parallelism, affine connection, curvature. (3 cr per qtr; prereq 26A or 26B or 55 and 131A or ¶131A)

116A-B. Modern Geometry. Geometric transformations; similarities, affinities, collineation, inversion. The notion of a transformation group. Projective geometry as a study of the invariants of the general linear group (Erlanger Program). Problems in geometry of transformation groups, mathematical analysis of the space problem. (3 cr per qtr; prereq 131A or ¶131A for 116B)

117A-B-C.† Geometry. Selected chapters of geometry, such as convex bodies, projective geometry, geometry and imagination, elementary algebraic geometry, geometry of transformation groups, axiomatic geometry, geometrical constructions. (3 cr per qtr; prereq 25A or 25B or 44 for each qtr)

121-122-123. Mathematical Theory of Statistics. See Stat 131-132-133.

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 13A or 42)

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 25A or 25B or 44)

127-128-129. Applied Mathematics for Social and Biological Sciences. Not accepted for mathematics majors (all degrees) as part of their mathematics programs. (3 cr per qtr; prereq 26A or 26B or 55)

130A-B-C. Introduction to Analysis. Theory of real numbers; elements of point set theory; limits; continuity; infinite sequences and series; integration and differentiation; vector analysis. (3 cr per qtr; principally designed for students planning to take graduate work with a major in mathematics, as preparation for graduate courses in analysis; prereq 26A or 26B or 55)

131A-B-C. Linear Algebra and Group Theory. Finite dimensional vector spaces; linear transformations and matrices over the real or complex fields; linear equations; determinants; characteristic values; canonical forms; bilinear and quadratic forms; applications; introduction to abstract concepts of modern algebra; more detailed study of finite groups, including Jordan-Hölder theorem and basis theorem for Abelian groups. (3 cr per qtr, §149; prereq 25A or 25B or 44)

132-133-134. Statistical Theory with Applications. (See Stat 131-132-133.)

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 Stat 90 or 131 or ‡)

133B-134B. Probability with Technological Applications. Spectral analysis of stationary processes, linear and nonlinear transformations, prediction and smoothing, recurrent events, random walk and diffusion, Markov chains, Poisson processes. (3 cr per qtr; prereq Stat 131 and ‡)

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 24A or 43 or ¶24A or ¶43)

140. Projective Geometry. Geometric properties invariant under projective transformations; theorems of Desargues, Pascal, and Brianchon, and applications. Methods used in some quarters are mainly synthetic; in other quarters they are mainly analytic. (3 cr; prereq 25A or 25B or 44)

144-145-146. Fourier Series and Orthogonal Functions. General theory of orthonormal functions developed and applied to Fourier, Legendre, Bessel, Hermite, and other series. Convergence and summability theorems are proved, and Fourier integral is considered. (3 cr per qtr; prereq 25A or 25B or 44)

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; prereq 26A or 27 or 55)

148. Differential Equations. Linear differential and difference equations with constant coefficients, isoclines, phase plane, reduction in order, Picard's method, uniform convergence, series solutions, Bessel functions, Legendre polynomials, introduction to boundary value problems. (3 cr, §150; prereq 26A or 27 or 106)

149. Determinants and Matrices. Determinants, matrices, linear equations, vector spaces, quadratic and bilinear forms, characteristic roots, applications to systems of ordinary differential equations. (3 cr, §131A; prereq 25A or 26B or 44)

150. Ordinary Differential Equations. Linear equations of second order, successive approximations. Existence theorems, systems of ordinary differential equations. Numerical integration and solution by series. (3 cr, §148; prereq 26A or 27 or 106)

151. Advanced Calculus I. Limits, properties of continuous functions of one and several variables, partial differentiation, implicit functions, maxima and minima, Taylor's theorem, transformations and mappings, integrals containing a parameter or variable limits, Stieltjes integral. (3 cr; prereq 25A or 26B or 55)

153. Advanced Calculus II. Infinite series, computation with series, series with variable terms, uniform convergence, power series. Improper integrals. Fourier series and orthogonal functions. Fourier integrals. Special functions. (3 cr; prereq 151 or 108)

155-156. Tensor Analysis with Applications. (3 cr per qtr; prereq 147, 149 or 131A, 147 or ♯)

157-158-159. Methods of Applied Mathematics. Integrated study of analytic tools used in applications of mathematics; emphasis on technique. Real and complex variables, matrices, ordinary and partial differential equations, calculus of variations, asymptotic expansions, etc. (3 cr per qtr; prereq 108 or 151 or ♯)

161-162-163. Analytical Dynamics. Basic laws and principles. Lagrange's equations. Motion of particles and rigid bodies; e.g., satellites and gyroscopes. Matrix methods for small oscillations. Variational methods, Hamilton's principle, extremal properties of eigenvalues. Hamilton's equations, transformation theory, separable systems. (3 cr per qtr; prereq 147, 149 or 131A, 147 or ♯)

164-165-166. Theory and Programming of Modern Digital Computers. Number systems. Analysis of arithmetic algorithms. Logical organization. Storage, control, and input-output units. Basic and advanced machine language and compiler programming. Libraries, advanced assembly techniques, interpretive systems, compilers. Application to mathematical and physical problems. Informal laboratory. (3 cr per qtr, §65 or §165A; prereq 26A or 27 or 55 or ♯)

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 ♯)

169. Mathematical Theory of Fluid Flow. General equations of fluid mechanics. Concepts from thermodynamics. Classical constitutive equations. Specialization to various subfields of fluid mechanics, including hydrostatics, barotropic perfect fluids, gas dynamics, and viscous flow theory. Examples of exact solutions. (3 cr; prereq 147 and 174, or ♯)

173-174-175. Elementary Partial Differential Equations. Partial differential equations of theoretical physics, one-dimensional wave equation, characteristics, classification of second order equations, heat and Laplace equations, uniqueness, maximum principle, orthogonal systems, Fourier series, separation of variables. **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. **Integral Transforms:** Fourier and Laplace transforms and their inversion, method of residues, applications to ordinary and partial differential equations, applications to the heat, wave, and Laplace equations. (3 cr per qtr; prereq 26A or 27 or 55 or ♯)

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, Markov chains, and discrete stochastic processes. (3 cr per qtr; prereq 108 or 151 or Stat 133 or ♯)

181-182-183. Selected Topics in the Theory of Numbers. (3 cr per qtr; prereq 153 or ♯)

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 26A or 26B or 55)

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 26A or 27 or 106)

185-186. Numerical Analysis in Engineering. Approximation of functions and least squares. Approximate solution of ordinary and partial differential equations, Moulton's, Runge's, relaxation and iteration methods. Calculation of eigenvalues of matrices and differential problems, Rayleigh-Ritz method. Integral equations. Programming of computers. (3 cr per qtr; prereq 184 or ♯)

187. Non-Euclidean Geometry. Foundations of Euclidean geometry, Euclid's fifth postulate and its implications. Hyperbolic plane geometry and trigonometry. Elliptic plane geometry and trigonometry. Consistency of non-Euclidean geometry. (3 cr; prereq 25A or 25B or 44)

190A-B-C. General and Algebraic Topology. General topological and metric spaces. Function spaces. Fundamental group and covering spaces. Singular and simplicial homology theory. Betti and torsion groups. Fix point theorems and applications to analysis. Classification of surfaces. (3 cr per qtr; prereq 131A or ¶131A)

192. Theory of Approximation in Numerical Analysis. Orthogonal functions, Chebyshev approximations, rational approximations, approximations in several variables, use of approximations in computing. (3 cr; prereq 174, 185, or ♯)

193A. Axiomatic Geometry. Axiomatic presentations of Euclidean and non-Euclidean geometries. Vector spaces and metric spaces. (3 cr; prereq 153 or ♯)

193B. Elementary Projective Geometry. Projective space as a global manifold. Homogeneous co-ordinates and classical projective spaces. Lattice description of projective space. Theorems of Desargue, Pappus, and Pascal. Quadratic surfaces. (3 cr; prereq 153 or ♯)

193C. Elementary Differential Geometry. Curves and surfaces in Euclidean 3-space. Frenet-Serret formulas for a curve. First and second fundamental forms for a surface, Gauss curvature. Meusnier, Euler, Dupin theorems. (3 cr; prereq 153 or ♯)

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 ♯)

202A-B-C. Advanced Logic. (3 cr per qtr; prereq 112C or ♯)

203A-B-C. Topics in Logic. (3 cr per qtr; prereq 112C or ♯)

205A-B-C. General Algebra. (Formerly 201A-B-C) A: Sets with compositions. Groups and semigroups with operators. Homomorphism theorems. Jordan-Hölder theorem. Abelian groups. Finitely generated groups. Rings, modules, and fields. Ideals and quotients. Commutative rings, especially polynomial and power series algebras. Unique factorization. Prime fields, finite fields. Finite field extensions. B: Vector spaces and modules. Duality, space of linear maps. Multi-linear algebra; tensor products; special algebras. Application to algebraic field extensions; Galois theory. Transcendental field extensions. Valuations. C: Simple and semisimple rings. Chain conditions on rings and modules. Wedderburn theory. Representations of finite groups. (3 cr per qtr; prereq 131C or ♯)

206A-B-C-D-E. Topics in Algebra. (Formerly 280A-B-C-D)

206A: Lattice Theory. Order relations, general lattices, modular and distributive lattices, Boolean algebras, algebraic and geometric models. (3 cr; prereq 205A or ♯)

206B: Group Theory. Finite groups, Sylow theory, simple groups, finitely generated groups, word problem, solvable groups, nilpotent groups. (3 cr; prereq 205A or ♯)

206C: Homological Algebra. Complexes, resolutions, homology and homotopy. Derived functors and their relation to homology. Finite groups. (3 cr; prereq 205B or ♯)

206D: Noetherian Modules. Hilbert's basis theorem, primary decomposition and uniqueness theorems, extension and contractions, local rings, regular local rings, structure of complete local rings. (3 cr; prereq 205C or ♯)

206E: Algebraic Number Theory. Integrally dependent rings, integrally closed rings, Dedekind domains, extension of Dedekind domains and decomposition of prime ideals, ramification theory, different and discriminant, class group and class number. (3 cr; prereq 205C or ♯)

207A-B-C. Foundations of Algebra. (Formerly 210A-B-C) Lattices and structure of algebraic systems, universal algebra, and interconnections between logic and algebra. (3 cr per qtr; prereq ♯)

208A-B-C. Structure of Rings and Algebras. (Formerly 203A-B-C) Rings with minimum condition, semi-simple rings, simple rings, Wedderburn theorems; matrix representations; crossed products; cyclic algebras; rational division algebras; primitive rings; rings with a radical; non-associative rings and algebras. (3 cr per qtr; prereq 205C)

210A-B-C. Theory of Local Rings. (Formerly 294A-B-C) 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, systems of parameters, multiplicity, unmixedness theorem. (3 cr per qtr; prereq 131C and ♯)

211A-B-C. Homological Algebra. (Formerly 295A-B-C) 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 131C and ♯)

212A-B. Topics in Number Theory and Algebraic Geometry. (Formerly 299A-B) Topics will include Riemann Zeta function, its functional equation and distribution of its zeros. Explicit formulas will be developed following A. Weil in terms of generalized functions. Theory of Zeta functions of algebraic number fields, function fields and of algebraic varieties, elliptic modular functions. Riemann-Roch theorems and complex multiplication. (3 cr per qtr; prereq 174, 205B or ♯)

221A-B-C. Complex Analysis. (Formerly 206-207-208 and 261-262-263) Review of fundamental concepts of analysis, real and complex numbers, analytic functions and conformal mapping. Cauchy's theorem and related concepts, sequences of analytic functions, Taylor and Laurent series; infinite products; residue calculus, the argument principle. Analytic continuation, algebraic functions. (3 cr per qtr; prereq 130C or equiv or 173-174-175 or ♯)

222A-B-C. Real Analysis. (Formerly 245A-B and 287-288-289) Review of fundamental concepts of analysis, elementary set theory. Measures and measure space, measurable functions, Borel and Lebesgue measure. Integration, fundamental convergence theorems, Radon-Nikodym theorem; Fubini's theorem. Differentiation of functions of a single variable; arc length. Metric, linear, and Banach spaces; L_p spaces, representation of linear functionals; C(X) spaces, Riesz representation theorem, Stone-Weierstrass theorem. Hilbert space, compact operators. (3 cr per qtr; prereq 130C or equiv or 221C or ♯)

223. Theory of Differentiation. (Formerly 298) Vitali's covering theorem; differentiation of set functions, Radon-Nikodym derivative, Lebesgue set, integral averaging. Calculus of generalized derivatives. Relation to classical differentiation process. Sobolev-Morrey inequalities; theory of trace. (3 cr; prereq 222C)

225A-B-C. Asymptotic Methods in Linear Analysis. (Formerly 240A-B-C) Techniques for studying asymptotic behavior of solutions of linear differential, difference-differential, and integral equations by Laplace transforms. Laplace transform in the complex plane. Behavior at infinity. Abelian and Tauberian theorems. Routh-Hurwitz and Pontryagin stability criteria. (3 cr per qtr; prereq 211C or ♯)

227A-B-C. Riemann Surfaces. (Formerly 209A-B-C) Heuristic introduction. Abstract definition of Riemann surface. Examples. Topology of two-dimensional manifolds. Existence and properties of harmonic functions. Generalized Riemann mapping theorems and the fundamental polygon. Introduction to classification theory. Method of extremal length. Theory of differentials. Existence of meromorphic functions. The special case of closed surfaces. (3 cr per qtr; prereq 221C or ♯)

228A-B-C. Topics in the Theory of Analytic Functions. (Formerly 267-268-269) (3 cr per qtr; prereq 221C or ♯)

229. Quasiconformal Functions. (Formerly 297) Geometric definition of quasiconformal mappings. Functions with generalized L_p-derivatives. Generalized solutions of Beltrami differential equations. Various characterizations of quasiconformal functions. Stoilow's theorem on interior mappings. (3 cr; prereq 221C or ♯)

230A-B-C. Topics in Several Complex Variables. (3 cr per qtr; prereq ♯)

235A-B-C. Functional Analysis. (Formerly 290-291-292) Basic properties of topological, locally convex and Banach spaces: theorems of Hahn-Banach, Krein-Milman, Mazur, Banach-Steinhaus, Eberlein; also open mapping, closed graph, uniform boundedness, Riesz convexity theorems; resolvents, spectra, spectral theorem in Hilbert space, integration of vector-valued functions. (3 cr per qtr; prereq 222C or ♯)

236A-B-C. Linear Spaces and Operator Theory. (Formerly 252A-B-C) Basic properties of topological linear spaces. Hilbert spaces. Spectral theorem and spectral multiplicity theory. Rings of operators. Dimension theory. (3 cr per qtr; prereq 205C and 222C or ♯)

237A-B-C. Topics in Operator Theory. (Formerly 214A-B) Linear ordinary differential equations, initial and boundary value problems; linear integral equations, semigroup theory, dynamical

systems. Functional analytic methods and necessary Banach space and measure theory material. (3 cr per qtr; prereq 221C and 222C or ‡)

238A-B-C. Banach Algebras and Harmonic Analysis. (Formerly 239A-B-C) Material from the books of Loomis, Naimark, Rudin, Hewitt. (3 cr per qtr; prereq 205C and 222C or ‡)

239A-B-C. Generalized Functions, Distributions, and Applications. (Formerly 253A-B-C) Material from the books of A. Friedman, Gelfand-Šilov, Hörmander. (3 cr per qtr; prereq 221C, 222C or ‡)

240A-B-C. The Wiener and Feynman Integrals. (Formerly 244-246-247) First quarter: heuristic survey of the field. Second quarter: rigorous proof of countable additivity of Wiener measure, the translation theorem, and other topics. Third quarter: analytic and sequential Wiener and Feynman integrals; ILSTOW and related Feynman and limiting Feynman integrals. (3 cr per qtr; prereq 222C or ‡)

241A-B-C. Topological Groups. Work as found in the books of Pontryagin, Weil, Montgomery-Zippin, Rudin, Hewitt. (3 cr per qtr; prereq 205C, 251C or ‡)

242A-B-C. Group Representations. Basic properties through the work of Gelfand, Mackey, etc. (3 cr per qtr; prereq 205C, 238C or ‡)

243A-B-C. Abstract Operator Theory. Analysis of linear operators on linear topological spaces; spectral theory; semigroup theory; perturbation theory; applications to differential equations and probability. Extensions to topics in nonlinear analysis as time permits. (3 cr per qtr; prereq 222C or ‡)

246A-B-C. Topics in Point Set Topology. (Formerly 213A-B-C) Dimension theory, upper semi-continuous collections, partitions, homotopy theory. (3 cr per qtr; prereq 190C or ‡)

247A-B-C. Algebraic Topology. (Formerly 190A-B-C and 220) Axiomatic homology theory; various homology and cohomology theories; introduction to homotopy theory. (3 cr per qtr; prereq 190C or ‡)

248A-B-C. Homotopy Theory. (Formerly 235A-B-C) Review of singular homology and cohomology, homotopy of mappings extension and retraction, classification of maps of the circle into the circle, fundamental groups, Hurewicz's theorem, fiber spaces, cross sections, homotopy groups, homotopy groups of special spaces, obstruction theory, homotopy groups of spheres, fundamental theorems of Morse theory. (3 cr per qtr; prereq 190C or ‡)

250A-B-C. Riemannian Geometry. (Formerly 217-218-219) Tensor algebra. Differential manifolds. Riemannian metric. Exterior differential calculus. Methods of global differential geometry. Differential equations of mathematical physics. (3 cr per qtr; prereq 115C or ‡)

251A-B-C. Differential Topology. (Formerly 215A-B-C) A general introduction to algebraic topology, as far as is needed for development of special tools of differential topology. Theory and applications of differentiable sheaves. (3 cr per qtr; prereq 190C or ‡)

252A-B-C. Lie Groups and Lie Algebras. (Formerly 224A-B-C) 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 205C or ‡)

254A-B-C. Algebraic Geometry. (3 cr per qtr; prereq ‡)

260A-B-C. Theory of Probability. (Formerly 258-259-260) Topics in modern probability theory, including recent advances in limit theorems and introduction to stochastic processes. (3 cr per qtr; prereq 222C or ‡)

261A-B-C. Stochastic Processes. (Formerly 284A-B-C) General theory of continuous parameter stochastic processes. Gaussian processes, processes with independent increments, Markov processes and their connections with functional equations. (3 cr per qtr; prereq 260C or ‡)

262A-B-C. Topics in the Theory of Probability. (Formerly 293A-B-C) (3 cr per qtr; prereq 260C or ‡)

266A-B-C. Theory of Ordinary Differential Equations. (Formerly 284-285-286 and 271-272-273) Existence and uniqueness theorems, linear and nonlinear differential equations, singular points and series solutions, eigenvalue problems, oscillation and comparison theorems, stability of solutions, periodic solutions, Poincaré-Bendixson theory, equations of Duffing and van der Pol. (3 cr per qtr; prereq 130C or equiv, 150, or ‡)

267A-B-C. Theory of Nonlinear Oscillations. (Formerly 285A-B-C) Background from theory of ordinary differential equations. Existence and stability of oscillations in nearly linear systems, periodic and almost periodic solutions, parametric resonance, invariant manifolds. (3 cr per qtr; prereq 266 or ‡)

268A-B-C. Topics in Differential and Difference Equations. (Formerly 304-305-306) (3 cr per qtr; prereq ‡)

271A-B-C. Partial Differential and Integral Equations of Applied Mathematics. (Formerly 274A-B-C) Linear integral equations; Fredholm's theorem, symmetric kernels, the expansion theorem, Volterra equations, topics in calculus of variations; Sturm-Liouville problems. Rayleigh-Ritz method, partial differential equations, introduction and classification. Heat equation and wave equation; energy method. Boundary value problems for Laplace and Poisson equations. Nonlinear hyperbolic problems. (3 cr per qtr; prereq 153 or 175 or ‡)

272A-B-C. Theory of Partial Differential Equations. (Formerly 275A-B-C) Derivation of special equations. First order of equations. Classification. Cauchy-Kowalewski theorem. Hyperbolic equations; general theory of characteristics, first order systems, energy method, special topics. Elliptic equations; maximum principle and applications, general theory of the Laplace equation, potential theory, boundary value problems. Higher order parabolic equations. (3 cr per qtr; prereq 130C or equiv, 150 or ‡)

273A-B-C. Topics in Partial Differential Equations. (3 cr per qtr; prereq 223, 272C or ‡)

276A-B-C. Calculus of Variations and Minimal Surfaces. (Formerly 277-278-279) Euler's equation, differentiability theorems, necessary conditions of Legendre and Weierstrass, isoperimetric problems. Theory of fields, Hamilton-Jacobi theory. Sufficiency theorems, direct methods, local behavior of extremals. Local and global properties of minimal surfaces, Plateau's problem. (3 cr per qtr; prereq 130C or equiv, 150 or ‡)

280A-B-C. Mathematics of Computers and Control Devices. (Formerly 227-228-229) Theory of elementary control and computing devices, open and closed systems, dynamic and transient responses. Synthesis and analysis of systems. Analog and digital computers. (3 cr per qtr; prereq 186 or ‡)

282. Advanced Numerical Analysis of Linear Systems. (Formerly 270B) Solution of linear equations, gradient method, projection method, matrix inversion and decomposition, matrix diagonalization, linear programming, extensions to Hilbert space. (3 cr per qtr; prereq 131B, 186, or ‡)

283. Advanced Numerical Analysis of Partial Differential Equations. (Formerly 270A) Linear equations of first order, hyperbolic, elliptic, and parabolic equations, choice of grid, boundary value problems, eigenvalue problems. (3 cr per qtr; prereq 175, 186 or ‡)

286A-B-C. Advanced Methods of Applied Mathematics. (Formerly 211A-B-C) Fundamental linear problems; linear transformations and quadratic forms, orthogonal series, linear integral equations, calculus of variations, eigenvalue problems and expansions, singular eigenvalue problems and expansions. (3 cr per qtr; prereq 159 or equiv or ‡)

287. Variational Methods in Boundary Value Problems. (Formerly 254A) Variational characterization of the solution of a boundary value problem in elliptic differential equations. Construction of arbitrarily close upper and lower bounds for physical quantities such as strain energy, electrostatic capacity, and virtual mass as well as for solutions of steady state problems in elasticity, potential theory, and hydrodynamics. (3 cr per qtr; prereq 153 or 175 or ‡)

288. Variational Methods in Eigenvalue Problems. (Formerly 254B) Minimum, maximum-minimum, and minimum-maximum characterizations of eigenvalues and eigenvectors ("natural frequencies" and "normal modes") of various differential operators occurring in mathematical physics. Methods yielding upper and lower bounds for eigenvalues. Approximation of eigenvectors. (3 cr per qtr; prereq 153 or 175 or ‡)

290A-B-C. Mathematical Theory of Fluid Dynamics. (Formerly 232-233-234) Equations of continuity and motion. Kinematics, Bernoulli's theorem, stream function and velocity potential. Applications of conformal mapping. Foundations of thermodynamics. One-dimensional flow. Plane flow of gas, characteristic method, hodograph method. Singular surfaces, shock waves and shock layers. Viscous flow, Navier-Stokes's equations, exact solutions; uniqueness, stability, and existence theorems. (3 cr per qtr; prereq 153 or 175 or ‡)

291. Mathematical Aspects of Boundary Layer Theory. (Formerly 242) Navier-Stokes's equations, exact solutions illustrating boundary layer concept. Boundary layer equations. General properties and critique. Theory of similar solutions, Goldstein's theorem, Blasius solutions, existence theorems. Von Mises transformation. Qualitative theory, asymptotic behavior, and uniqueness. Remarks on compressible boundary layers, Stewartson-Illingworth theorem. (3 cr per qtr; prereq 150, 153 or 175, or ‡)

293. Information Theory. (Formerly 241) Mathematical theory of transmission of information in the presence of noise; heuristic background of the problem; review of some topics from probability theory; the entropy function; discrete memoryless channels; finite memory channels; continuous channels with additive noise. Axiomatic approach—emphasis on mathematical rather than engineering aspects. (3 cr per qtr; prereq Stat 131, 153 or 175, 178A or ‡)

296A-B-C. Mathematical Problems in Theoretical Physics. (Formerly 307-308-309) (3 cr per qtr; prereq ‡)

299A-B-C. Reading and Research. (Formerly 248A-B-C)

The courses listed below are offered from time to time.

100. Foundations of Geometry

102-103. Advanced Analytic Geometry

119. Topics in Finite Groups

120. Representations of Groups

126. Calculus of Finite Differences

135. Integral Equations

137. Advanced Theory of Equations

199. Calculus of Variations

226A-B-C. Conformal Mapping

253A-B-C. Topics in Advanced Differential Geometry

277A-B-C. Potential Theory

292A-B-C. Joint Seminar: Aeronautical Engineering

MECHANICAL ENGINEERING**

Professor

Richard C. Jordan
Perry L. Blackshear
Ernst R. G. Eckert
Edward A. Fletcher
Warren E. Ibele
Clarence E. Lund
Gayle W. McElrath
Katsuhiko Ogata
Ephraim M. Sparrow
Robert E. Summers
James L. Threlkeld

Associate Professor

John E. Anderson
Richard J. Goldstein
Fulton Holtby
Millard H. LaJoy
Homer T. Mantis
Thomas E. Murphy
Kenneth T. Whitby

Assistant Professor

Saul Blumenthal
Adolph O. Lee
Benjamin H. Liu

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

Language Requirement—For the M.S. degree, none. For the Ph.D. degree, reading knowledge of two languages (French, German, and Russian are acceptable). Substitution of other languages or in special cases a research technique may be permitted.

Master's Degree—The M.S. degree is offered under both Plan A and Plan B with the major in mechanical engineering or industrial engineering. Work outside mechanical engineering is recommended for the minor under Plan A and for both the related fields under Plan B.

In addition to the completion of 45 credits of course work, the Plan B candidate will be required to submit three written reports representing the quality but not the range of the Master's thesis. These papers are to be prepared as an additional part of the work required for three advanced courses, seminars, or independent work with the joint permission of the student's adviser and the instructor of the course.

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

Note—To receive graduate credit in a mechanical or industrial engineering major, courses must be selected from those listed under "Advanced Courses in Mechanical (or Industrial) Engineering."

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

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. Mechanical vapor compression refrigeration; refrigerants; thermodynamic properties of moist air; psychrometric charts; psychrometry and humidity measurement; psychrometric processes; psychrometric systems. (3 cr; prereq 32, 133)

162.* Thermal Environmental Engineering. Solar radiation; weather and climates; steady-state and periodic heat transmission in structures; thermal loads for enclosed spaces; effects of thermal environment upon people, processes, and materials; systems for year-around control of thermal environment. (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)

171x. Process Engineering I. Analytical and physical fundamentals of fabrication processes including casting, forging, and welding. Operating characteristics of the process and methods of optimizing process and product output. (3 cr; prereq Met 56 and MM 142)

172x. Process Engineering II. Analytical and physical fundamentals of postfabrication processes including machining, shearing, forming, and assembly. Materials, mechanics, economics, heat transfer, and functional characteristics of the metal cutting processes. (3 cr; prereq 171)

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 44 or 45) 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 172) 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 172) Holtby

113. Advanced Metal Cutting. Advanced machine tool operation. Selection, tooling, and set-up of machine tools for production. (3 cr; prereq 172) Holtby

114. Advanced Welding. Theory and applications of welding processes; factors affecting weldability; considerations in the design of weldments. (3 cr; prereq 172) Holtby

MACHINE ELEMENTS AND INSTRUMENTATION

123. Creative Engineering. Application of fundamentals of engineering design; creative aspects. (3 cr)

124. Experimental Stress Analysis. Experimental application and theoretical evaluation of methods of stress analysis. Strain gauges, surface coatings, photoelasticity, dynamic stress measurements, penetration methods, and fracture methods. (3 cr; prereq MM 41)

127. Friction and Lubrication. Friction mechanism and boundary lubrication. Hydrodynamic and hydrostatic lubrication theory applied to finite bearings. Introduction to gas bearings. (3 cr; prereq Hydr 103 or equiv)

128. Photoelastic Stress Analysis. Fundamentals of advanced stress analysis. Theory of photoelasticity and operation of polariscopes. Applications to solutions of special design problems. (3 cr; prereq MM 41)

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 44 or 45 or equiv, Math 26A) Ogata

224-225-226. Advanced Applied Dynamics. Application of principles of dynamics to selected mechanical engineering problems. (3 cr per qtr; prereq 129)

228. Photoelasticity. Stress analysis by photoelasticity. Stress patterns. Frozen stresses. Solution of individual problems. (3 cr; prereq 128)

229. Advanced Vibration Engineering. Advanced dynamics of vibration, vibration in mechanical, electrical, and equivalent systems. (3 cr; prereq 129)

296-297-298. Feedback Control Systems. Basic considerations of feedback control system design. Root locus method and synthesis of linear feedback control systems in S plane. Describing function analysis and phase plane analysis of nonlinear feedback control systems. Statistical design principles and optimal control systems. (3 cr per qtr; prereq 198, 199, Math 174 or ¶Math 174) Ogata

THERMODYNAMICS AND HEAT TRANSFER

136. Reactor Heat Transfer. Heat conduction with internal heat generation, thermal stresses, liquid metal heat transfer, forced convection in noncircular ducts, boiling and two-phase flow. (3 cr; prereq 133 or equiv)

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, analogue, the regenerator. (3 cr; prereq 133) Eckert

234. Convection. Heat transfer in laminar and turbulent boundary layer and channel flow, dimensional analysis. Free convection. Condensation and evaporation. Convective mass transfer. (3 cr; prereq 233) Eckert

235. Radiation. Heat radiation of black bodies, or electrical conductors and nonconductors, of gases and flames. Heat exchange by radiation. Configuration and interchange factors. (3 cr; prereq 234) Eckert

236. Advanced Theory of Heat Transfer. Analytical treatment of problems of convection and radiation. Boundary layer and pipe flow solutions and associated mathematical techniques. Radiation problems, including integral equation formulation, and their solution. (3 cr; prereq 133) Sparrow

270-271-272. Magnetohydrodynamics. Basic equations of magnetohydrodynamics. Fundamental properties of magnetohydrodynamic flows. Magnetohydrodynamic models and their extensions. Applications: magnetohydrodynamics power, generation, propulsion. (3 cr per qtr; prereq 134 or AE 102A, Math 147 or ‡) J Anderson

POWER AND PROPULSION

140-141. Thermodynamics of Modern Power Devices. Gas and solid state thermocouple, magnetohydrodynamic systems, fuel cells, and solar energy systems. Thermodynamic principles and transport phenomena involved in each device. (3 cr per qtr; prereq 133)

142. Vapor Cycle Power Systems. Vapor cycle analysis, regeneration, reheat, compound cycle modifications, combined gas turbine-vapor cycle systems, binary systems. Combustion problems; unusual energy sources, solar, nuclear for space power systems. (3 cr; prereq 32 and 133)

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 146, GeCh 15 or ‡) Fletcher

150.* Internal Combustion Engines. Principles of spark ignition engine, fuel-air cycle analysis, combustion flames, knock phenomena, air flow and volumetric efficiency, mixture requirements, ignition requirements and performance. (3 cr; prereq 32) Murphy

151. Advanced Internal Combustion Engines. Principles of diesel engine, combustion of stratified charge, knock, theory of spray formation and vaporization. Fuels and deposits, engine lubrication, air and liquid cooling. (3 cr; prereq 150)

152. Gas Turbines and Compound Engines. Gas turbine cycles, regeneration, reheat and intercooling. Free turbine and free piston gasifier. Scavenging of two stroke engines, matching of compressor and turbine to engine. Turbo-jet engine performance. (3 cr; prereq 150)

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 109 or ‡) Fletcher

242. Advanced Power Plants. Thermodynamic and economic evaluation, planning, and management of modern and anticipated future power plants and components. (3 cr; prereq 142 or equiv) Lee

246. Energy Transport in Chemically Reacting Gases. Thermodynamics, kinetics, and transport processes in chemically reacting gases; energy fluxes in chemically reacting systems with and without equilibrium; surface phenomena; a review of equations of motion for chemically reacting systems, and energy transport in chemically reacting flowing streams. (3 cr; prereq 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

164. Refrigeration and Cryogenics. Thermoelectric cooling gaseous air cycle; steam jet refrigeration; production of dry ice; thermodynamics of binary mixtures, the h-x diagram, absorption refrigeration. Liquefaction of air, hydrogen and helium; production of oxygen and nitrogen by separation of air; other cryogenic topics. (3 cr; prereq 160)

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

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 △)

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 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 100)

170x. Production Planning and Control. Planning of production requirements; routing, scheduling, and co-ordination of production; inventory policies and control. (3 cr; prereq 100)

171x. Quality Control. Quality standards, application of statistical methods and sampling theory; interpretation of results and corrective action. (3 cr; prereq Math 90 or ME 99 or ♯)

172. Manufacturing Cost Analysis. Financial accounting concepts, standard cost systems, manufacturing cost accounting, cost information for management decision making. (3 cr; prereq 100)

173x. Engineering Economic Analysis. Analysis of capital expenditures and annual operating costs as the basis for management policies and decisions. (3 cr; prereq 100)

194. Topics in Management Science. Analytical tools for decision making and management of the production function. Emphasis upon topics appearing in current literature; mathematical models, assumptions, limitations, and new developments. (3 cr; prereq 15 cr in industrial engineering)

Advanced Courses in Industrial Engineering

140. Process Economics. Quantitative and qualitative comparison of competitive manufacturing processes. Economics of process selection and optimization. Linear programming methods of assignment of work to available facilities. (3 cr; prereq ME 172)

141. Industrial Metrology. Fundamental concepts of the science of industrial measurements. Variability of manufacturing process, process capability, errors of measurement. (3 cr; prereq ME 99 and ME 172)

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 or 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)

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 Math 90 or ME 99) 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 Math 90 or ME 99)

176. Probability Models in Engineering. Concepts of compound statements, sets and functions, conditional probabilities and simple stochastic processes (including finite Markov chains) and their relation to selected problems in engineering. (3 cr; prereq ME 99 or equiv)

177. Industrial Sampling Techniques. Selection and operation of attributes sampling plans; operating characteristic curves; sampling techniques for continuous production; variables sampling plans; administrative and economic comparisons. (3 cr; prereq 171)

180. Management for Engineers. Management functions and relations with employees, other supervisors, and staff departments. (3 cr; prereq 100)

182. Industrial Safety. Safety requirements for production processes, equipment, and plants; organization and administration of safety programs. (3 cr; prereq 100)

193. Introduction to Optimal Control and Dynamic Programming. Concepts of optimization, linear and nonlinear optimal systems, adaptive systems, stochastic optimization problems and introduction to dynamic programming. (3 cr; prereq ME 199)

195-196. Applied Industrial Engineering. Industrial engineering surveys and programs; case problems; studies in local plants. (3 cr; prereq 15 cr in industrial engineering)

198. Design and Analysis of Experiments I. One-factor experiments, design constructed to reduce experimental error, general linear regression model, analysis of variance, estimation and comparison of effect, orthogonal contrasts, components of variance, fixed random, and mixed models, incomplete block designs, introduction to general factorial experiments. (3 cr; prereq ME 99 or Math 132 or ♯)

199. Design and Analysis of Experiments II. Two or more factor experiments, designs involving crossed, nested, and mixed classifications; qualitative and quantitative factors; experiments, block confounding, fractional factorial experiments, introduction to response surface analysis. (3 cr; prereq 198 or ♯)

251-252-253.‡ Advanced Industrial Engineering. Manufacturing policy, production engineering, plant operation, engineering economy, and industrial development. (3 cr per qtr; prereq ♯) McElrath

261-262-263.‡ Production Engineering Problems. Application of industrial engineering principles to solution of manufacturing problems in local plants. (3-5 cr per qtr; prereq ‡) McElrath

271-272-273.‡ Industrial Engineering Research. Research studies in selected areas of industrial engineering, production, and management; work of thesis quality but lesser scope. (3-5 cr per qtr; prereq ‡) McElrath

Engineering Graphics

101. Illustration for Design. (3 cr; prereq 27 or ‡)

118. Graphic Analysis of Experimental Data. (3 cr; prereq 26, Math 25A or ‡) Barich

120. Advanced Descriptive Geometry. (3 cr; prereq 27, Math 24A or ‡) Barich

130. Nomography. (3 cr; prereq 26, Math 24A or ‡) Barich

131. Graphical Mathematics. (3 cr; prereq 26, Math 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
Patarasp R. Sethna

Associate Professor
Allan A. Blatherwick
Carl N. De Silva
Chih-Chun Hsiao
Theodore J. Mentel
William H. Warner

Assistant Professor
Glenn E. Bowie
John J. P. O'Connor

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

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

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

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

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

142. Experimental Mechanics I. Strain gauges. 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 aerospace structures, its analysis and simulation. Elevated temperature problems. Thermal fatigue. Resonance and acoustic fatigue. (3 cr; prereq 150)

164-165-166.‡ Problems in Mechanics and Materials. Short duration research problems, literature studies, and reports. (0-3 cr per qtr; prereq ‡, faculty sponsor required before registration) Graduate staff

176. Introduction to Random Vibration Theory. Statistical descriptions of response of single-degree-of-freedom damped vibrators to nondeterministic forces. Effects of damping and frequency spectra. Measurable quantities. Response of two-degree-of-freedom systems. Impedance methods. Response of linear continuous systems. Comparison higher approximations, descrip-

tions of damping, model coupling and spectrum shaping. Acoustic excitation. Fatigue failure criteria. (3 cr; prereq Aero 175 or Math 132, or equiv)

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 narrow beam, 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 Math 147 or equiv)

187. Theory of Linear Viscoelasticity. Linear viscoelastic behavior; linear viscoelastic constitutive laws; method of viscoelastic analysis; and applications to simple quasi-static and dynamic viscoelastic problems. (3 cr; prereq 41 and Math 148 or 150; offered 1964-65 and alt yrs)

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 Math 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 Systems. General theory of vibrations of dynamical systems in the neighborhood of steady motion. Gyroscopic systems. Application to gyroscopic stabilizers, gyro-compass, gyro-verticals, inertial navigation. Stability of solution by Lyapunov's direct method. Application to gyroscopic systems. (3 cr; prereq 196) Sethna, Goodman

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 Math 148 or 150A) Sethna, Goodman, Plunkett

212. Theory of Vibrations II. Nonlinear systems. Methods in the phase plane, singular points. Response of one and two degrees of freedom systems with nonlinear restoring forces. Self-sustained oscillations. Methods of Van der Pol and Andronow and Witt. Asymptotic methods of Krylov, Bogoliubov, and Mitropol'skiy. (3 cr; prereq 193 or 194, Math 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 Math 148, 149, MM 211, 212 or ‡) 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 Math 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 Math 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, nonhomogeneous viscoelastic analysis. (3 cr; prereq 180 or 184 or ♯) Hsiao

264-265-266.‡ Selected Topics in Mechanics and Materials. Topics of current interest. (0-3 cr per qtr; prereq ♯) Graduate staff

285. Continuum Mechanics. Review of matrices and Cartesian tensors. Analysis of stress. Kinematics: deformation, strain, rates of deformation and strain. Conservation laws: mass, momentum, energy; laws of motion. Constitutive equations: fluids, elastic and hyperelastic solids. Rate theory, stress flux, hypoelasticity. (3 cr; prereq 184 or ♯) De Silva, Warner

290. Theory of Plates and Shells. Stress analysis of medium-thick flat slabs. Finite difference and energy methods of analysis. Concentrated loads. Relation between theory and model tests. Membrane theory of shells. Flexure of cylindrical shells. Pressure vessels. (3 cr; prereq 180 or 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, Math 147 or 152, ¶Math 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

Gerald T. Evans, M.D.C.M., Ph.D.
Ellis S. Benson, M.D.
R. Dorothy Sundberg, M.D., Ph.D.

Associate Professor

Robert A. Bridges, M.D.
Ruth F. Hovde, M.S.
Paul H. Lober, M.D.

Assistant Professor

Patricia M. Bordewich, M.S.
Grace M. Ederer, M.P.H.
Esther F. Freier, M.S.
Lorraine M. Gonyea, M.S.
Verna L. Rausch, M.S.
Joseph W. St. Geme, Jr., M.D.
Edmund Y. Yunis, M.D.

Graduate work in the field of medical technology is available for the qualified candidate who wishes to prepare himself for a career of teaching and investigation in the area of clinical laboratory. Regardless of ultimate aim each student spends a period of time in the clinical laboratories to familiarize himself with the aspects of methodology, teaching, and research. Each student is required to carry out a problem of independent research in one of the subareas of this field under the direction of his major adviser.

Prerequisites—For a major in medical technology certification as MT(ASCP) or eligibility for such certification is required in addition to a Bachelor's degree from an acceptable institution with sufficient prerequisite work and scholarly attainment in chemistry and biological sciences to justify graduate work in these areas. Previous experience in a clinical laboratory is desirable. For a minor in medical technology certification as MT(ASCP) is not required.

Minor—It is suggested that students who major in medical technology present a minor in one of the following fields: anatomy (hematology or cytology), physiological chemistry, physiology, microbiology, public health, zoology, or pathology.

Language Requirement—Reading knowledge of either French or German. In special cases another language may be substituted by petition.

Master's Degree—Offered under Plan A; in special cases Plan B may be followed by petition to the graduate faculty.

Minor in Medical Technology—Work for a minor is offered to students in allied sciences. Choice of particular courses to be presented in fulfillment of requirements will be made after consultation with the student's adviser.

110, 111.* Advanced Clinical Laboratory Techniques. Assignment on individual basis for observation, study, and practice in special problems; techniques and methodology in units of clinical laboratories (microbiology, chemistry, hematology, histology, or immunology). (5 cr per qtr) Staff

120x. Seminar: Medical Technology. Review and discussion of current literature; presentation and discussion of research being carried on in the department. (1 cr) Rausch

130, 131.* Elements of Administration in Medical Technology. Organization and role of the laboratory service in hospitals; job analysis and classification; personnel assignments and evaluation; plant, supplies, and equipment. 130: Lectures. 131: Assignment of specific problems in management. (2 cr per qtr) Ederer

140, 141.* Educational Administration in Medical Technology. Development, organization, and administration of educational programs in medical technology. 140: Lectures. 141: Clinical practice in techniques; analysis and construction of courses of study. (3 cr per qtr) Hovde, Rausch

145. Development of Medical Technology. Current problems. (3 cr) Hovde

150x. Selected Topics in Microbiology. Advanced seminar; topics assigned for conferences and reading. (Cr ar; may be taken 1 or more qtrs) St Geme

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) Yunis, Bridges

MEDICINE

(Including Divisions of Internal Medicine and Dermatology)

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

METALLURGICAL ENGINEERING

Professor
Richard A. Swalin
Gust Bitsianes
Strathmore R. B. Cooke
James E. Lawver
Morris E. Nicholson

Associate Professor
Iwao Iwasaki
Henry S. Jerabek
John M. Sivertsen

Assistant Professor
Y. P. Gupta

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

Language Requirement—For the Master's degree, none. For the Ph.D. degree, either (a) two foreign languages selected from German, French, and Russian (other languages may be considered on petition); or (b) upon petition, one of the above languages and a special research technique. Students working toward the Ph.D. degree

must either complete or show substantial progress toward completion of one language or the special research technique in their first year of residence.

Master's Degree—Either a Master's degree with departmental designation or an undesignated Master's degree is offered. Students who have a B.S. in metallurgy or in metallurgical engineering have the option of obtaining either the designated or the undesignated M.S. degree. Students who have a B.S. degree in other fields e.g., geology, physics, chemistry, etc.) may choose either (a) to make up the deficiencies in the basic engineering curriculum and proceed normally to the designated M.S. degree in metallurgical engineering, or (b) proceed directly to the undesignated M.S. degree.

Only Plan A will be allowed for students working toward either Master's degree.

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

Metallurgical Engineering

106. Principles of Process Metallurgy. Material and heat balances in metallurgical processes, combustion of fuels, heat utilization. (3 cr; prereq 8 cr in inorganic chemistry) Bitsianes

107. Principles of Process Metallurgy. Phases in pyrometallurgical systems. Roasting, agglomeration, matte and reduction smelting. (3-4 cr depending on lab; prereq 106) Bitsianes

107A. Process Metallurgy Laboratory. Techniques and calculations involving the unit processes. Temperature and fluid flow measurements; agglomeration, reduction, simple smelting and refining systems; associated heterogeneous reactions. (1 cr; prereq 106 or ‡) Bitsianes

108. Principles of Process Metallurgy. Converting, metal refining, retorting, hydrometallurgical processes, electrolytic methods. (3-4 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 ‡) Bitsianes, Cooke

122. Hydrometallurgy. Application of physicochemical 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. Physicochemical principles. Slag-metal equilibriums, kinetics of metallurgical reactions, slag constitution. (3 cr; prereq 108) Bitsianes

135.° Metallurgical Unit Processes. Gas-solid processes. Blast furnace smelting, control of slag-metal and gas-solid reactions. Oxygen enriched blast and high top pressure. (3 cr; prereq 11) Bitsianes

136.° Metallurgical Unit Processes. Integration of operations and processes on a plant basis. Applications in nonferrous metallurgy. (3 cr; prereq 108) Bitsianes

138.° Advanced Process Metallurgy. Application of physical chemistry to some advanced problems in metallurgical engineering. Heterogeneous chemical reactions. (2 cr; prereq 134) Bitsianes

141-142-143.† Special Problems in Process Metallurgy. Laboratory investigation of problems involved in metallurgical unit processes. (Cr and hrs ar; prereq 108) Bitsianes

150-151. Introduction to Mineral Processing Research, I and II. General principles, techniques, and procedures used in mineral processing research. Guided scientific student investigations using advanced methods in experimental design and data analysis. Application of use of digital computers. (3 cr per qtr; prereq Math 90 or MinE 126 or IE 198 or ‡) Lawver

155. Electric and Magnetic Separation of Minerals. Electric separation of dielectric minerals using electrostatic fields and separation of conductors from insulators by corona discharge. Laboratory methods for determining electric properties of minerals and laboratory experiments using high and low intensity magnetic separators. (2 cr; prereq 112) Lawver

201-202-203.*‡ Research in Process Metallurgy. (Cr ar) Bitsianes

204-205-206.*‡ Research in Mineral Dressing. (Cr ar) Cooke, Iwasaki

210-211-212.*‡ Seminar: 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, Iwasaki

Metallurgy

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) Swalin, Sivertsen

101A-102A-103A. Science of Materials Laboratory. (1 cr per qtr; prereq ¶101-102-103)

153-154-155. Physical Metallurgy. Solidification and transformations in metals and alloys. Their influence on structure and properties. Cold working and annealing of metals. (3 cr per qtr; prereq 103 or ‡) Jerabek, Nicholson

153A-154A-155A. Laboratory in Physical Metallurgy. (1 cr per qtr; prereq ¶153-154-155) Jerabek, Nicholson

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 56, 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 155) 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, wear, fatigue in metals. Seminar procedure. (3 cr; prereq 155 or ‡) Jerabek

170-171-172.‡ 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 103) Sivertsen

174. Modern Theory of Metals and Alloys. Free electron theory of metals and application. Imperfection in crystals. (3 cr; prereq 173 or ‡) Sivertsen

175. Imperfections in Metals. Theory of imperfections and their effects on properties of metals. (3 cr; prereq 174 or ‡) 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 course in thermodynamics) Gupta

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 ‡)

261-262. Theories of Mechanical Behavior of Solids. Dislocations and crystal structure, elastic theory of interaction between dislocations and dislocation mobility. Theories of work-hardening, recovery, creep, fatigue, and fracture. (3 cr per qtr; prereq 101 or ‡) Gupta

263. Advanced X-ray Diffraction of Metals. Reciprocal lattice, structure factor, Fourier analysis, diffuse scattering and low angle scattering. (3 cr; prereq 155 or ‡) Sivertsen

271, 272. Structure and Cohesion of Metals and Semiconductors. Basic physical theory of bonding in metals, alloys, and semiconductors, stability of phases and elastic constants of these materials. Crystal structures of the various systems discussed and related to fundamental parameters such as sizes of atoms and electronic structure of the crystal. Topics include applications of Tight Bonding Approximation, Wigner-Seitz Method, etc., to problems of calculating equilibrium structures, heats of solution and energies of formation of defects. (3 cr per qtr; prereq PCh 118, 119, Phys 109, Met 182) Sivertsen

MICROBIOLOGY

Professor

John Spizizen, Ph.D., *head*
S. Gaylen Bradley, Ph.D.
Robert A. Good, M.D., Ph.D.
James J. Jezeski, Ph.D.
Joseph C. Olson, Ph.D.
Edwin L. Schmidt, Ph.D.
Dennis W. Watson, Ph.D.

Associate Professor

K. Gerhard Brand, M.D.
Martin Dworkin, Ph.D.
Leroy C. McLaren, Ph.D.
Louis H. Muschel, Ph.D.
Palmer Rogers, Ph.D.
Joseph V. Scaletti, Ph.D.

Assistant Professor

Dwight L. Anderson, Ph.D.
Robert W. Bernlohr, Ph.D.
Brooks D. Church, Ph.D.
Joseph W. St. Geme, Jr., M.D.
John E. Verna, Ph.D.

Lecturer

Wendell H. Hall, M.D., Ph.D.
John A. Ulrich, Ph.D.

Language Requirement—For the Master's degree, one foreign language. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and the option of a collateral field of knowledge. Acceptable languages are French and German.

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, MdBc 100 or 101, or BioC 120) Spizizen 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 1964-65 and alt yrs) Bradley

111s. Experimental Microbiology. Advanced laboratory study in comparative morphology, taxonomy, and physiology of bacteria. For microbiology majors and others interested chiefly in biological and chemical aspects of microbes. Stress enrichment, isolation, identification, cultivation, structure, and function of microorganisms. (5 cr; prereq 53, 121 and ♯) Church

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 1965-66 and alt yrs) Bradley

116w. Immunology. Host-parasite interactions; nature of antigens and antibodies; chemical basis of serologic specificity; qualitative and quantitative aspects of antigen-antibody reactions; theories of antibody production; cellular antigens and blood grouping; nature of complement and its role in immunologic phenomena; mechanisms of hypersensitivity; hypersensitivity-like states and immunologic diseases; homotransplantation and tumor immunity; mechanisms of natural and acquired immunity. (3 cr; prereq 53) Watson

116Aw. Immunology Laboratory. (2 cr; prereq ¶116)

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

122. 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; offered first term SS only) Rogers, 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. Biology of Microorganisms. Lectures, demonstrations, and laboratory exercises in taxonomy, anatomy, physiology, biochemistry, and ecology of microbes. Fundamental properties of bacteria. (4 cr; prereq 4 cr in biological sciences, OrCh 61, 62 or ♯) Dworkin

201f,w,s. Research in Microbiology. Graduate students with the requisite preliminary training may elect research, either as majors or minors. (Cr and hrs ar) Staff

202f,w,s. Diagnostic Microbiology. Laboratory procedures for isolation and identification of microorganisms from patients. Work is carried out in the diagnostic microbiology laboratories of the hospital. (Cr ar; prereq grad student in microbiology, ♯) St Geme, staff

203f,w,s. Seminar. (1 cr) Dworkin

205f,w,s. Advances in Immunology. Research reports: evolution and mechanisms of immune response, cellular and humoral aspects of hypersensitivity, immunological tolerance, autoimmunity and its relation to disease, and other topics. (1 cr per qtr) Watson, Good, Muschel, and staff

206s. Laboratory Methods, Applied Animal Cell Culture and Virology.** Laboratory exercises on preparation of animal cell cultures; study and laboratory diagnosis of viral and rickettsial infections. (3 cr; prereq 124 or ¶124, ♯; offered 1964-65 and alt yrs) Verna, staff

207. Advanced Medical Microbiology. (2 cr; prereq ♯) Brand

223s. Bacterial Metabolism. Advanced treatment of metabolism: enzymes; biological energy; fermentation; respiration; nitrogen metabolism. (3 cr; required of all PhD candidates in microbiology, open to others by consent; prereq 121 or equiv, introductory biochemistry) Bernlohr

MINERAL ENGINEERING

Professor
Eugene P. Pfleider
Strathmore R. B. Cooke

Associate Professor
Adrian C. Dorenfeld
Charles Fairhurst
W. David Lacabanne
Donald H. Yardley

Prerequisites—For major work, adequate preparation in undergraduate subjects and in the sciences fundamental to mineral engineering, in addition to general

** Microscope required. Students may obtain use of microscope by purchasing $3 microscope cards from the bursar.

admission requirements. For minor work, the prerequisites to the courses to be pursued, and approval of the major department.

Language Requirement—For the Master's degree, none. For the Ph.D. degree, either (a) two foreign languages selected from German, French, and Russian (other languages may be considered on petition); or (b) upon petition, one of the above languages and a special research technique. Students working toward the Ph.D. degree must either complete or show substantial progress toward completion of one language or the special research technique in their first year of residence.

Master's Degree—Either a Master's degree with departmental designation or an undesignated Master's degree is offered. Students who have a B.S. in mineral engineering have the option of obtaining either the designated or the undesignated M.S. degree. Students who have a B.S. degree in other fields (e.g., geology, physics, chemistry, etc.) may choose either (a) to make up the deficiencies in the basic engineering curriculum and proceed normally to the designated M.S. degree in mineral engineering, or (b) proceed directly to the undesignated M.S. degree.

Only Plan A will be allowed for students working toward an undesignated M.S. degree, whereas either Plan A or Plan B will be permitted for students working toward an M.S. degree with departmental designation.

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

111,* 112,* 113.* Principles of Mineral Engineering: I, Exploration; II, Development and Exploitation; III, Earth Fluids and Flow. Principles and techniques of exploration, factors and concepts involved. Sampling design, combining theory, geostatistics. Mining systems; unit operations, drilling, explosives, and transportation. Sedimentary rock and earth fluids characteristics. Fluid flow through reservoir rocks and aquifers. Energies and mechanisms of petroleum production. (3 cr per qtr) Yardley, Lacabanne

121. Mine Plant Engineering. Basic engineering principles in design and selection of mine and petroleum plant equipment. Calculations involving compressed air, pumping, transmission of gases and fluids, electrical equipment, and power systems. (3 cr; prereq ME 30 or ‡) Dorenfeld

122. Mine Plant Engineering. Basic engineering principles in design and selection of mine plant equipment. Calculations involving power transmission and drilling, transporting, and hoisting of materials. (3 cr; prereq 121, MM 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) 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 or ‡) Dorenfeld

126*-127.* Operations Analysis in Mineral Engineering I-II. Investment characteristics, capital costs; problems of variations products specifications. Statistical methods, tests of significance, correlation techniques; applications to cost estimates, sampling, mine and mill operations, blending, automation, and optimization techniques. (3 cr per qtr; prereq 122 or 125 or ‡) Dorenfeld

131*-132.* Rock Mechanics I, II. Elementary analysis of stress and strain. Rock stresses in mining. Design and layout of tunnels and mine workings. Rockbursts, subsidence. Techniques of underground stress measurement. Elementary blasting theory. Laboratory investigation of physical behavior of rocks. (3 cr per qtr; prereq MM 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. Engineering Field Study. Study of mining and petroleum operations, mine and petroleum plants, and metallurgical plants in selected regions. (3 cr; prereq ‡) Staff

141. Mineral Economics I. Minerals in national and world affairs, their importance and distinctive features. Distribution, demand, and conservation of strategic supplies. Marketing and prices. State and national policies affecting development. Analysis of mineral data. (3 cr; prereq Geo 62 or ‡) Pfleider

142.° Mineral Economics II. Examination and valuation of mining and oil properties. Geologic factors and mineral titles. Sampling and reserve estimates. Analysis of costs and profitability. Taxation, depreciation, and depletion. Present worth computations and mine financing. (3 cr; prereq 141 or ‡) Pfleider

144-145.° Mine Systems Analysis. Systems design in exploration, development, and exploitation of a mineral property. Integration of concepts from geology and geophysics, rock mechanics, mine or petroleum plant engineering, and mineral economics and valuation principles to a specific problem chosen by student. Preparation of report. (2 cr for 144, 4 cr for 145; prereq 142 or ‡) Pfleider and staff

151-152-153.°‡ Special Mining Engineering Problems. Literature survey or research work on mining problems. (Cr and hrs ar; prereq 112) Staff

155.° Materials Handling and Bulk Flow. Unit operations of excavation, loading, and transportation as related to mass movement of materials. Bulk material properties and systems. Strength theories, cohesion, flow principles. Engineering calculations and laboratory experiments. (3 cr; prereq MM 142 or ‡) Pfleider

160.° Geology and Technology of Nonmetallic Rocks and Minerals. Geologic and geographic setting, genesis, evaluation, exploitation, processing, and marketing of industrial rocks and minerals. Unique problems associated with this group of mineral materials. (3 cr; prereq 112 or ‡; offered 1964-65 and alt yrs) Yardley

171. Fluid Flow Through Porous Media I. Petrophysics of porous rocks and aquifers; single and polyphase flow for compressible and incompressible fluids. Ground water hydrology. Fracture flow. Electrical characteristics of porous rocks. (2 cr; prereq Phys 9 or 13) Lacabanne

171A. Fluid Flow Laboratory. Core analysis, porosity, permeability, surface areas, saturation measurements, linear and radial flow. Resistivity, formation factors, etc. (1 cr; prereq 171 or ¶171) Lacabanne

172.° Fluid Flow Through Porous Media II. Reservoir and aquifer energies and mechanisms of fluid movement and production. Material balance equations; fractional flows; effects of rock and fluid compressibilities. Steady and unsteady states. Water well hydraulics. (3 cr; prereq 171) Lacabanne

173. Natural Gas Engineering. Properties of natural gas; critical conditions of gases, compressibility factor, retrograde condensation. Estimation of gas reserves. Gas flow measurement, orifice meters and gas well back pressure tests; gas hydrates. (2 cr; offered when demand warrants) Lacabanne

180.° Geochemical Exploration. Application of geochemical techniques and principles to the search for ore bodies. Laboratory work on geochemical methods for determination of total and specific heavy metal content of rocks, soil, water, and plants. (3 cr; prereq ‡) Yardley

185.° Selected Topics in Mineral Exploration. Exploration programming in relation to theories of ore genesis. Analysis of effects of contract requirements on exploration decisions. Theory of ore sampling and combining. Statistical analysis of grade estimates. Search theory in exploration. (3 cr; offered 1964-65 and alt yrs) Yardley

201-202-203.°‡ Seminar: Mineral Engineering. (Cr ar) Lacabanne and staff

210.° Engineering Report. Detailed study and report of the actual operations of a mine. (Cr and term ar) Pfleider

212-213-214.°‡ Mining Research Problems. (Cr ar) Staff

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

241. Advanced Mineral Economics I. Study and analysis of mineral resources as related to national and world requirements. Presentation of assigned topics and class discussion. Invited lectures. (3 cr; prereq 142 and Geo 156 or 157 or equiv...Econ 2T recommended...or ‡) Pfleider

251-252. Advanced Rock Mechanics I, II. Analysis of stress and strain. Rock behavior under stress. Theories of rock failure in drilling and comminution. Folding and faulting; hydra-frac process. Original experimental investigations. Critical analysis of methods of rock testing. Model analysis. (3 cr per qtr; prereq MM 180) Fairhurst

MUSIC

Professor
Paul M. Oberg
Paul Fetler
Johannes Riedel
Roy A. Schuessler

Associate Professor
Dominick J. Argento
Arnold F. Caswell
Heinrich Fleischer
Paul S. Ivory

Assistant Professor
Frank P. A. Bencriscutto

Prerequisites—Candidates for graduate work must have a working knowledge of piano and performing ability in some phase of instrumental or vocal music, plus 30 undergraduate quarter credits in one of the following branches of music: (a) history and literature, (b) theory and composition, (c) piano pedagogy, or (d) music education. Placement tests in music theory and applied music are required of all entering students.

Language Requirement—For the master of fine arts degree. none. For the Master's degree, a reading knowledge of French or German. Substitution may be made by petition when a different language is needed for an individual research problem. For the Ph.D. degree, either (a) two foreign languages, or (b) one language and the option of a special research technique or a collateral field of knowledge. When two languages are offered, French and German are acceptable.

Master of Fine Arts Degree—The candidate must complete a program of approximately 2 full years of graduate credit, 45 of which must be earned in graduate courses at the University of Minnesota. He must execute and leave a record of a creative project (production, recital, or exhibition) which will be accompanied by a supporting paper that deals with the planning and/or execution of the creative work. A minimum of 9 credits will be required in history or literature of music, and the department requires a minimum of 9 credits in areas of study outside the major department. The individual program must be approved by the departmental M.F.A. committee. The candidate will be subject to final written and oral examinations.

Admission to candidacy is limited to a selected group of students with a Bachelor's degree from an approved university or college or the equivalent and to those who provide evidence of exceptional promise as creative artists in one or more of the following subfields: applied music, theory and composition, conducting, and church music.

Master's Degree—Offered under both Plan A and Plan B. The thesis subject and major work may be chosen from either the historical, theoretical, or music education subfields. An original composition may be offered in place of the usual research thesis under Plan A. Under Plan B, courses from the subfields of music not used for the concentration may be taken as related work, except that all Plan B students must present at least one field of 9 credits outside the various music subfields.

Doctor's Degree—Work leading to the Ph.D. degree with thesis is offered with emphasis on music history and literature, theory and composition, or music education. Students with marked creative ability may substitute an original composition for full orchestra for the usual research thesis.

100x. Advanced Applied Music. Advanced literature in piano, voice, organ, and orchestral instruments. (2 or 4 cr; prereq entr exam) Staff

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 1964-65 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 1964-65 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 1964-65 and alt yrs) Riedel

110. Music Bibliography. General reference sources. Music bibliographical materials in English, other languages; bibliographical drills in music history, theory and composition, music education, applied music. (3 cr; prereq one of the following: 36, 62, 72, 99, or ♯) Riedel

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 1964-65 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 1964-65 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 1964-65 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 1964-65 and alt yrs) Riedel

132. Symphonies of the Romantic Era. Schubert, Schumann, Mendelssohn, Berlioz, Liszt, Brahms, Franck, Dvorak, Tschaikowsky, Bruckner, Richard Strauss; their relation to dominant romantic trends of the 19th century. (3 cr; prereq 6 cr in music history or art history or political history since 1750 or English or German literature since 1750, or ♯; offered when feasible) Riedel

132A. Neoromantic Music. (1885-1917) Music of Bruckner, Mahler, Sibelius, Strauss, Schönberg, Reger, Elgar, Puccini, Leoncavallo, Charpentier, Franz, Cornelius, Wolf; impressionism. (3 cr; prereq 36 or ♯; offered 1964-65 and alt yrs) Riedel

133. Baroque Performance Practices. Ornamentation, phrasing, articulation, and improvisation in the music of the period of 1550-1759. A study of music instruction books of this era leading to analysis and performance of baroque music in baroque style. (3 cr; prereq 6T, 36, or ♯, ability to perform with some facility; offered when feasible) Laudon

134-135-136.° History of Church Music. Trends. Relationship of music to various theologies and liturgies. (3 cr per qtr; prereq 36 or ♯) Riedel

137-138-139. Keyboard Harmony. Practical ear training as applied to the piano; chorales are transposed into all keys in four parts and expanded chords by melodic and harmonic analysis; modulation. (1 cr per qtr; prereq 6T) Argento

140. Interpretation of Choral Masterpieces. Musical and vocal techniques necessary for presentation of great choral compositions from Renaissance to 20th century. (3 cr; prereq 6T or ‡; offered when feasible)

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) Laudon

147, 148, 149. Opera Workshop. Opportunity for student to prepare and perform operatic roles—standard and contemporary. A union of musical and dramatic interpretation is emphasized, and scheduled private instruction is given in addition to ensemble work. All projects and roles sung in English language. (2 cr per qtr; prereq ability to sing an aria satisfactorily) Knowles

150. Organ Literature. 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 1965-66 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 1965-66 and alt yrs) Riedel

157-158-159.‡ German Lieder. Selected songs as regards interpretation and style. 157: Schubert, Mozart, Beethoven. 158: Schumann, Brahams, 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 1965-66 and alt yrs) Bencriscutto

164-165-166.° Music in the Baroque Era. In Italy, Netherlands, Germany, Austria, France, Spain. (3 cr per qtr; prereq 36; offered 1964-65 and alt yrs) Laudon

170-171-172. Piano Pedagogy I. Group teaching of children both at beginning and advanced levels in the following situations: the studio piano teacher; pre-piano classes or keyboard experience; piano in public schools. Both demonstration and lecture classes and a required laboratory set-up to afford practical, on-the-spot experience and training in teaching children. (2 cr per qtr; prereq 2 yrs piano, 2 yrs theory, or ‡)

175. Training in Advanced Musicianship. Dictation of melodic, harmonic, rhythmic, two- and three-part contrapuntal materials; score reading, both vocal and instrumental; training in tonal memory. (3 cr; prereq 6T) Fetler

177.° Analysis of Contemporary Music. Twentieth-century styles and techniques including works of Bartok, Hindemith, Stravinsky, Schönberg, and others. (3 cr; prereq 6T) Fetler

180-181-182. Piano Pedagogy II. Group teaching of adults both at beginning and advanced levels in the following situations: the piano minor, the piano major, the music education piano major, the nonmusic major, in college teaching, as well as in adult education and extension classes along with the public school teacher. Demonstration and lecture classes and a required laboratory set-up to afford practical, on-the-spot experience and training in teaching adults. (2 cr per qtr; prereq 2 yrs piano, 2 yrs theory, or ‡)

190. Hymnology. History of hymn texts and tunes. Byzantine and Roman hymns. Lutheran hymn. Anglican hymn. Baptist, Congregational, Methodist, Presbyterian, Unitarian, and other hymns. History of hymn books. History of hymn settings. (3 cr; prereq 6 cr in Mus 34, 35, 36 or Art 66, 67, 68 or Phil 50, 51, 52 or Engl 66, 67 or ‡)

197-198-199. Advanced Counterpoint. Bach's *Art of the Fugue;* practice in technique of writing three- and four-voice fugues; contrapuntal devices and problems; analysis of polyphonic examples of various periods. (2 cr per qtr; prereq 99) Fetler

200-201-202.° Basis of Musical Expression. (3 cr per qtr; prereq 146; offered when feasible) Oberg

203. Notation of Polyphonic Music. History of notation, both vocal and instrumental; transcriptions of original works, written in black notation, white mensural notation, keyboard and lute tablatures, problems of transcribing and editing. (3 cr; prereq ‡; offered 1964-65 and alt yrs) Riedel

204x. Graduate Applied Music. (12 cr upon completion of 3 qtrs and presentation of complete grad recital; prereq entr exam; minimum of 12 hrs practice per wk) Staff

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: Composition and Orchestration. (3 cr per qtr; prereq grads who have completed an undergrad major sequence in music theory and composition, incl 99, 123, 129, 143, 199) Fetler

For music education courses, see index.

NUCLEAR ENGINEERING

In a broad sense, nuclear engineering encompasses the processing, separation, development, and testing of materials for nuclear reactors; the design and operation of nuclear reactors for research, isotope production, breeding, power, and heat generation; the utilization as well as the disposal of radionuclides and fission products; and the exploitation of nuclear energy sources.

Although the Graduate School does not offer a degree in nuclear engineering, a graduate student may prepare himself for a career in nuclear engineering through a proper choice of courses in existing majors, and through use of the special facilities for the study of heat transfer, metallurgy, neutron physics, gamma irradiation, radiochemistry, servomechanism and control, and reactor simulation.

A student interested in nuclear engineering should consult with the graduate faculty of the major of his choice concerning a suitable program of study. Departments participating in the Nuclear Engineering Committee include Mechanical Engineering, Chemistry, Physics, Chemical Engineering, Electrical Engineering, Metallurgical Engineering, and the School of Public Health.

The University of Minnesota is a participant in the Argonne National Laboratory, and through this affiliation supplementary instruction and research may be arranged. Recipients of the AMU-ANL and the AEC special fellowships in nuclear science and engineering may take their graduate work at the University of Minnesota in one of the above-mentioned departments.

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., *head*
A. B. Baker, M.D., Ph.D.
Ellis S. Benson, M.D.
Jesse E. Edwards, M.D.
Robert Hebbel, M.D., Ph.D.

Associate Professor
John I. Coe, M.D.
Paul H. Lober, M.D., Ph.D.
Nathaniel A. Lufkin, M.D.
Lee W. Wattenberg, M.D.

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) two foreign languages or (b) one foreign language and the option of a collateral field of knowledge. French, German, and Russian are acceptable languages.

Master's Degree—Offered only under Plan A.

Master's Degree with Designation in Pathology—Given only after 3 years of work.

Doctor's Degree—The Ph.D. degree with designation in pathology may be awarded after completion of 3 or more years in graduate work and presentation of a thesis of high quality.

101. Pathology. General pathology. (8 cr; prereq completion of 1st yr in Med School or equiv) Dawson, Hebbel, and staff

102. Pathology. Special pathology. (8 cr; prereq 101) Dawson, Hebbel, and staff

104x. Autopsies. (Cr ar; prereq 102) Dawson, Hebbel

105. Diseases of the Kidney. (3 cr; prereq 102) Hebbel

106. Diseases of the Heart. (1 cr; prereq 102) Staff

110x. Seminar: Pathology. (1 cr per qtr; prereq 102) Dawson

111x. Conference on Autopsies. (1 cr per qtr; prereq 102) Dawson

112. Diagnosis of Tumors. (Cr ar; prereq 102) Hebbel

113x. Surgical Pathology. (Cr ar; prereq 102) Hebbel

114. Diseases of the Liver. (1 cr; prereq 102) Staff

115. Advanced Neuropathology. (Cr ar, §NPsy 150, §NPsy 210; hrs ar) Baker

116. Problems in Neuropathology. (Cr ar, §NPsy 143; prereq 102; hrs ar) Baker

117. Neuropathology. (Cr ar, §NPsy 143; hrs ar) Baker

119. Survey of Neuropathology. Examination of specimens from current autopsies. (Cr ar, §NPsy 151 and §NPsy 212; hrs ar)

120. Diseases of the Lungs. (1 cr; prereq 102) Dawson

121. Diseases of the Alimentary Tract. (1 cr; prereq 102) Hebbel

122. Basic Science of Cancer. (4 cr; prereq MdBc 100 or equiv) Wattenberg

140f,w,s. Seminar: Experimental Pathology. (Formerly CBio 140) (1 cr) Halberg

141f,w,s. Problems in Experimental Pathology. (Formerly CBio 141) (Cr and hrs ar) Staff

150x. Problems in Pathology. (Cr and hrs ar; prereq 102, △) Staff

201x. Research. (Cr and hrs ar; grad students with necessary preliminary training may elect research, either as majors or minors in pathology)

207f,w,s. Research in Experimental Pathology. (Formerly CBio 207) (Cr and hrs ar) Staff

PEDIATRICS

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

PHARMACEUTICAL CHEMISTRY

Professor

Ole Gisvold, Ph.D., *head*
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 pharmaceutical chemistry, which is also concerned with the phytochemistry of natural products used for medicinal purposes.

Prerequisites—Graduate work leading to the M.S. and Ph.D. degrees with a major in pharmaceutical chemistry is open to students who have shown exceptional scholarship and ability in undergraduate courses of this or some other college of pharmacy of equal standing. Consideration will be given to applications of students who are not graduates in pharmacy but whose pattern of undergraduate work includes training in such allied or related subjects as would qualify them to do graduate work successfully with a major in pharmaceutical chemistry.

Language Requirement—For the Master's degree, one foreign language (German would be routinely acceptable). For the Ph.D. degree, either (a) two foreign languages (German and French would be routinely acceptable) or (b) one foreign language and the option of a collateral field of knowledge.

Master's Degree—In general, offered under Plan A. Plan B may be followed by petition.

Doctor's Degree—Graduate work leading to the Ph.D. degree is offered to students prepared for advanced work in pharmaceutical chemistry.

161-162-163. Organic Medicinal Agents. Sources, production, properties, reactions, structure-activity relationships, and uses of natural and synthetic organic compounds—both simple organic compounds (hydrocarbons, alcohols, amines, etc.) and vitamins, hormones, alkaloids, organometallics, etc. (3 cr per qtr; prereq OrCh 62) Gisvold and staff

164-165-166. Special Analytical Methods. Food, Drug, and Cosmetic Act and many of the official analytical methods of the U.S.P., N.F., and A.O.A.C. Analytical procedures involving instrumental methods. (3 cr per qtr; prereq 55, OrCh 63) Portoghese and staff

173. Special Problems in Pharmaceutical Chemistry. Elementary investigation of the analysis, synthesis, and phytochemistry of medicinal agents. (Cr ar; prereq ‡) Staff

201-202-203.° Seminar: Pharmaceutical Chemistry. (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 1965-66 and alt yrs) Staff

208.° Carbohydrates and Glycosides. Origin, isolation, characterization, and chemistry. (3-5 cr; prereq OrCh 63 or ‡; offered 1964-65 and alt yrs) Gisvold

209.° Akaloids. Isolation, purification, and characterization. (3-5 cr; prereq OrCh 63 or ‡; offered 1964-65 and alt yrs) Soine

211.° Terpenes and Plant Pigments. Discussion of their chemistry; experimental investigation of methods of isolation and characterization. (3-5 cr; prereq OrCh 63 or ‡; offered 1964-65 and alt yrs) DiGangi

212.° Fats, Waxes, Steroids, and Related Compounds. Origin, isolation, characterization, and chemistry. (3-5 cr; prereq OrCh 63 or ‡; offered 1964-65 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	Associate Professor	Assistant Professor
Charles V. Netz, *head*	Robert H. Miller	Hugh F. Kabat
Willard J. Hadley	Edward G. Rippie	

Pharmaceutical technology offers a selection of courses in physical pharmacy and hospital pharmacy. The pharmaceutical technology program with emphasis in physical pharmacy is designed for the student who desires to prepare himself for a career in education, industry, or research. The hospital pharmacy program, leading to a master of science degree in hospital pharmacy, is designed for the student who desires a responsible supervisory and managerial position in the hospital pharmacy.

Program in Hospital Pharmacy

Prerequisites—A degree from a college of pharmacy and an exceptional scholarship record. Evidence of personal capability and fitness for work in the hospital field is likewise necessary in each case and will be considered an essential requirement for admission.

Language Requirement—Knowledge of a foreign language may be waived upon petition to the Graduate School.

Minor Fields—The choice of minor fields of study may vary considerably depending on the research interest of the student. The selection of courses will be made after consultation with the student's adviser.

Master's Degree—Either Plan A or Plan B is acceptable.

Program in Pharmaceutical Technology

Prerequisites—A degree from a college of pharmacy and an exceptional scholarship record. Consideration will also be given to applicants who are graduates of institutions other than colleges of pharmacy provided their undergraduate courses satisfy the prerequisites for the graduate courses in pharmaceutical technology. The record must show completion of mathematics courses through differential equations and statistics. These courses can be completed after admission to the Graduate School. In addition, 1 year of physical chemistry is prerequisite to a number of required courses in the department.

Language Requirement—For the Master's degree, one foreign language. For the Ph.D. degree, either (a) two foreign languages or (b) with the consent of adviser one foreign language and the option of a collateral field of knowledge.

Minor—The choice of the particular courses to be presented in fulfillment of a minor in graduate work will be made after consultation with the student's adviser.

Master's Degree—In general, offered under Plan A. Plan B may be followed by petition.

Doctor's Degree—Graduate work toward the Ph.D. degree is offered.

165.* Cosmetics and Dermatological Preparations. Pharmaceutical aspects of cosmetics and dermatological preparations. (3 cr; prereq 56) Miller

166-167.* Pharmaceutical Manufacturing. Production and control of pharmaceutical preparations on a pilot plant scale. Formula development and product stabilization. (3-5 cr per qtr, prereq PhmC 163, PhmT 56 or ‡) Miller

168.* Preparation of Parenteral Products. Principles and procedures involved in manufacture of parenteral products. (3 cr; prereq ‡) Kabat

170. Hospital Pharmacy Administration I. The history, classification, organization, and functions of the departments in a hospital in relation to the pharmacy service. (2 cr; prereq 69 or ‡) Kabat

171. Hospital Pharmacy Administration II. The development, organization, responsibility, and administration of pharmacy services in a hospital. (3 cr; prereq 170 and ‡) Kabat

172. Hospital Pharmacy Survey. (1 cr; prereq 171 and ‡) Kabat

173.* Special Problems in Pharmaceutical Technology. Problems in formulation, production, and evaluation of pharmaceutical products. (Cr ar; prereq ‡) Staff

201x.* Seminar: Pharmaceutical Technology. (1 cr; required of majors in pharmaceutical technology) Staff

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) Rippie

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. (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., *head*

Assistant Professor
Lee C. Schramm, Ph.D.

Prerequisites—A degree from an accredited college of pharmacy and an exceptional scholastic record. Consideration will also be given to applicants who are graduates of institutions other than colleges of pharmacy provided their undergraduate courses satisfy the prerequisites for the graduate courses in pharmacognosy.

Language Requirement—For the Master's degree, one foreign language, German or French. For the Ph.D. degree, (a) two foreign languages, one of which must be German (and as the second French or Spanish would be acceptable) or (b) with consent of adviser, one foreign language and the option of a collateral field of knowledge.

Master's Degree—In general, offered under Plan A. Plan B may be followed by petition.

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

160. Intermediate Pharmacognosy. Crude drug production, biogenesis, enzymes, biological and fermentation products, insecticides, fungicides, and herbicides. (3 cr; prereq 3 or ‡) Staff

162. Metabolism. Biochemistry and physiology of drug-producing organisms. Chemical and physical methods for production and analysis of their medicinal constituents. (3 cr; prereq 3 or ‡) Staff

163. Microscopy and Microchemical Methods. Their use in study of drug-producing organisms and their constituents. (3 cr; prereq 3 or ‡) Staff

164. Pesticides and Plant Growth Regulators. Their use in cultivation and preservation of medicinal plants and their products. (3 cr; prereq 3, Phcl 56, or ‡) Staff

165. Basic Application of Radionuclides. Properties and utilization of radioactive substances of importance in biology, pharmacy, public health, and civil defense. (3 cr; prereq ‡) 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. (3 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. Problems of radioisotope applications. (Cr ar; prereq ‡) Staff

201-202-203.* Advanced Pharmacognosy. Advanced studies in pharmacognosy of living organisms producing medicinally important substances. (3-5 cr per qtr; prereq 162 or 163, and ‡) Staff

204x. Research in Pharmacognosy. (Cr ar; prereq ‡) Staff

PHARMACOLOGY

Professor

Frederick E. Shideman, M.D., Ph.D., *head*
Raymond N. Bieter, M.D., Ph.D.
Norman O. Holte, D.D.S.
Gilbert J. Mannering, Ph.D.
Harold N. G. Wright, Ph.D.

Associate Professor

Frank T. Maher, M.D., Ph.D.
Jack W. Miller, Ph.D.

Assistant Professor

Elizabeth M. Cranston, Ph.D.
Akira E. Takemori, Ph.D.
Travis I. Thompson, Ph.D.

Pharmacology is a broad science which considers the interactions between chemical substances or drugs and living organisms or life processes at all levels of organization. Facilities are available for most types of training and research in this field. For those primarily interested in toxicology or psychopharmacology appropriate programs are provided. Excellent opportunities exist for co-operative research with the clinical departments of the Medical School.

Graduate training in the field of pharmacology usually is oriented toward the Ph.D. degree, either as a major or a minor subject. The M.S. degree is offered only under special circumstances. A number of graduate fellowships, research assistantships, teaching assistantships, or traineeships are usually available.

Prerequisites—In addition to fulfilling requirements for admission to the Graduate School students should be well grounded in the biological and physical sciences.

Major—For a major the student is required to complete each of the medical courses prerequisite to, and including, the major courses in general pharmacology (103 and 104). These include courses in physiology and biochemistry. Additional requirements are Phcl 106, 201, 202, 203, 204, and 205 and such other courses as may be indicated by the major adviser.

Minor—To meet the requirements for a minor in pharmacology, the student must satisfactorily complete course work representing 22 credits. These courses must include Phcl 103, 104, 204, and 205.

Language Requirement—For the Master's degree, one foreign language—French or German. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and a collateral field of knowledge. Routinely acceptable languages for the Ph.D. are French, German, Italian, Russian, and Spanish.

Master's Degree—Offered only under Plan A.

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

101-102.† General Pharmacology. Lectures and laboratory exercises on the action and fate of drugs. Limited to students of dentistry and pharmacy. (8 cr) Cranston, Holte, Mannering, Miller, Shideman, Takemori, Wright

103-104.† General Pharmacology. Lectures and laboratory exercises on the action and fate of drugs. (10 cr; prereq Phsl 106, 107, or equiv and MdBc 100, 101, or equiv) Shideman, Cranston, Holte, Mannering, Miller, Takemori, Wright

105. Forensic Medicine and Medical Jurisprudence. Lectures on legal aspects of medicine and on laws governing practice of medicine. (1 cr; prereq enrollment in Medical School or ‡) Mannering, McCoid

106. Toxicology. Lectures on the chemistry, action, fate, and detection of toxic substances. (2 cr; prereq 101 and 102 or 103 and 104 or ¶104) Wright, Mannering

109x. Problems in Pharmacology. (Cr and hrs ar; prereq ‡) Shideman and staff

162x. Biological Assay of Drugs. (3 cr; prereq 101 and 102 or ‡) White

201. Advanced Pharmacology: Physiological Disposition of Drugs. Principles underlying absorption, distribution, metabolism, and excretion of drugs. (3 cr; prereq 101 and 102 or 103 and 104 or ‡; offered 1965-66 and alt yrs) Miller, Mannering, Shideman, Takemori

202. Advanced Pharmacology: Pharmacodynamics. Lectures and laboratory exercises on physiological, biochemical, and behavioral effects of drugs utilizing modern techniques. (3 cr; prereq 101 and 102 or 103 and 104 or ‡; offered 1964-65 and alt yrs) Miller, Takemori, and staff

203x. Research in Pharmacology. (Cr and hrs ar; prereq 103 and 104 or ‡) Shideman and staff

204x. Seminar: Selected Topics in Pharmacology. (3 cr on completion of 3 qtrs; prereq 101 and 102 or 103 and 104 or ‡) Miller and staff

205x. Seminar: Survey of Current Pharmacological Literature. (3 cr on completion of 3 qtrs; prereq 101 and 102 or 103 and 104 or ‡) Takemori and staff

206x. Seminar: Psychopharmacology. Selected topics on behavioral aspects of drug action. (3 cr on completion of 3 qtrs; prereq ‡) Shideman, Thompson, and staff

PHILOSOPHY

Associate Professor
D. Burnham Terrell

Professor
May Brodbeck
Herbert Feigl
Ralph G. Ross

Associate Professor
Homer E. Mason
Grover E. Maxwell
Karl H. Potter
Francis V. Raab

Assistant Professor
Gareth B. Matthews

Graduate Major in Philosophy

Prerequisites—To be accepted as a graduate major in philosophy, the applicant must present a satisfactory undergraduate record including 18 Upper Division credit hours in philosophy with a grade average of B or above. In special cases provisional registration may be arranged.

Subfields of Specialization—The following classification of philosophical studies is adopted for the purpose of these regulations: (a) history of philosophy; (b) logic; (c) metaphysics and epistemology; (d) ethics; (e) philosophy of science; (f) philosophy of religion; (g) aesthetics; (h) social and political philosophy.

Language Requirement—Students are required to choose the languages they will study in fulfillment of the language requirement from the following four: Greek, Latin, French, German. For the M.A. degree, one of these languages is required; for the Ph.D. degree, two are required.

Master's Degree—Offered 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 three examinations: one in history of philosophy, and two others in subfields selected by the candidate from those listed above, at least one 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 four subfields; and a further examination either in one other of the subfields of specialization listed above, or in one of the other specialized subfields specified by the graduate faculty in philosophy in its *Instructions for Graduate Students.*

Graduate Minor in Philosophy

Prerequisites—Registration as a graduate minor in philosophy is permitted only upon consultation with a graduate adviser in the department.

Master's Degree—The general requirements of the Graduate School must be satisfied.

Doctor's Degree—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)

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 1964-65 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 1965-66 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 one course from 50-51-52, or ‡)

118. Medieval Philosophy. Analysis of selected works of principal medieval philosophers, e.g., Augustine, Anselm, Aquinas, Scotus, Ockham. (3 cr; prereq 50, 51 or ‡) Matthews

120. Rationalism. Philosophies of Descartes, Spinoza, and Leibniz. (3 cr; prereq one course from 50-51-52 or ‡; offered when feasible)

121. Descartes. Analysis of philosophical works of Descartes. (3 cr; prereq one course from 50-51-52 or ‡; offered 1964-65 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 1965-66 and alt yrs) Terrell

130. Berkeley. Detailed study of Berkeley's philosophical works. (3 cr; prereq 52 or ‡; offered 1964-65 and alt yrs) Terrell

131. Hume. Detailed study of Hume's *Treatise and Inquiry*. (3 cr; prereq 52 or ‡) Terrell

132. Later Empiricism. Major developments in empiricist traditions, principally in Great Britain, between Hume and Russell. (3 cr; prereq 52 or ‡; offered when feasible) Terrell

134. Kant. Philosophy of Kant based on analysis of selected passages from his major works. (3 cr; prereq 52 or ‡) Mason

136. Brentano. The philosophy of Franz Brentano; its significance in the background of contemporary philosophy. (3 cr; prereq 52 or ‡; offered when feasible) Terrell

137. Kierkegaard. Detailed examination of major philosophical works of Kierkegaard. (3 cr; prereq one course from 50-51-52 or ‡; offered 1965-66 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 1964-65 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 ‡) 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) Brodbeck

157. Metaphysics. Some recent attempts to discover general principles characteristic of the universe. (4 cr; prereq one 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

162. Philosophy of Language. Contemporary attempts to deal with philosophical problems about language. Concept of meaning. Some attention to notions of language found in various forms of philosophical analysis. (3 cr; prereq 2 or 6 Upper Division cr in philosophy or ‡; offered when feasible) Mason

164. The Logic of the Social Sciences I. Philosophical examination of foundations of 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 1964-65 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: Philosophy. Topics to be arranged according to students' interests. (3 cr per qtr; prereq 9 cr, or ‡) Staff

193-194-195.† Seminar: History and Philosophy of Theology. (3 cr per qtr; prereq ‡)

210-211-212-213.† Seminar: Moral Philosophy. Systematic study of concepts and problems relating to ethical discourse. (3 cr per qtr; prereq 150) Mason, Raab, Terrell

217-218-219.† Seminar: 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: Epistemology. Problems in theory of knowledge. Consult *Class Schedule* for topics to be discussed during any given year. (3 cr per qtr; prereq 158 or ‡) Staff

227-228.† Seminar: Logical Theory. Selected topics in the philosophy of logic. (3 cr per qtr; prereq 154 and 155 or ‡) Brodbeck

230-231-232.† History of Philosophy, Advanced. Primarily for graduate students who have had no previous courses in the history of philosophy. Philosophy majors who have taken 50-51-52 may enroll with permission. (3 cr per qtr)

233-234-235.† Seminar: Philosophy of Religion. 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: 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

PHYSICAL MEDICINE AND REHABILITATION

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

PHYSICS

Professor

Alfred O. C. Nier
J. Morris Blair
Warren B. Cheston
Robert J. Collins
George D. Freier
Francois N. Frenkiel
Stephen G. Gasiorowicz
George W. Greenlees
Edward L. Hill
Norton M. Hintz
Homer T. Mantis
Edward P. Ney
Otto H. Schmitt
Joseph Valasek
Frank Verbrugge
Clifford N. Wall
John H. Williams
John R. Winckler

Associate Professor

Benjamin F. Bayman
A. Mark Bolsterli
Hans W. J. Courant
Walter H. Johnson, Jr.
Paul J. Kellogg
James H. Werntz, Jr.
Cecil J. Waddington

Assistant Professor

James A. Earl
Thomas E. Feuchtwang
Donald A. Geffen
Russell K. Hobbie
Lewis H. Nosanow
Carl H. Poppe
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, reading knowledge of two languages chosen from French, German, and Russian. 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, Math 26A or 106 for 100)

100A-101A-102A.° Introduction to Analytic Mechanics. Analytic course in Newtonian mechanics; conservation principles. Topics include: particle dynamics in one, two, and three 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, §100 or §MM 28 for either 100A or 101A; prereq 9 or 14, Math 26A or 106 for 100A...majors in fields other than physics may use MM 28, MM 29 as prereq 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, Math 26A or 106 for 103A)

107-109-111. Atomic and Nuclear Physics. Interpretation of experimental phenomena. Kinetic theory, Maxwell-Boltzmann distribution, special relativity, the nuclear atom, atomic and molecular structure and spectra, black-body radiation, wave mechanics, nuclear physics, modern developments in classical physics, astrophysics, particle physics. (3 cr per qtr, §50 or 51; prereq 9 or 14, Math 26A or 106, ♯ if taken out of sequence)

108-110-112.° Principles of Modern Physics. Combines elementary quantum mechanics with its historical background and applications to atomic and nuclear physics. Origin of quantum theory, electrons and quanta, atomic structure, particles and waves, the theory of quantum mechanics, one-electron atoms, exclusion principle, multi-electron atoms, X rays, scattering and nuclear physics. (3 cr per qtr; prereq 51, ¶Math 153 or 108)

113. Techniques of Nuclear Physics. Statistics of random events; interactions of photons, charged, and neutral particles with matter; detection devices; beam handling; measurement and analysis of cross sections. (3 cr; prereq ¶103A)

114-116-118.° Elementary Physical Investigation. Problems, either experimental or theoretical, of special interest to student. Written report. (Cr ar; prereq △)

120-121-122.‡ Experimental Atomic and Nuclear Physics. Techniques and methods used in physics research laboratories. Experiments with vacuum gauges and equipment; mass spectroscopy; X-ray diffraction; health physics; detection of charged particles, neutrons, and gamma rays; measurement of several fundamental atomic constants. (3 cr; prereq 51 or ¶107 or ¶108, ♯; 1 or 2 qtrs may be taken in any order)

123. Thermodynamics. Formulation of basic laws of thermodynamics concerning temperature, energy, and entropy; application to simple systems. (3 cr; prereq 9 or 14, Math 26A or 106)

124-125. Kinetic Theory and Statistical Mechanics. Kinetic theory dealing principally with gases, the Maxwell-Boltzmann distribution, and elementary theory of transport processes; principles of statistical mechanics, dealing with equilibrium properties of both classical and quantum systems of independent or interdependent particles. (3 cr; prereq 123 or ♯)

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 51 and ¶Math 26A or ¶Math 106)

131.° Geometrical Optics. Fundamentals of ray optics and its applications to optical instruments and their components. (3 cr; prereq 15 cr in physics, Math 25A or 44)

133.° Physical Optics. Wave theory of interference, diffraction, polarization and double refraction and their applications. (3 cr; prereq 15 cr in physics, Math 25A or 44)

133A. Physical Optics Laboratory. Parallel to 133. (1 cr; prereq ¶133)

134.° Experimental Optics. Laboratory. Spectrometry, optics of compound lenses, photometry, absorption, interferometry, and polarized light. (3 cr; prereq 15 cr in physics, Math 25A or 44)

136.° Spectrum Analysis. Laboratory. Measurement of wave lengths, intensities, and absorption coefficients in the infrared, visible, and ultraviolet regions of the spectrum. (3 cr; prereq 15 cr in physics, Math 25A or 44)

144.° Electrical Measurements. Ballistic and current galvanometers, magnetic flux measurements, potentiometers, D.C. and audio-frequency A.C. bridges, elementary D.C. and A.C. circuit theory. (4 cr; prereq 9 or 14, Math 26A or 55)

146.° Physics of Vacuum Tubes and Associated Circuits. Characteristics of vacuum tubes, power supply and amplifier circuits; applications to physics research. (4 cr; prereq 144 or ♯)

148.° Application of Electronic Circuits. Use of tubes and transistors in amplifier, oscillator, and pulse generating circuits employed in physics research. (4 cr; prereq 146 or ♯)

Zool 155, 156, 157.° Biophysics. (3 cr per qtr; prereq 28 cr distributed between physics and biology, and ♯...physical chemistry and general physiology recommended; schedule uncertain, consult dept)

165.° Introduction to Physics of the Atmosphere. Survey of physical processes which determine the mean state of the atmosphere. Topics in radiative transfer and thermodynamics reviewed in preparation for discussion of heat budget and temperature distribution of the atmosphere. Atmospheric properties and phenomena treated include: formation of clouds and precipitation, convection and stability, atmospheric electricity and ozone. (3 cr; prereq 50, Math 26A or 106)

166.° Meteorology I. Quantitative description of large-scale atmospheric motions. Basic equations of meteorological hydrodynamics introduced and applied in actual weather situations. (3 cr; prereq 165 or ♯)

167.° Meteorology II. Theoretical meteorology. Critical examination of mathematical models used to describe large-scale flow processes; energy transformations in atmospheric flow; atmospheric turbulence and eddy transport. (3 cr; prereq 166, vector analysis or ♯)

171-172-173.° Classical Theoretical Physics. Topics: classical mechanics, special theory of relativity, and classical electrodynamics. Application of advanced mathematical techniques to these subjects. (3 cr per qtr; prereq 104 or both 102A and 105A, Math 153 or 108 or equiv)

171A-172A-173A. Techniques of Theoretical Physics. Drill in solution of mathematical physics problems. (1 cr per qtr; prereq ¶171-172-173 or ♯)

181-183-185. Atomistics and Elementary Quantum Mechanics. Elementary quantum mechanics, with applications from atomic and nuclear physics. Schrodinger's equation, wave mechanics, matrix representations, perturbation theory, electromagnetic radiation, scattering, and the many-body problem. (3 cr per qtr; prereq 111 or 112, Math 153 or 108 or equiv)

Special prerequisites are noted for certain courses below.

201-202-203.° Dynamics of Fluid Motion. (3 cr per qtr)

204-205-206.° Statistical Thermodynamics. (3 cr per qtr)

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)

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; prereq 173, ¶Math 208 or ¶263 or equiv)

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)

231-232-233.° Theory of Atomic and Molecular Structure. (3 cr per qtr)

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)

240-241-242.*‡ Seminar: Solid State and Low Temperature Physics. (Cr ar)

246-247-248.* Cosmic Rays. (3 cr per qtr)

249-250-251.* Solid State Physics. (3 cr per qtr; prereq 173 and 185 or ♯)

252-253-254.*‡ Seminar: Nuclear Physics. (Cr ar)

255-256-257.*‡ Seminar: Mass Spectroscopy. (Cr ar)

258-259-260.*‡ Seminar: Cosmic Rays. (Cr ar)

261-262-263.* Mathematical Foundations of Quantum Mechanics. (3 cr per qtr; offered when demand warrants)

264-265-266.* Elementary Particle Physics. (3 cr per qtr; prereq 185 or ♯)

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)

301-302-303.*‡ Research in Physics. (Cr ar)

PHYSIOLOGICAL HYGIENE

Professor

Ancel Keys, Ph.D., *head*
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, two foreign languages (French and German).

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 of these students should be drawn up early in their course of study and be submitted to the dean of the Graduate School.

PubH 191. Science of Human Nutrition. Surveys, nutritional status, malnutrition. (3 cr; prereq ♯; offered when demand warrants) Anderson, Grande

PubH 192. Physiology of Exercise. Muscular efficiency, training, deconditioning, effects of exercise on physiological systems. (Cr ar; prereq Phsl 106, 107 or equiv, and ♯; offered when demand warrants) Simonson, Taylor

PubH 195. Public Health Aspects of Cardiovascular Disease. (3 cr; prereq ♯) Keys, Grande, and staff

PubH 202x. Seminar: Physiological Hygiene. Nutrition, tests and measurements of human physical fitness, gerontology, adaptation in health and disease, circulatory dynamics, and related topics. (1 cr)

PubH 220x. Readings in Problems of Physiological Hygiene. (Cr ar; prereq ‡)

PubH 290x. Research in Physiological Hygiene and Related Areas. (Cr ar)

PHYSIOLOGY

Professor

Maurice B. Visscher, M.D., Ph.D., *head*
Francisco Grande, M.D.
Eugene D. Grim, Ph.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.
Irwin J. Fox, M.D.
Rodney B. Harvey, M.D., Ph.D.

Assistant Professor

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, one foreign language. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and the option of a collateral field of knowledge. Acceptable languages are French, German, and Russian.

Master's Degree—Offered under both Plan A and Plan B, the latter by petition.

Doctor's Degree—Work for the Ph.D. degree is offered to candidates whose background of training is approved by the graduate faculty. The requirements for the minor program can be satisfied either by the use of a conventional minor or, in appropriate instances, the use of a supporting program.

100. General Physiology. For high school teachers in biological sciences and for those who wish an introduction to modern physiological science. (4 cr; prereq college algebra, 1 yr chemistry, college physics)

106-107.† Human Physiology. (7 cr for 106, 8 cr for 107; prereq organic chemistry, zoology, and neuroanatomy; students may register for lect without lab) Visscher and staff

112x. Hemodynamic Measurements. Demonstrations and student participation in the setting up, calibration, and use of modern tools for measurements of blood pressure, blood flow, cardiac output, circulation time, oxygen saturation of blood, blood volume, and vasomotor control of vascular beds. For students specially interested in cardiovascular problems. (3 cr; limited to 10 students; prereq ‡)

113x. Problems in Physiology. Arranged with qualified students. Topics assigned for laboratory study, conferences, and reading. (Cr ar; may be taken 1 or more qtrs; prereq 107) Visscher and staff

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, 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, 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 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 yrs) 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) 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) Cavert, Lorber

236s. Renal Hemodynamics. (Cr ar; prereq 107 within past 8 yrs) Harvey

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 PHYSIOLOGY

Professor
Milton F. Kernkamp
Clyde M. Christensen
Carl J. Eide
David W. French
Helen Hart
Thomas H. King
Thor Kommedahl
Albert J. Linck

Associate Professor
John B. Rowell
Theodore W. Sudia
Roy D. Wilcoxson

Assistant Professor
Neil A. Anderson

Instructor
Matthew B. Moore

Prerequisites—To major in either plant pathology or plant physiology, a general background in basic sciences and in mathematics is necessary; and it is expected that a student will make up deficiencies in any such course before he becomes a candidate for an advanced degree. Deficiencies can be scheduled after consultation with the major adviser.

To minor in either plant pathology or plant physiology, a student must satisfy the graduate faculty that he is adequately prepared.

Course Requirements—In addition to courses in plant pathology and plant physiology, courses in other fields of agricultural or biological sciences may be applied toward an advanced degree for either major, minor, or supporting program of study, if the adviser approves. A student majoring in these fields will continue studies during at least one summer.

Language Requirement—For the Master's degree, one foreign language. For the Doctor's degree, the requirement may be met by either (a) two foreign languages, or (b) one foreign language plus a collateral field of study or a special research technique.

Master's Degree—Offered under Plan A; rarely under Plan B.

Doctor's Degree—Work for the Ph.D. degree is offered in plant pathology or in plant physiology.

Plant Pathology

101. Nematodes in Relation to Plant Diseases. Nematodes as plant pathogens; nematode taxonomy, morphology, life cycle, biology, and control; pathogenicity and host-parasite relationships; alone and in combination with other plant pathogens. (3 cr; prereq 1, 51, or 120 and 6 cr in zoology or Biol 2, or ‡) R Anderson, Kernkamp

105. Introduction to the Study of Fungi. Structure, habits, classification, and identification of fungi. (3 cr, §106, §107; prereq 9 cr in botany or Biol 2 or ‡) Christensen

106, 107.* Mycology. Morphology and taxonomy of fungi. (3 cr per qtr; prereq 1 or 51 or 105 or equiv) N Anderson

112, 113. Plant Pathology. Diseases of ornamental plants, vegetable crops, fruit crops, field crops, and trees. Lectures, conferences, laboratory, and field work. Laboratory and field work continues throughout the summer. (3 cr per qtr; prereq 120 and 105 or equiv) Kommedahl, other staff

117. Virus Diseases of Plants. Nature of plant viruses and virus diseases; methods for studying virus diseases. (3 cr; prereq 1 or 51 or 120; offered 1965-66 and alt yrs, or when demand warrants) King

118. Bacterial Diseases of Plants. Bacteria as plant pathogens; representative types; techniques used in studying bacterial diseases of plants. (3 cr; prereq 1 or 51 or 120 and 3 cr in bacteriology; offered 1964-65 and alt yrs) Eide

119. Principles of Plant Disease Control. General consideration of principles and practices. (3 cr; prereq 1 or 51 or 120) King

120x. Introductory Plant Pathology for Advanced Students. (See PlPa 1). General plant pathology. (3 cr, §1 or §51; prereq 14 cr in plant sciences or ‡) French, Moore

141. Insects in Relation to Plant Diseases. (Same as Ent 141) Insect transmission and dissemination of plant pathogens; plant-insect relationships; habits of principal insect vectors—practical control methods. (3 cr; prereq 5 cr in entomology and 5 cr in plant pathology or their equiv, or ‡) Wilcoxson, Peterson

156. Study of Fungi for Advanced Students. General characteristics of fungi; cultural and taxonomic procedures and practices. (6 cr; prereq 9 cr in botany, or ‡; offered only at Itasca Biology Session) French

201x.* Research in Nematology. Taxonomy or ecology of plant parasitic and free-living terrestrial or aquatic nematodes. (Cr ar; prereq 101 or ‡) Kernkamp, R V Anderson

203x.* Research in Plant Pathology. Special assignment of work in laboratory and field problems in pathological research. (Cr ar)

207x.* Problems in Mycology. Research along such lines as taxonomy of natural groups, fungus flora of particular regions, localities, or habitats; investigation of fungi involved in industrial or natural processes; morphology or physiology of special forms. (Cr ar; for minor or major; prereq 105, 106, 107) Christensen, N Anderson

211. History of Plant Pathology. Development of plant pathology as a science. (2 cr; offered 1964-65 and alt yrs, or when demand warrants) Kernkamp

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, 105 or equiv, and Agro 131; offered 1964-65 and alt yrs) Kernkamp, N Anderson

216. Physiology of Plant Pathogens. Concepts and current information on the physiology and biochemistry of plant pathogens and applications to host-parasite relationships. (3 cr; prereq 105, 120, BioC 105 or ‡) Kernkamp

217. Ecology of Plant Pathogens. Effect of environment on plant pathogens and plant disease epidemics. (3 cr; prereq 1 or 51 or 120, 105 or equiv) Wilcoxson

218. Principles of Plant Pathology. Systematic consideration of basic factors governing development of plant diseases. (3 cr; prereq 1 or 51, 105 or equiv, MicB 53, and 6 addtl cr in plant pathology) Eide

219. Physiology of Plant Pathogens Laboratory. Designed to illustrate principles in study of physiology of plant pathogens and their parasitic associations, utilizing advanced research techniques. (2 cr; prereq 216 or ¶216, 108, or ‡) Kernkamp

Agricultural Plant Physiology

103. General Plant Physiology. Major physiological processes in plants; application of physiological principles to agricultural problems. (3 cr; prereq Bot 51 or 140) Linck

108. Plant Physiological Methods. Lectures concerning principles underlying major plant physiological methods and extensive experience in the laboratory. (2 cr; prereq 103 or Bot 140 and quantitative analysis, or equiv) Linck

136. Physiological Basis of Chemical Action. Entrance, movement, and metabolism of chemicals of agricultural importance in plants. (3 cr; prereq Biol 2 and Bot 140 or equiv; offered 1965-66 and alt yrs) Linck

137. Animal Diseases and Poisonous Plants. (Same as VMC 137) Systematic study of important plants poisonous to animals; identification, toxicology, diagnosis, and treatment. (3 cr; prereq $) Kommedahl, Johnson

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; offered 1965-66 and alt yrs) Linck

162. Physical Factors of the Environment and Plant Growth. Effects of physical factors of environment on physiological processes important in growth and development of economic plants. (3 cr; prereq Biol 2, Bot 140 or equiv; offered 1965-66 and alt yrs) 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; offered 1964-65 and alt yrs) Sudia

166. Water Relations of Economic Plants. Water economy of plants. Absorption, translocation, transpiration, and osmotic relations of economic plants. (3 cr; prereq Biol 2 and Bot 140 or equiv; offered 1964-65 and alt yrs) Sudia

214. Radioisotope Techniques Applied to Biology. Lecture and laboratory course on 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 course in nuclear physics) Linck, Caldwell

251x. Seminar: Plant Physiology. Critical review of progress and problems in plant physiology. (1 cr) Staff

254x. Research Problems in Plant Physiology. Special assignment of work in plant physiology. (Cr ar) Linck, Sudia

259. History of Plant Physiology. Development of plant physiology from 17th to 20th centuries. Collateral readings required. (2 cr; prereq botany and 1 qtr physiology; offered 1964-65 and alt yrs) Sudia

POLITICAL SCIENCE

Professor
Charles H. McLaughlin
Harold W. Chase
Benjamin E. Lippincott
Orville C. Peterson
Lloyd M. Short
Mulford Q. Sibley
John E. Turner
George A. Warp

Associate Professor
Charles H. Backstrom
Edwin Fogelman
Robert T. Holt
Francis J. Sorauf, Jr.

Assistant Professor
William H. Flanigan
Thomas M. Scott

The graduate faculty of the Department of Political Science offers instruction leading to the M.A. and Ph.D. degrees. It is directed toward educating career political scientists for teaching, research, and public service. Instruction for graduate majors is conducted separately from undergraduate instruction, and course requirements for graduate degrees with major in political science can be satisfied only by completion of courses open only to graduate students (200-level courses). Although course numbers are provided to permit registration of students for supervised individual reading and research, these can be used only in exceptional circumstances and with the explicit consent of the graduate adviser and the instructor; the department strongly desires that course requirements be satisfied by registration in organized seminars. Those who are inadequately prepared to enter particular seminars may in some cases be asked to complete as additional work prerequisite undergraduate courses. All major programs, and all minor programs for the Ph.D., must be approved by a graduate adviser of the department.

Prerequisites—Courses in political science are open to all regularly enrolled graduate students who can meet course prerequisites. Before being accepted as a candidate for a graduate degree with a major or minor in political science, a student must satisfy his adviser that he is prepared for graduate work in the subfields proposed for specialization. Candidates must have a minimum of 27 undergraduate credits in the major, but in exceptional cases completion of courses in other social sciences may be accepted as part of the prerequisites.

A more detailed explanatory statement of prerequisites, subfields and subareas, and requirements for the M.A. and Ph.D. degrees may be obtained from advisers or the office of the department.

Language Requirement—For the Master's degree, one foreign language. A special research technique may be substituted upon recommendation of the major adviser and the approval of the department committee on graduate work. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge.

Areas of Study—Graduate instruction in the field of political science is offered in seven subfields, which for the purpose of stating degree requirements have been arranged in two groups. In each subfield seminars, ranging in number from 7 to 12, are offered. From five to seven of these are directed to particular areas within the subfields; in addition two or three research seminars are offered in each subfield on topics appropriate to the interests of staff and students. The principal groups and subfields are as follows:

Group I

1. Political theory
2. Comparative government and politics
3. International relations

Group II

4. Politics and behavior
5. American governmental systems and processes
6. Public administration
7. Public law

In those few cases in which courses are assigned to more than one subfield (Pol 241 A-B, 242 in International Relations and in Public Law, Pol 262 in American Governmental Systems and Processes and in Public Law, Pol 278 in Public Administration and in Public Law), students can offer them in satisfaction of course requirements in either subfield but not in both subfields. Both subfields may be offered, but other courses must be chosen to satisfy requirements in one of them.

General Requirement—All candidates for graduate majors with major in political science must complete Pol 200 (Scope and Methods of Political Science, I), or present evidence of satisfactory completion of a similar course at another approved institution. Candidates for the M.A. degree under Plan A and for the Ph.D. degree must also complete Pol 201 (Scope and Methods of Political Science, II). Candidates for the M.A. under Plan B are advised to do so if they intend later to go on to the Ph.D. Whenever possible Pol 200 and 201 should be completed during the first year of graduate study.

Note—For information on work in public administration and international relations and area studies, see index.

Requirements for the Degree of Master of Arts

Plan A with Major in Political Science—The work leading to the Master's degree under Plan A consists of at least 3 quarters of graduate study, including: (a) in addition to Pol 200 and 201, at least 18 credits in political science including three

seminars (9 credits) in each of two subfields; (b) at least 9 credits in the minor department comprising either a 9-credit course or a sequence of related courses totaling 9 credits; (c) a substantial thesis based upon independent research; (d) successful completion of a written preliminary examination in each of the subfields presented, and a final oral examination covering these subfields and the thesis.

Plan A with Minor in Political Science—Candidates for graduate degrees with political science as the minor must take at least one 9-credit course or a group of related courses lying in either one or two subfields and totaling 9 credits. Either 200-level or 100-level courses may be used.

Plan B with Political Science as the Field of Concentration—Candidates for the Master's degree without thesis must complete: (a) in addition to Pol 200 (and Pol 201, if taken) at least 21 to 27 credits in political science seminars chosen from either two or three subfields; (b) a minimum of from 18 to 24 credits of course work in at least two related disciplines; (c) research papers as specified in the requirements of the Graduate School; (d) a final written examination covering the subfields presented and oral examination covering these and the research papers. Courses elected in political science together with those in the related fields should constitute an integrated plan of study. Normally at least two of the required research papers, if submitted in 3-credit courses, or one, if submitted in a 6- or 9-credit course, should be prepared for courses in the field of concentration.

Requirements for the Degree of Doctor of Philosophy

Major in Political Science—The candidate shall, with the approval of his adviser, choose and prepare himself for examination in three subfields of specialization. It is recommended that he present subfields drawn from both groups, but at least one subfield must be chosen from Group I. One subfield shall be designated as the thesis subfield or subfield of concentration. In it the candidate shall take a minimum of seven seminars (21 credits), ordinarily including two or three research seminars (6 to 9 credits). In each of the other two subfields the candidate will take a minimum of five seminars (15 credits), usually not including research seminars. These course requirements are in addition to Pol 200 and 201. A minor or supporting program of courses in one or more related disciplines (the number of credits to be in accordance with the requirements of the Graduate School) is also required; the courses should be selected to support the major program.

A full-time student taking four seminars per quarter and well prepared by undergraduate training for graduate work in political science can complete course work for the Ph.D. in approximately 2 years. Students who lack sufficient preparation will be expected to master a subfield by additional course work or independent study, as the adviser may determine. Students who have received the M.A. degree at other institutions must pass a qualifying examination in one subfield of the graduate major before the end of the first year of residence.

Candidacy for the Ph.D. degree is achieved by completion of the prescribed course work and of written and oral preliminary examinations covering the subfields presented in the major field, and in the minor field or supporting program if required by it. The degree is then obtained after submission of an acceptable dissertation embodying independent research and a final oral examination devoted to the thesis and to relevant aspects of the subfield in which it is written.

Minor in Political Science—A candidate for the Ph.D. degree who elects political science as his minor shall prepare himself for examination in one or two subfields, completing courses at least sufficient to satisfy the minor requirements of the Graduate School. If he concentrates in one subfield he must include 9 credits of 200-level courses; if he chooses two subfields he must include one 3-credit 200-level course in each.

Written Examinations—The department requires all candidates for the Ph.D., whether majoring or minoring in political science, and all candidates for the M.A. with major in political science, whether under Plan A or Plan B, to take assembled written preliminary examinations in each of the subfields of specialization included in their political science programs. Successful completion of these examinations in each subfield (i.e., C+ or better in minor subfields, B or better in major subfields) is prerequisite to permission to take oral examinations. Assembled written examinations 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 subfields to be offered. The Ph.D. candidate will be given two written examinations in each of his subfields. The first will be designed to test his knowledge of fundamental principles, methods, and relationships essential to a command of the subfield; the second will deal with areas within the subfield, offering sufficient alternatives to accommodate the area specializations of students. Candidates are expected to demonstrate a substantial knowledge of the subfields and areas chosen within them, not just the materials covered in courses.

Candidates for the M.A. degree will be given one preliminary examination in each subfield presented. These examinations will be more closely related to course work.

Further details concerning the administration of the written examinations, and reading lists suggestive of the literature to be covered in each subfield, are available in mimeographed form in the office of the Department of Political Science.

Curriculum—In the listing of courses which follows, 100-level courses are open to Upper Division and graduate students. Although graduate credit may be obtained in these courses, it cannot be offered in satisfaction of course requirements for graduate majors in political science; it is acceptable to the extent stated above in satisfying requirements for a minor field or supporting program, or as additional work prerequisite to 200-level seminars. The 200-level courses include seminars which may be offered in satisfaction of course requirements for majors.

GENERAL

200.* Scope and Methods of Political Science I. The field of political science; relation to other sciences; types of approach; research methods and techniques; bibliography. (3 cr; prereq ‡) Sorauf

201.* Scope and Methods of Political Science II. Contemporary trends and currents within political science; problems in analysis and theory; normative and empirical political science. (3 cr; prereq ‡) Sorauf, Holt

POLITICAL THEORY

160.* American Political Thought. From colonial times to present; Puritanism; Constitution; utopianism; Calhoun; history of anarchist, socialist, populist and syndicalist thought; social Darwinism; conservatism; political thought in law and literature. (3 cr; prereq B or 9 cr in social science or ‡) 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; 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: idea of sovereignty; Protestant conceptions; English Civil War; Hobbes, Spinoza, Locke; idea of progress; Godwin, Burke, Rousseau, rise of romanticism; German idealism. (3 cr; prereq B, or 9 cr in social science or ♯) Sibley

Note—In selecting courses to satisfy degree requirements no distinction is made between reading and research seminars in the subfield of political theory.

205Af-Bw-Cs.°‡ Topics in the Development of Political Thought. Selected topics are examined each quarter. In general these will relate in 205A to ancient, in 205B to medieval, in 205C to modern political thought. Specific areas of concentration will be varied from year to year, e.g., Plato's outlook, development of natural law views, 13th-century political theory, development of modern anarchism, utilitarianism, Marxism, Hegelianism. (3 cr per qtr; prereq 164 for 205A, 165 for 205B, 166 or 162 for 205C or equiv or ♯) Sibley

208Aw-Bs.° Readings in the Classics of Politics. Plato, Aristotle, Machiavelli, Hobbes, Locke, Rousseau, Mill, Marx, Lenin, Hitler. (3 cr per qtr; prereq 164, 165 or ¶164, ¶165 or ♯) Lippincott

210Aw-Bs.°‡ Topics in Twentieth-Century Political Thought. Selected aspects of 20th-century political thought; specific subjects will vary from year to year, e.g., traditional theory and its critics, socialist perspectives, conservatism and the radical right, the scientific revolution and politics, the Christian revolution and politics. (3 cr per qtr; prereq 162 or equiv or ♯) Lippincott

212Af-Bw-Cs.° Contemporary Political Theory. Intensive examination of selected empirical theories from the standpoint of their usefulness for political analysis: communication theory, game theory, systems theory, decision-making theory, conflict theory, structural-functional theory, etc. (3 cr per qtr; prereq ♯) Fogelman

214Af-Bw.°‡ American Political Thought. Examination of major issues and thinkers (statesmen, novelists, academic men, etc.). Relation of political thought to problems of American culture. (3 cr per qtr; prereq 160 or equiv, grad major in American studies, or ♯) Sibley

216Af-Bw-Cs.°‡ Problems in Political Thought. Selected problems varied from term to term, e.g., liberty, authority, obligation, theory of democracy, relation of politics to law, socialism, religion, and politics. (3 cr per qtr; prereq ♯) Lippincott, Sibley, Fogelman

219Af-Bw-Cs.°‡ Individual Reading and Research in Political Theory and Development of Political Thought. (3 cr per qtr; prereq ♯) Lippincott, Sibley, Fogelman

COMPARATIVE GOVERNMENT AND POLITICS

141-142.° European Government and Politics. Britain, France, Germany, and Italy. Political institutions in their social setting; problems of power and responsibility, governmental stability; political decision making, government and the economic order. (3 cr per qtr; prereq B or 12 cr in social science or ♯) 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 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)

149f-150w.° Government and Politics of South Asia. Political institutions of South Asian countries in their social setting, sources and nature of ideologies; politics and class structure; parties and elections; economic and social policies. (3 cr per qtr; prereq 6 cr or 12 cr in social science or ♯)

153.° Japanese Government and Politics. Constitutional and political development in Japan; political ideas, government, political parties, and problems. (3 cr; offered 1965-66 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 1964-65 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.° Government and Politics of Developing Areas. Analysis of political problems of new nations; political consequences of the breakdown of traditional society and problems of developing new institutional forms and procedures. (3 cr; prereq C or 15 cr in any combination of economics, sociology, and/or anthropology) Holt 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

196s. Proseminar in East and South Asia. For description see course listing under the subfield International Relations.

Note—Graduate students who select comparative government as the field of concentration must complete seminar work in at least two culture areas. It is expected that a student will have completed some work in area courses before registering in the interarea analytical courses (228, 229, 230, 233).

220Af-Bw.° Government and Politics in Western Europe. Analysis of political institutions of Britain, France, Germany, and Italy; political development; social structures; ideologies, parties, and pressure groups; voting behavior. (3 cr per qtr; prereq 142 or equiv) Turner or Holt

221s.° Government and Politics of the U.S.S.R. Analysis of rise of Bolshevism; sources and nature of the belief system; development of Communist regime; institutional features; organization of power; role of the party; social, economic, and foreign policies. (3 cr; prereq 143 or equiv) Turner or Holt

223.° Government and Politics of Japan and China. Analysis of Japanese and Chinese political institutions in their social setting: political development; ideologies; organization of political power; parties and pressure groups; socio-economic basis of political action. (3 cr; prereq 153 and 154 or equiv; offered 1965-66 and alt yrs) Turner

224.° Government and Politics of India and Southeast Asia. Analysis of political institutions of India and selected countries of Southeast Asia in their cultural setting; political development; ideologies; relationship of social structure to political institutions; parties and pressure groups. (3 cr; prereq 150 or equiv or ‡)

226.° Government and Politics in Latin America. Analysis of political institutions and processes, with emphasis upon selected countries: social and economic basis of politics; parties and interest groups; political instability and change. (3 cr; prereq 155, 156 or equiv or ‡) Klein

228.° Democratic Systems. Application of the comparative method to analysis of democratic systems; prerequisites for modern democracy; origin and development; socio-economic basis of politics; organization of power; role of parties and interest groups; patterns of voting behavior; nature and role of elites. (3 cr; prereq 142 or equiv) Turner, Holt, or Klein

229.° Totalitarian Systems. Application of the comparative method to analysis of totalitarianism; origin and development; socio-economic basis of power and authority; institutional features; nature and role of ideologies; evolution of elite structures; role and functions of the party; economic and social policies; limitations upon totalitarianism. (3 cr; prereq 143 or 154 or equiv) Turner, Holt, or Klein

230.° Politics of Developing Systems. Application of the comparative method to analysis of political development, especially of contemporary underdeveloped areas; factors that make for different theories of development. (3 cr; prereq 157 or equiv or ‡) Holt or Klein

232.* Comparative Methodology and Research Design. A study of the logic of comparative research design; conceptual requirements of cross-cultural research. (3 cr; prereq ♯) Turner, Holt, or Klein

233A-B.*‡ Research Seminar: Comparative Government and Politics. Group research upon selected topics under faculty guidance and supervision. (3 cr per qtr; prereq ♯) Turner, Holt, Klein

234Af-Bw-Cs.*‡ Individual Reading and Research in Comparative Government and Politics. (3 cr per qtr; prereq ♯) Turner, Holt, Klein

INTERNATIONAL RELATIONS

171.* Scandinavian Foreign Policy. (3 cr; prereq 6 cr in history or political science or ♯; offered when feasible)

175.* Diplomacy. Nature, functions, historical development of diplomacy; relation to forms of government and power systems. Traditional diplomacy, diplomacy by conference and in international organizations, personal diplomacy, open and secret diplomacy. Essentials of diplomatic usage. Diplomatic agents. (3 cr; offered 1965-66 and alt yrs) McLaughlin, Burke

176w.* U.S. Foreign Affairs Administration. Control of foreign relations; treaties and executive agreements; structure and function of foreign affairs agencies—Department of State, U.S. Information Agency, Central Intelligence Agency; Department of Defense, National Security Council; co-ordination of agencies; the Foreign Service and other overseas agencies. (3 cr; offered 1965-66 and alt yrs) McLaughlin

177s.* U.S. Foreign Policy. Analysis of factors conditioning U.S. foreign policy: geographic and economic position, defense needs and dispositions, social structure, ideologies, psycho-cultural characteristics, technological revolution, public opinion, political participation; role of parties, interest groups, bureaucracy; leadership; decision-making processes. (3 cr; offered 1965-66 and alt yrs)

180f-181w†-182s.* International Law (Peace). 180-181: Relation of international law to individuals, states, international community, jurisdictional problems; survey of principles developed in diplomatic practice, national courts, international adjudications. 182: Status of diplomatic agents and consuls, treaties, arbitration, treatment of aliens, pacific settlement. (3 cr per qtr) McLaughlin

183s.* International Law (Conflict). War and hostile measures short of war, military occupation, war crimes, neutrality, collective security sanctions. (3 cr; prereq 181 or ♯; offered when feasible) McLaughlin

184f.* International Politics I. State action in international relations; forms of state action; foreign policy-making analysis; capabilities analysis. (3 cr) Klein

185w.* International Politics II. Analysis of systems of interaction among nation-states; balance of power, bipolar, and other types of international system; conflict and co-operation. (3 cr) Klein

186s.* Regional International Systems. Examination and comparison of selected regional systems of interaction among nation-states, past and contemporary; stability and change. (3 cr; prereq 185) Klein

187f.* International Organization I. The organization of interaction among nation-states; decision-making in international organizations; comparison of national and international political institutions; world organization for collective security and peaceful settlement of disputes. (3 cr)

188w.* International Organization II. World organization for social, economic, cultural, and humanitarian co-operation; comparison of functional and political organizations; problems of international administration. (3 cr)

189s.* Regional International Organization. Analysis and comparison of selected regional international organizations; regional defense, social and economic co-operation; relationship between regional and world organizations, economic and political integration. (3 cr)

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

235Af-Bw.* Seminar: International Politics. Major approaches and concepts employed in study of international political relations; international communications; international conflict; problems of research and development of theory. (3 cr per qtr; prereq 184 or 185 or ♯)

236s.* Research Seminar: International Politics. Supervised group research and research training in selected topics or problems. (3 cr; prereq ♯)

238Af-Bw.° Seminar: International Organization. Examination of universal and regional international organizations; organizational decision-making and international administration; political and economic integration. (3 cr per qtr; prereq 187 or 188 or ‡)

239s.° Research Seminar: International Organization. Supervised group research and research training in selected problems or topics. (3 cr; prereq ‡)

241Af-Bw.° Seminar: International Law. Historical development of the relationship of economic, social, and political systems to systems of international law; analysis of relevant juristic concepts. (3 cr per qtr; prereq 181 or equiv) McLaughlin

242s.° Research Seminar: International Law. Supervised group research and research training in selected subjects or problems. (3 cr; prereq ‡) McLaughlin

245f.° Seminar: Diplomacy. Patterns of postwar diplomacy in bilateral relations, conferences, international agencies; problems of agency co-ordination, selection and training of personnel, in foreign affairs administration. (3 cr; prereq 175 or 176 or ‡) McLaughlin

246w.° Seminar: Foreign Policy. Principal approaches to analysis of foreign policy; case studies in decision-making in foreign relations; problems in defense and deterrence. (3 cr; prereq 177 or ‡)

247s.° Research Seminar: Diplomacy and Foreign Policy. Supervised group research in selected subjects or problems. (3 cr; prereq ‡)

249Af-Bw-Cs.° Individual Reading and Research in International Relations. (3 cr per qtr; prereq ‡) Staff

POLITICS AND BEHAVIOR

137f.° American Political Parties. Role and functions of the party in American government; party composition and organization; process of nomination and policy formulation; regulation of party organization and activities. (3 cr; prereq 2 or 5 or ‡) Sorauf

138s.° American Political Campaigns and Elections. Examination of national, state, and local campaigns and elections, including field work in local political parties and election campaigns. (3 cr; prereq 2 or 5 or ‡) Backstrom

167f-168w.° Political Behavior. Political personality and public opinion. Role of attitudes, interests, and values. Voting behavior and elections. Group and organizational behavior. Mass society, elite theory and group theory. Conceptual approaches and advanced analytic techniques. (3 cr per qtr) Flanigan

250.° Public Opinion and Political Participation. Description and analysis of public opinion, opinion leaders, and opinion elites; attitudinal and social determinants of voting behavior, campaign participation, and other political activity; analysis and interpretation of electoral decisions. (3 cr; prereq ‡) Flanigan

251.° Seminar: Political Parties. Party systems and subsystems; party organizational characteristics, goals, and incentives; distribution of power and authority within the party; chief party functions; party as an organizer of governmental power; determinants of party structure and role. (3 cr; prereq ‡) Sorauf

252.° Seminar: Interest Groups. Description and analysis of role of interest groups; leadership, maintenance of following, and representation of values; theories of groups, group behavior, and overlapping group membership; interest group relations with other political organizations. (3 cr; prereq ‡) Flanigan or Sorauf

255.° Seminar: Political Leadership and Decision-Making. Theories of political leadership; social and cultural support of leaders; description and analysis of leadership recruitment and rejection; decision-making, choice and bargaining in political organizations. (3 cr; prereq ‡; offered 1964-65 and alt yrs) Flanigan

256.° Seminar: Political Psychology and Socialization. Theories of political psychology, opinion formation, and attitude change; political style and ideology; processes of individual political development and socialization. (3 cr; prereq ‡; offered 1965-66 and alt yrs) Flanigan

258A-B.° Research Seminar: Politics and Behavior. A: Quantitative techniques of data collection and analysis; survey research methods; scaling, bloc analysis, and content analysis; aggregate statistical techniques; simulation. B: Advanced research topics. (3 cr per qtr; prereq ‡; A offered 1965-66 and alt yrs, B when feasible) Flanigan

259Af-Bw-Cs.° ‡ Individual Reading and Research in Politics and Behavior. (3 cr per qtr; prereq ‡) Sorauf, Backstrom, Flanigan

265.° Seminar: Community Power Systems. For description see course listing under the subfield American Governmental Systems and Processes.

AMERICAN GOVERNMENTAL SYSTEMS AND PROCESSES

107f.* The American Chief Executive. Constitutional powers and political roles of the President and governors; the chief executive and administration; executive relations with legislatures; party and popular leadership; presidential roles in crisis. (3 cr; prereq 2 or 5 or ‡)

108w.* Legislative Organization and Procedure. Congress and state legislatures at work. (3 cr; prereq 2 or 5 or ‡) Short

109s.* The Judicial Process. Structure of the American judiciary; selection of judges; the process of litigation; influences on judicial decisions; impact of and compliance with decisions; role of the Supreme Court in the American political system. (3 cr; prereq 2 or 5 or ‡) Sorauf

115f.* State Government. The states in the American federal system; intergovernmental relations with national and local governments; governmental institutions and processes, with special reference to Minnesota. (3 cr; prereq 2 or 5 or ‡) Short

116f.* Local Government. Local units in their social, legal, and theoretical context. (3 cr; prereq 2 or 5 or ‡) Scott

117w.* Local Government. Politics of local units; leadership and decision-making processes. (3 cr; prereq 2 or 5 or ‡) Scott

118s.* Local Government. Metropolitan problems; governmental organization and political processes. (3 cr; prereq 2 or 5 or ‡) Scott

260f.* Seminar: Legislative Process. National and state legislatures; their internal organization; party organizations and influences with legislatures; interest groups and other external influences; legislative roles and behavior; policy-making processes in American legislatures. (3 cr; prereq ‡) Backstrom

261w.* Seminar: Executive Process. The Presidency and the governorships, cabinets and staff aids; relations with legislatures; the executive as party and popular leader; the executive and administrative agencies. (3 cr; prereq ‡)

262s.* Seminar: Judicial Process. Judicial systems and roles; selection of judges; organizing and supporting litigation; influences on judicial decisions; impact and enforcement of judicial decisions; courts and other institutions of government. (3 cr; prereq ‡) Sorauf

263.* Seminar: Intergovernmental Relations. The American federal system; state-local relationships; interunit co-operation and conflict; metropolitan dispersal and integration. (3 cr; prereq ‡)

264.* Seminar: Local Government and Politics. Selection of local leadership; relationship of the political system to governmental forms and social institutions; role and impact of political institutions; policy-making at the local level; studies in policy problems; the emerging metropolis. (3 cr; prereq ‡) Backstrom, Scott

265.* Seminar: Community Power Systems. Structure of influence in communities; methods and approaches to study of community power; determinants of power in the community. (3 cr; prereq ‡) Backstrom, Scott

266.* Seminar: Public Policy. Politics of the policy-making process; interest group, client, and constituent pressures; decision-making and bargaining in policy-making; topics in major areas of regulation, planning, fiscal, and welfare policy. (3 cr; prereq ‡; offered when feasible)

268A-B.* Research Seminar: American Governmental Processes. Research methods, techniques, and problems; selected topics. (3 cr per qtr; prereq ‡) Sorauf, Backstrom, Scott

269Af-Bw-Cs.*‡ Individual Reading and Research in American Governmental Systems and Processes. (3 cr per qtr; prereq ‡) Short, Sorauf, Backstrom, Scott

PUBLIC ADMINISTRATION

120f.* 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

121w.* 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

123f.* Planning. (Same as Arch 104, Econ 110, and Soc 106) Social, economic, political, geographic, and technical phases of modern city planning. (3 cr) Borchert, Heller, Peterson, Vivrett, Warp

124f.* Government and Welfare. Federal, state, and local programs in fields of social insurance, public assistance, welfare services, and housing. Philosophy, policy development, and administration. (3 cr; prereq 2 or 5 or ‡) Warp

126w.* Government and the Economic Order. Survey of relation of government to all of the major areas of the economy; policy-making and policy decisions. (3 cr; prereq 2 or 5 or ♯) Warp

127s.* Administrative Regulation. 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

131f.* Public Administration. Organization and areas, administrative responsibility. (3 cr; prereq 2 or 5 or ♯) Short

132w.* Public Administration. Personnel administration. (3 cr; prereq 131 or ♯) Short

133s.* Public Administration. Financial administration. (3 cr; prereq 131 or ♯) Short

135s.* Development Administration. Administration of economic, social, and political development; planning, organizing, and programming of change; technical assistance, synergistic interaction between government and industry, loans and subsidies, contracts, public enterprise; resources administration. (3 cr) Warp

176w.* U.S. Foreign Affairs Administration. For description see course listing under the subfield International Relations.

270Af.* Public Administration Seminar: Organization Theory and Administrative Behavior. Factors conditioning organization; theories of organization; models and typologies, leadership, authority, and decision-making; communication; automation, operations research, and management systems. (3 cr; prereq regis only with consent of staff) Warp

270Bw.* Public Administration Seminar: Finance. Role of fiscal planning and management in the administrative process; organization for financial administration; revenue estimating and administration; budgetary theory; the budget process—planning, authorization, expenditure control; accounting and auditing; treasury management and debt administration; procurement; intergovernmental fiscal relations. (3 cr; prereq regis only with consent of staff) Short

270Cs.* Public Administration Seminar: Personnel. Modern bureaucracies; history and background of personnel policy and administration in the United States; legal foundation and organization; position classification and compensation; recruitment and selection process; training; employment policies and morale; employee relations and organization; retirement systems. (3 cr; prereq regis only with consent of staff) Short

273.* Topics in Development Administration. Advanced analysis of selected topics in development administration. (3 cr; prereq ♯) Warp

275.* Seminar: Comparative Public Administration. Examination of approaches to the study of comparative public administration; critical analysis of methodological studies; development and testing of hypotheses from empirical data concerning several governments. (3 cr; prereq ♯) Warp

278.* Administrative Law. Ethics in administration, executive control, legislative oversight, judicial review, administrative procedure; research. (3 cr; prereq ♯) Warp

280s.* Seminar: Local Administration. Administrative relationships and processes in local government; accountability of administration; administrative measurement; personnel and financial administration; purchasing and contracting; legal service; administrative planning and research; reporting and public relations. (3 cr; prereq ♯) Peterson

282Af-Bw-Cs.*‡ Administrative Internship. Supervised field work in an approved local, state, or federal government agency; preparation of an acceptable formal report. (Cr ar; prereq ♯) Consult Warp

283Af-Bw-Cs.*‡ Research Seminar: Public Administration. Examination of research methods and techniques; identification of research needs in an area of public administration; selection of a topic, development of a research design, collection of data, and preparation of a substantial report. (3 cr per qtr; prereq ♯) Short, Warp

284Af-Bw-Cs.*‡ Individual Reading and Research in Public Administration. (3 cr per qtr; prereq ♯) Short, Warp

PUBLIC LAW

101f.* Principles of the American Constitution I. Nature of constitutions, judicial review, national-state and interstate relations. (3 cr; prereq 2 or equiv) Chase

102w.* Principles of the American Constitution II. Organization and powers of the national government. (3 cr; prereq 101 or equiv) Chase

103s.* Principles of the American Constitution III. Constitutional rights, due process and equal protection of the law. (3 cr; prereq 101 or 102 or equiv) Chase

109s.* The Judicial Process. For description see course listing under the subfield American Governmental Systems and Processes.

180f-181w†-182s.* International Law (Peace). For description see course listing under the subfield International Relations.

183s.* International Law (Conflict). For description see course listing under the subfield International Relations.

241Af-Bw.* Seminar: International Law. For description see course listing under the subfield International Relations.

242s.* Research Seminar: International Law. For description see course listing under the subfield International Relations.

262s.* Seminar: Judicial Process. For description see course listing under the subfield American Governmental Systems and Processes.

278.* Administrative Law. For description see course listing under the subfield Public Administration.

285.* Research Seminar: Judicial Process and Administrative Law. Supervised research and research training in selected topics or problems. (3 cr; prereq ‡) Warp, Sorauf

290Af-Bw.*‡ Seminar: Constitutional Law. (3 cr per qtr; prereq 101, 102, 103 or ‡) Chase

292s.* Research Seminar: Constitutional Law. Supervised research and research training in selected topics or problems. (3 cr; prereq ‡) Chase

295Af.* Fundamental Concepts of Public Law. State and law; coercion and consent; concepts of right and obligation; basis of property; contract, tort; vehicles of legal growth—legislation, administrative regulation, judicial action; separation and distribution of powers; domestic jurisdiction and the international legal community. (3 cr; prereq ‡)

295Bw-Cs.*‡ Jurisprudence. Legal systems in relation to social systems. Examination of interests protected, extent of state intervention, institutional devices and procedures for doing justice and maintaining order, vehicles of legal change and growth, basic legal concepts, in kin-organized societies, political societies based on status, politico-economic societies based on contract, modern industrialized democratic societies. Limits of social control by law. (3 cr per qtr; prereq 295A and basic course in either constitutional, administrative, or international law)

299Af-Bw-Cs.*‡ Individual Reading and Research in Public Law. (3 cr per qtr; prereq ‡) Chase, McLaughlin, Sorauf, Warp

POULTRY SCIENCE

Professor	Associate Professor	Assistant Professor
Elton L. Johnson	Milo H. Swanson	M. Roger Fedde
Robert N. Shoffner	Paul E. Waibel	Richard E. Phillips
Hubert J. Sloan		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) two foreign languages or (b) one foreign language plus a special research technique or a collateral field of knowledge. Acceptable foreign languages are German, French, Spanish, Russian, Japanese.

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. Application of principles of genetics and physiology of reproduction to breeding of poultry. (4 cr; prereq 1, or ‡, Agro 30; offered 1964-65 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 spring [1964-65], fall [1965-66] and alt yrs)

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

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

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

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

216x.° Research in Poultry Breeding. (Cr ar; prereq 9 cr in genetics or equiv) Shoffner

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

218x.° Research in Poultry Products. (Cr ar; prereq ‡) Swanson

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

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, BioC 6 or ‡...BioC 116 recommended; offered 1964-65 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, BioC 6 or equiv or ‡...BioC 116 recommended; offered 1964-65 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 BioC 6 or ‡...BioC 124 recommended; offered 1965-66 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 BioC 6 or ‡; offered 1965-66 and alt yrs) Snetsinger

PSYCHIATRIC NURSING

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

PSYCHIATRY AND NEUROLOGY

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

PSYCHOLOGY

Professor

John G. Darley
Ralph F. Berdie
Marvin D. Dunnette
George W. England
Norman Garmezy
Starke R. Hathaway
Vivian H. Hewer
James J. Jenkins
David L. LaBerge
Gardner Lindzey
Lloyd H. Lofquist
Howard P. Longstaff
Kenneth MacCorquodale
Paul E. Meehl
Wallace A. Russell
William Schofield
Benjamin Willerman
Edmund G. Williamson
Robert D. Wirt

Associate Professor

Elliot Aronson
Peter F. Briggs
David P. Campbell
Gordon T. Heistad
David T. Lykken
Warren W. Roberts
Leverne F. Snoxell
Forrest L. Vance

Assistant Professor

Dana H. Bramel
Jan D. Duker
Marshall G. Greenberg
A. Jack Hafner
Robert M. Knights
Wentworth Quast
Milton A. Trapold
Robert G. Warnken
Bernard Wiener

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—French, German, Russian, or Spanish. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge. When two languages are offered any combination of those listed above may be approved.

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

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

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 two or three experimental projects per quarter. (3 cr per qtr; prereq 2, 5, 70, or equiv) LaBerge, Trapold

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 one 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 one 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) 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) Jenkins, Darley, 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 work adjustment. (3 cr per qtr; prereq 2 and 5 or 5 cr in statistics) Lofquist

132-133.† Psychology of Motivation. Classical and contemporary theories of motivation. Elaboration of basic drives into motives, acquisition of new drives and goals; dynamics of the elaborated drive structure. Motivation in complex situations involving set, level of aspiration, Zeigarnik effect, frustration, etc. (3 cr per qtr; prereq 9 cr) Russell

135-136-137. Counseling Psychology. Theories and techniques used 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. (3 cr per qtr; prereq 9 cr or ♯ for 135-136, 130 for 137) Lofquist, Warnken

140. Social Psychology. Survey of theories and evidence. Effects of other persons, mass communications, social class, and group membership upon the individual's attitudes and behavior. (3 cr; prereq 2, 5, and 9 cr in social science) Aronson, 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; offered when feasible) Willerman

144-145.† Abnormal Psychology. Normal and abnormal behavior contrasted. Dynamics and determinants of personality maladjustments. (3 cr per qtr; prereq 9 cr or 6 cr plus Biol 2 or 12 cr in a social science) Garmezy

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

150. Perception. Critical analysis of methods of investigation and data obtained in study of selected problems of perception: psychophysical methods, form perception, space perception, constancy, spatially co-ordinated behavior and attention. Emphasis primarily but not exclusively on visual perception. (3 cr; prereq 55, 70 or ‡) Pick

151. Animal Psychology. Historical, philosophical, and biological foundations; consciousness; motivation; learning; reasoning; judgment; abnormal behavior; social influences. (3 cr; prereq 2, 5 or equiv in another science) Roberts

155. Industrial Psychology. Application of psychological methods in business and industry. Staffing, personnel development and training; employee motivation and morale; social psychological factors in industry; biomechanics and production; theories of industrial organization; communication and leadership in an industrial setting. (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

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; offered when feasible) 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 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, Meier, Schofield

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. Advanced Social Psychology. Discussion of theory and research concerning social influence processes. (2 cr per qtr; prereq ‡; offered 1964-65 and alt yrs) Aronson, Bramel

210,* 211,* 212.* Research Problems. (Cr ar) Graduate staff

213. Seminar: Philosophical Psychology. (3 cr; prereq 202 and course in logic or philosophy) Meehl

215, 216, 217. Seminar: Special Areas of Psychology and Related Sciences. Based on a syllabus of required and optional reading. Offered irregularly according to announcements in Official Daily Bulletin. (Cr ar)

221, 222, 223. Seminar: Personality Research. Theoretical and methodological problems in contemporary research concerning the psychology of personality. (Cr ar; prereq ‡) Garmezy and staff

224, 225, 226. Seminar: Advanced Clinical Child Psychology. Topics and problems including brain dysfunction; parent personalities of disturbed children, among other disorders. (1 cr per qtr; prereq ‡) Hafner, Quast

227-228-229. Seminar: Vocational Rehabilitation Counseling. Topics and problems in vocational counseling of disabled and hospitalized persons. Specific disabilities and vocational implications. Role and responsibilities of the rehabilitation counselor. (1 cr per qtr; prereq ‡) Lofquist, Warnken

230, 231, 232. Field Work in Psychometrics and Applied Psychology. (Cr ar; prereq written permission of inst) Berdie, Darley, Lofquist, Longstaff, Schofield, Warnken, Wirt, others

235-236-237. Counseling Psychology Practicum. Experience in use of psychological and related methods in dealing with individuals. (1-3 cr per qtr; prereq 137 and ‡) Berdie, Snoxell, others

240, 241, 242. Seminar: Student Personnel Work. Topics and problems relating to content, development, and co-ordination of comprehensive student personnel programs. (1 cr per qtr; prereq ♯) Williamson

243. Experimental Psychodynamics. Application of experimental methods to problems emphasized by the rise of clinical psychology. Relation of certain clinical concepts to learning and motivational theory. (3 cr; prereq 145 and 129 or 117 or ♯) 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. (Cr ar; prereq Math 40 or equiv) LaBerge

250-251-252. Advanced Seminar: Vocational Rehabilitation Counseling. Advanced topics, research, and special disability problems in vocational counseling of disabled and hospitalized persons. (1 cr per qtr; prereq 229) Lofquist

253-254.‡ Research in Psychopathology. Review of theoretical and empirical status of specific areas in psychopathology; determinants of behavior disorder. (3 cr per qtr; prereq 145 or equiv, 1 yr grad study or ♯) Garmezy

257-258-259.† Research Methods in Social Psychology. Discussion of research techniques in social psychology; critical examination of existing laboratory and field studies; partcipation in design and execution of original research. (3 cr per qtr; prereq ♯; offered 1965-66 and alt yrs) Aronson, Bramel

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 by writing reports on advanced psychometric topics. (3 cr) Greenberg

271-272-273.† Clinical Psychology II: Treatment. Theory and practice of individual psychotherapy. (3 cr per qtr; restricted to PhD candidates in clinical psychology; prereq 173 and 246) Meehl, Williams, Schofield

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 Counseling Psychology. Presentation and discussion of research being conducted by University personnel workers. Proposed, completed, and research in process. (1 cr per qtr; prereq ♯) Campbell

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)

296x. Internship in Clinical Psychology. (2-4 cr per qtr; prereq PhD candidate in clinical psychology program and permission of director of clinical psychology training program) Clinical Psychology staff

299. Tabulating Equipment Laboratory. Use of electric tabulating machines in treatment of research data. (1 cr; prereq PubH 110, 111, or equiv)

PUBLIC ADMINISTRATION

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. Routinely acceptable languages are French, German, and Spanish.

Examinations—All candidates will be required to pass a final comprehensive written examination in public administration and a final oral examination covering all course work offered for the degree and the thesis.

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, Minnesota 55455.

PUBLIC HEALTH**

Professor

Gaylord W. Anderson, M.D., Dr.P.H., *director*
Richard G. Bond, M.S., M.P.H.
Donald W. Cowan, M.D., M.S.
Ruth E. Grout, M.P.H., Ph.D.
James A. Hamilton, M.A., M.C.S.
George S. Michaelsen, M.S.
Marion I. Murphy, M.P.H., Ph.D.
Theodore A. Olson, M.A., Ph.D.
Leonard M. Schuman, M.D., M.S.
James W. Stephan, M.B.S.
Stewart C. Thomson, M.D., M.S., M.P.H.

Associate Professor

Allyn G. Bridge, M.D., M.P.H.
John O. Buxell, M.S., M.P.H.
Harry Foreman, M.D., Ph.D.
E. Gartly Jaco, Ph.D.
Harold J. Paulus, M.S., Ph.D.
Ruth von Bergen, M.P.H.
George E. Williams, M.D.

** Inquiries concerning other work in public health, including courses of study leading to the degrees of M.P.H., master of public health, and M.H.A., master of hospital administration, should be addressed to the Director of the School of Public Health, 1325 Mayo Memorial Building, University of Minnesota, Minneapolis, Minnesota 55455.

Assistant Professor

Eleanor M. Anderson, M.P.H.
Clare L. Blanchard, M.P.H.
Norman A. Craig, M.P.H.
Marie J. McIntyre, M.S., M.S. (Hyg.)
Gustave L. Scheffler, B.S.C.E.
Ruth Edna Stief, M.P.H.

Lecturer

Henry Bauer, Ph.D.
Leslie W. Foker, M.D., M.P.H.
William A. Jordan, D.D.S., M.P.H.

Language Requirement—For the Master's degree, knowledge of a foreign language may be waived on recommendation of the adviser. For the Ph.D. degree, reading knowledge of two foreign languages or of one foreign language and option of a special research technique or a collateral field of knowledge. Acceptable languages are: French, German, Norwegian, Russian, Spanish, or Swedish.

Minor—For the Master's degree, PubH 100A, B, and C and courses in statistics and either epidemiology or public health administration.

For the Ph.D. degree, PubH 100A, B, and C and 20 additional credits selected on the basis of the candidate's field of major study.

Master's Degree—Offered under both Plan A and Plan B. All candidates for this degree must take PubH 100A, B, and C.

Public Health Nursing—A program offered under Plan B is designed to prepare public health nursing faculty for collegiate schools of nursing. This program, developed in co-operation with the School of Nursing, has public health as its major with related fields in education and social science. Other qualified nurses with interest in supervision, advanced practice (including school nursing), or positions of responsibility in community programs of long-term patient care also may enter a Plan B program.

Doctor's Degree—Work leading to the Ph.D. degree is offered for majors in biostatistics, environmental health, epidemiology, hospital administration, and physiological hygiene. For further information on these programs, see the index reference.

100A. Elements of Public Health I. Occurrence and prevention of communicable, degenerative, and industrial diseases; protection of food, water, and milk; maternal and child health. (3 cr; prereq 3, 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 ‡) Bond, Buxell, Olson

102A. Environmental Sanitation. General principles of urban and rural sanitation; problems encountered by official health agencies. (2 cr; prereq 100A or ¶100A and ‡) Bond, others

103. Public Health Bacteriology. Bacteriologic and serologic diagnosis, public health laboratory administration and methods. (Cr ar; prereq MicB 102, 116, ‡) Bauer

104.° Epidemiology I. Basic epidemiologic principles applicable to infectious and noninfectious disease; host-agent-environment complex; factors underlying spread of infectious disease; laboratory applications of statistical and epidemiologic methods. (3 cr; prereq 100A, 140 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) Bridge

107A. Maternal and Child Health Program. Community programs for major maternal and child health problems. (1 cr, §107; prereq hospital administrators and ‡) Bridge

108. Introduction to 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, Weckwerth

109.° Institutional Sanitation. Sanitation practices in hospitals and other institutions. (3 cr; prereq hospital administrators or ‡ and 100A) Bond, Michaelsen

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

112A, B, C.° Public Health Engineering—Plan Examinations. 112A: Water supplies. 112B: Waste disposal systems. 112C: Swimming pools and plumbing. (1 cr per qtr, §114; prereq engineering degree and 102, and ‡) Bond, Buxell

113A, B, C.° Public Health Engineering—Field Investigations. 113A: Water supplies. 113B: Waste disposal. 113C: Swimming pools and plumbing. (2 cr per qtr, §114; prereq engineering degree and ‡ and 102) Bond, Buxell

114. Environmental Sanitation Programs. Public health supervision of activities in urban and rural sanitation. (3 cr, §112, §113, or §116; prereq ‡) Bond, Buxell

115.° Food Sanitation. Sanitary problems in production, processing, and distribution of milk, meat, shellfish, and other foods; methods of public health supervision. (3 cr; prereq 100A and ‡) Olson

115A. Institutional Food Protection Programs. Public health implications in design, construction, and installation of food service equipment; sanitary controls in food preparation and service; regulatory controls by official public health agencies. (2 cr; prereq ‡) Bond, Stauffer

116.° Public Health Engineering Administration. Administrative organization of environmental sanitation activities. (2 cr, §114; prereq ‡) Bond

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

122. 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 components of community health programs; group procedures; community organization; methods and materials. (2 cr; prereq ‡) Grout, Craig

125A. Public Health Education. Purposes; scope; methods and materials; planning, with special emphasis on hospitals. (1 cr; prereq hospital administrators or ‡) Grout

126. Occupational Health Programs. Professional, social, economic, and legal aspects; organization; technical aspects of specific health hazards. (3 cr; prereq 100A or ¶100A and ‡)

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 ‡) von Bergen, 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

138. Hospital Engineering Problems. Application of environmental engineering, sanitation, and maintenance principles and techniques to effective planning, administration, and operation of hospitals. (Cr ar; prereq ‡) Staff and visiting lecturers

139. Advanced Field Practice in Public Health Nursing: Mental Health. Opportunity for increasing competence in public health nursing practice including use of behavioral and mental health concepts; seminar analysis concurrent with experience with public health nursing patients including psychiatric patients. (Cr ar; prereq ‡) von Bergen

140.° Vital Statistics I. Official sources; population changes; rates; trends; significant differences. (3 cr) Bearman

141. Social and Economic Aspects of Medical Care. Social and economic forces affecting administration and financing of medical care; sickness insurance, group hospitalization; concern of government in provision of medical care. (Cr ar; prereq ‡)

145. Low Level Radioactivity and Radiation Measurements. Advanced isotope techniques designed for assay of low levels of radioactivity in environmental samples. Includes use of gamma spectrometry, liquid scintillation spectrometry, and low background anticoincidence beta counters. (3 cr; prereq ‡) Foreman

146. Radiological Health II. Biological effects of radiation covering radiation biochemistry, acute radiation syndrome, chronic effects, cellular and hematological aspects and mutagenic properties of radiation. (3 cr; prereq ‡) Foreman

147. Environmental Radioactivity. Measurement, evaluation, and control of environmental radioactivity with special emphasis on radiation to the general population. Includes natural radioactivity, fallout, reactor environs, radioactive wastes, and radiation ecology. (3 cr; prereq ‡) Foreman

149. Public Health Aspects of Housing and the Residential Environment. Principles of healthful housing and their application in community planning and development. (3 cr; prereq ‡) Buxell

151. Health Aspects of Air Control in Hospitals. Basic considerations in control of natural and mechanical air flow in hospitals to avoid spread of infection, to control odors, and to promote patient care. (2 cr; prereq ‡) Michaelsen

152.° Industrial Hygiene Engineering. Field and laboratory methods used by industrial hygiene engineers in study and control of occupational health hazards. (3 cr; prereq ‡) Michaelsen

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

157. Radiation Protection Criteria for Hospital Design and Operation. Radiation protection methods in design, shielding, equipping, and operation of a radioisotope laboratory, X-ray, and other ionizing radiation facilities. (2 cr; prereq ‡) Michaelsen

158. Hospital Safety. Theories and practices in accident and fire prevention and control for hospitals and other medical care facilities. (3 cr; prereq ‡) Michaelsen, Scheffler

159. Chemical Laboratory Safety. Principles of accident and fire prevention in chemical laboratories. (1 cr; prereq ‡) Scheffler

160. Principles of Administration in Hospitals. Lectures, seminars, and field trips in hospital administrative principles; top management and board of trustees, personnel policy formation, human relations. (6 cr) Hamilton, Stephan

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 for 162, 6 cr for 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, Stephan

170. Administration of Public Health Nursing. Interpretation of background and trends in public health nursing; analysis of staff and supervisory practice. (2 cr, §170A; prereq health officers, others ‡) Murphy

170A. Administration of Public Health Nursing. Scope; relationship to other aspects of public health. (1 cr, §170; prereq ‡) Murphy

171°-172.° Studies in Public Health Nursing. Orientation to research methodology; design and completion of a project. (3 cr per qtr; prereq 140, 175, or ‡) 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) Murphy, E Anderson, Blanchard, Fredlund, McIntyre

174A-B. Seminar: Administration, Supervision, and Consultation. Application of principles; analysis of selected aspects of administrative and supervisory process in public health nursing situations. (2 cr per qtr; prereq public health nurse, ‡) Murphy, Blanchard

175. Foundations of Public Health Nursing I. Investigation of role of public health nursing within nursing and public health; review of content and process inherent in dynamic public health nursing; current trends in education and practice. (3 cr) von Bergen and staff

176. Foundations of Public Health Nursing II. Dynamics of human behavior; analysis of public health nursing practice through use of case material. (3 cr; prereq 175) von Bergen, Williams

177A-B. Clinical Seminar: Public Health Nursing. Experience with selected patients and families; concurrent seminar. (3 cr per qtr; prereq 176) von Bergen and staff

178. Seminar: Public Health Nursing Consultation. Opportunity for selected students to deepen understanding of process involved in consultation. (2 cr; prereq ‡)

179. 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

180. Introduction to Biostatistics. Variation; frequency distribution; probability; estimation; significance tests; binomial, normal, Poisson distributions; serial dilutions; most probable number. (6 cr; prereq environmental health students only, others ‡) Bearman

181-182-183. Principles and Methods in Public Health Education. Role of public health educator; group procedures; community organization; communication theory; methods and materials; program planning and evaluation. (3 cr per qtr; prereq ‡) Grout, Craig

185. Air Analysis. Laboratory and field exercises on problems involving industrial hygiene and air pollution. Exercises include air flow measurement, calibration of instruments, analysis of different gases, stack sampling, dust counting and sizing, and industrial plant visits. (3 cr; prereq 152 or 155, ‡) Paulus

190. Field Work in Health Education. Supervised field experience. (Cr ar; prereq 183, 227) Grout, Craig

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

200. Research. Opportunities will be offered by the School of Public Health and by various cooperating organizations for qualified students to pursue research work. (Cr ar)

210. Seminar: Public Health. (Cr ar)

212.° Seminar: Public Health Engineering and Sanitation. (Cr ar; prereq ‡) Bond

213. Seminar: Epidemiology. (Cr ar; prereq ‡) Schuman

214. School Health Programs. Review of major health problems among children of school age; methods of providing and evaluating school health services. (Cr ar; prereq 107 or ‡)

215. Maternal and Child Health. Administration of well-child and antepartum conferences; psychosomatic problems of children. (Cr ar; prereq MD, ‡) Bridge

221. Seminar: Nursing in Long-Term Patient Care and Rehabilitation. Exploration of multidisciplinary aspects; role relationships affecting nursing; review of current research findings. (Cr ar; prereq 179) E Anderson and associates

222. Seminar: School Nursing and Related Field Practice. Exploration of nursing in the school setting; role relationships; review of current research. (Cr ar; prereq 107 or ¶214) Murphy, Fredlund

223. Orientation to Teaching Public Health Nursing. Evolution of public health nursing within collegiate nursing education; rationale for the relationship; impact of various related developments. (3 cr; prereq ‡) Murphy, McIntyre

224. Seminar: Public Health Nursing Within the Curriculum. Course objectives: organization; opportunity to explore problems in development of plans for teaching public health nursing. (Cr ar; prereq ‡) Murphy, McIntyre

225. Practicum in Teaching Public Health Nursing. Planning for and evaluation of instruction; selected field experiences and seminars. (Cr ar; prereq ‡) Murphy, McIntyre

227.* Problems in Public Health Education Programs. Independent study and experimentation in health education. (Cr ar; prereq ‡) Grout, Craig

230. Field Practice in Environmental Sanitation. (Cr ar; prereq ‡) Bond

241.* Epidemiology of Noncommunicable Diseases. Application of basic epidemiologic principles to noncommunicable diseases and to trauma; selected disease examples. (3 cr; prereq 104) Schuman

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: Listening Comprehension. (2 cr; prereq undergrad spch major, ‡) Nichols

ROMANCE LANGUAGES

Associate Professor
Armand A. Renaud

Professor
Walter T. Pattison
Harry F. Williams

Associate Professor
Rodolfo O. Floripe
Elizabeth Nissen
Arturo Serrano-Plaja

Assistant Professor
John H. Matthews
Richard A. Narváez
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 (for majors in French: Spanish, Italian, or Portuguese; for majors in Spanish: French, Italian, or Portuguese). Candidates for the Doctor's degree must have a knowledge of Latin equivalent to at least 2 years of high school Latin; a reading knowledge of a second Romance language; and, by the end of the first year of graduate work, a reading knowledge of an additional foreign language, French, Spanish, Italian, Portuguese, German.

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

Doctor's Degree—Offered in both French and Spanish.

Comparative Literature—For information on this program see page 95.

French

100f. French Phonetics. (3 cr; prereq French maj or ‡) Sullivan

105s. French Stylistics. (3 cr; prereq 57 or ‡) Sullivan

107f-108w-109s. Structure of Modern French. Application of linguistics to study of present-day French. (3 cr per qtr; prereq 57 or ¶57 or ‡) Mantini

110f. Rise of French Romanticism. (3 cr; offered 1964-65 and every 3rd yr)

111f. Nineteenth-Century Literature: The Drama. (3 cr; offered 1965-66 and every 3rd yr) Matthews

114s. Introduction to Romance Philology. Origins of the Romance languages. Outline of factors that have influenced their growth and structure studied in significant early Catalan, French, Italian, Portuguese, Provençal, Roumanian, and Spanish texts. (3 cr; prereq Fren 30, or Ital 25, or Port 25, or Span 30, or ‡) Williams and staff

121f. Pre-Renaissance and Pléiade Poetry. (3 cr; offered 1965-66 and every 3rd yr) Renaud

124w. Montaigne and Pascal. (3 cr; offered 1965-66 and every 3rd yr) Renaud

125f. Renaissance and Baroque Drama: Corneille and the Origins of the Classical Drama. (3 cr; offered 1964-65 and every 3rd yr) Renaud

126s. The Classical Tragedy: Racine. (3 cr; offered 1965-66 and every 3rd yr) Renaud

127f. Classical Comedy: Molière. (3 cr; offered 1966-67 and every 3rd yr) Renaud

128w. French Poetry from d'Aubigné to La Fontaine. (3 cr; offered 1966-67 and every 3rd yr) Renaud

129s. The Novel of the Seventeenth Century. (3 cr; offered 1964-65 and every 3rd yr) Renaud

130w. The Poetry of Victor Hugo. (2 cr; offered 1964-65 and every 3rd yr)

131f. Baudelaire. (2 cr; offered 1966-67 and every 3rd yr) Matthews

132f. Symbolist Poets: Verlaine, Rimbaud, Mallarmé. (2 cr; offered 1964-65 and every 3rd yr) Matthews

140w. The Novel of the Eighteenth Century. (3 cr; offered 1966-67 and every 3rd yr)

141s. Eighteenth-Century Dramatic Literature. (3 cr; offered 1964-65 and every 3rd yr)

142f. Voltaire. (3 cr; offered 1964-65 and every 3rd yr)

143w. Diderot. (3 cr; offered 1964-65 and every 3rd yr)

144f. Rousseau. (3 cr; offered 1966-67 and every 3rd yr)

148s. The Drama of the Twentieth Century: Claudel, Giraudoux, Anouilh, Montherlant, Camus, Sartre. (3 cr; offered 1966-67 and every 3rd yr) Matthews

153w. Balzac. (3 cr; offered 1965-66 and every 3rd yr)

154s. Stendhal. (3 cr; offered 1964-65 and every 3rd yr)

155w. Flaubert, Maupassant, and Narrative Techniques. (3 cr; offered 1964-65 and every 3rd yr) Matthews

156w. Zola, Goncourt, and the Naturalistic Novel. (3 cr; offered 1965-66 and every 3rd yr) Matthews

158w. Proust. (2 cr; offered 1966-67 and every 3rd yr) Matthews

159f. The Art of the Novel: Mauriac and Malraux. (3 cr; offered 1965-66 and every 3rd yr)

161s. From Gide to the Existentialist Novels of Sartre and Camus. (3 cr; offered 1964-65 and every 3rd yr) Matthews

165s. Poetry in the Twentieth Century: Apollinaire, Valéry, Eluard. (2 cr; offered 1965-66 and every 3rd yr) Renaud

175f-176w-177s. French Literary Doctrines from the Pléiade to the Present. (2 cr per qtr; offered 1965-66 and every 3rd yr)

207-208-209. Old Provençal. Literature; poetry of the troubadours. (2 cr per qtr) Williams

210-211. French Seminar: History of "Sensibilité" in the Eighteenth Century Through the Revolution. (3 cr per qtr)

222. French Seminar: The Baroque in Sixteenth- and Seventeenth-Century Literature. (3 cr) Renaud

223. French Seminar: Religious Thought in the Seventeenth Century. (3 cr) Renaud

230-231-232. Research Methods and Materials. (1 cr per qtr)

241-242-243. Old French Philology. (Formerly 171-172-173) (2 cr per qtr; prereq 1 yr Latin and 114 or ‡; offered 1964-65 and alt yrs) Williams

244f-245w-246s. Readings in Old French Literature. (Formerly 204-205-206) (2 cr per qtr; prereq 114 or ‡; offered 1965-66 and alt yrs) Williams

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

114. Introduction to Romance Philology. Origins of the Romance languages. Outline of factors that have influenced their growth and structure studied in significant early Catalan, French, Italian, Portuguese, Provençal, Roumanian, and Spanish texts. (3 cr; prereq Fren 30, or Ital 25, or Port 25, or Span 30, or ‡) Williams and staff

150w. Modern Poetry (Leopardi, Carducci, etc.) (Formerly 71) (3 cr; prereq ††; offered 1964-65 and alt yrs) Nissen

155f. Modern Short Story (Verga, Pirandello, etc.) (Formerly 76) (3 cr; prereq ††; offered 1964-65 and alt yrs) Nissen

159f-160w. Dante. (3 cr per qtr; prereq one course above 50; students may enter either qtr with ‡; offered 1965-66 and alt yrs) Nissen

161f-162w. The Sixteenth Century. (3 cr per qtr; prereq one course above 50; offered 1964-65 and alt yrs)

164s. Dante in English. (3 cr; prereq ‡; offered when feasible) Nissen

172f. Modern Drama (Giacosa, Pirandello, etc.) (3 cr; prereq one course above 50; offered 1964-65 and alt yrs) Nissen

173s. Boccaccio. (3 cr; prereq one course above 50; offered 1965-66 and alt yrs) Nissen

174s. Petrarch. (3 cr; prereq one course above 50; offered 1964-65 and alt yrs) Nissen

175w-176s. The Italian Novel. 175: Manzoni's *Promessi Sposi*, Verga's *Mastro Don Gesualdo*, Fogazzaro's *Piccolo Mondo Antico*, Deledda's *Elias Portolu*. 176: Four novels selected from the works of Svevo, Pirandello, Bacchelli, Palazzeschi, Silone, Moravia, Pratolini, Vittorini, Calvino. (3 cr per qtr; prereq one course above 50, ‡; offered 1964-65 and alt yrs) Nissen

180f. Early Italian Poetry: The Frederician Poets and the Dolce Stil Nuovo. Development of certain fundamental poetic forms (sonnet, *sestina, ballata, madrigale, canzone*). (3 cr; prereq 67 or ‡; offered when feasible)

185w. Survey of Italian Literature. (3 cr; prereq one course above 50; offered when feasible)

186s. Survey of Italian Literature. (3 cr; prereq one course above 50; offered when feasible)

259-260-261. Directed Readings in Romance Languages. (Cr depends upon amount of work accomplished) Nissen

Portuguese

114. Introduction to Romance Philology. Origins of the Romance languages. Outline of factors that have influenced their growth and structure studied in significant early Catalan, French, Italian, Portuguese, Provençal, Roumanian, and Spanish texts. (3 cr; prereq Fren 30, or Ital 25, or Port 25, or Span 30, or ‡) Williams and staff

Spanish

105s. Spanish Stylistics. (3 cr; prereq 57 or equiv) Narváez

107f-108w-109s. The Structure of Modern Spanish. A scientific approach to the structure of present-day Spanish, with special attention to syntax, phonology, word formation, and dialectal differences. (3 cr per qtr; prereq 57 or ‡ or ¶57) Narváez

110f-111w-112s. Spanish Literature: Nineteenth Century. (3 cr per qtr; prereq 65, 66, 67; offered 1964-65 and alt yrs) Pattison

114s. Introduction to Romance Philology. Origins of the Romance languages. Outline of factors that have influenced their growth and structure studied in significant early Catalan, French, Italian, Portuguese, Provençal, Roumanian, and Spanish texts. (3 cr; prereq Fren 30, or Ital 25, or Port 25, or Span 30 or ‡) Williams and staff

115f. Spanish Literature of the Seventeenth Century: The Drama. (3 cr; prereq 65, 66, 67; offered 1965-66 and alt yrs) Serrano-Plaja

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†† The prerequisite is course 25 or consent of instructor; but for students beginning Italian in the Upper Division it may be course 3 or 50 with consent of instructor.

116w. Spanish Literature of the Seventeenth Century: The Novel. (3 cr; prereq 65, 66, 67; offered 1965-66 and alt yrs) Serrano-Plaja

117s. Spanish Literature of the Seventeenth Century: Poetry. (3 cr; prereq 65, 66, 67; offered 1965-66 and alt yrs) Serrano-Plaja

120. The Ballad. (3 cr; prereq 65, 66, 67; offered when feasible)

130f. Cervantes: Don Quijote. (3 cr; prereq 65, 66, 67; offered 1964-65 and alt yrs) Pattison

131w. The Picaresque Novel. (3 cr; prereq 65, 66, 67; offered 1964-65 and alt yrs) Rundorff

140f. Latin-American Literature: Poetry. Silva, Darío, Nervo, Chocano, Herrera y Reissig, Lugones, Agustini, Mistral, Ibarbourou, Storni, López Verlarde, and Neruda. (3 cr; prereq 65, 66, 67 or 76; offered 1965-66 and every 3rd yr) Floripe

141w. Latin-American Literature: Essay, Short Story, Drama. Rodó, González Prada, Ricardo Rojas, Blanco Fombona, Ugarte, Vasconcelos, Alfonso Reyes, Quiroga, Gallegos, Florencio Sánchez. (3 cr; prereq 65, 66, 67 or 76; offered 1965-66 and every 3rd yr) Floripe

142s. Latin-American Literature: Novel. Gallegos, Azuela, Rivera, Güiraldes, Barrios, Gálvez, Lynch, Ciro Alegría. (3 cr; prereq 65, 66, 67 or 76; offered 1965-66 and every 3rd yr) Floripe

143f-144w-145s.‡ Colonial and Nineteenth-Century Latin-American Literature. (3 cr per qtr; prereq 65, 66, 67 or 76; offered 1966-67 and every 3rd yr) Floripe

146f-147w-148s.‡ Spanish-American Novel and Short Story. (3 cr per qtr; prereq 65, 66, 67 or 76; offered 1964-65 and every 3rd yr) Floripe

155f. Spanish Literature of the Sixteenth Century: The Novel. (3 cr; prereq 65, 66, 67; offered 1964-65 and alt yrs) Serrano-Plaja

156w. Spanish Literature of the Sixteenth Century: The Drama. (3 cr; prereq 65, 66, 67; offered 1964-65 and alt yrs) Serrano-Plaja

157s. Spanish Literature of the Sixteenth Century: Poetry. (3 cr; prereq 65, 66, 67; offered 1964-65 and alt yrs) Serrano-Plaja

Arab 161f-162w-163s. Hispano-Arabic Literature and Culture. (3 cr per qtr; prereq ‡) Irving

174f. Twentieth-Century Spanish Literature: Drama. Benavente, Martinez Sierra, Linares-Rivas, Alvarez Quintero, Valle Inclán, Marquina, Garcia Lorca, and Casona. (3 cr; prereq 65, 66, 67; offered 1965-66 and alt yrs) Pattison

175w. Twentieth-Century Spanish Literature: Prose. Unamuno, Azorín, Baroja, Valle Inclán, Ortega y Gasset, Pérez de Ayala, Gómez de la Serna. (3 cr; prereq 65, 66, 67; offered 1965-66 and alt yrs) Pattison

176s. Twentieth-Century Spanish Literature: Poetry. Juan Ramón Jiménez, Unamuno, Antonio and Manuel Machado, Valle Inclán, García Lorca, Alberti, Moreno Villa, Aleixandre, León Felipe, Guillén, and Salinas. (3 cr; prereq 65, 66, 67; offered 1965-66 and alt yrs) Pattison

180. The Eighteenth Century: Studies in the Principal Writers. Feijóo, Jovellanos, Cadalso, Moratín, and others. (3 cr; prereq 65, 66, 67)

230-231-232. Research Methods and Materials. (1 cr per qtr; offered 1965-66 and alt yrs)

241-242-243.° Old Spanish Philology. (2 cr per qtr; offered 1965-66 and alt yrs) Williams

244-245-246.° Readings in 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 1964-65 and alt yrs) Williams

250-251-252.° Spanish Seminar. (2 cr per qtr) Pattison, Serrano-Plaja

253-254-255.° Seminar: Latin-American Literature. (2 cr per qtr; offered when feasible)

259-260-261. Directed Readings in Romance Languages. (Cr depends upon amount of work accomplished) Staff

SCANDINAVIAN

Professor
Alrik Gustafson

Associate Professor
Marion Nelson
Cecil Wood

Prerequisites—For major work in Scandinavian languages and literatures, 27 credits in language and literature, 18 of which must be in Scandinavian, and reading

knowledge of any one of the Scandinavian languages; for minor work, 18 credits in language and literature, 12 of which must be in Scandinavian.

In Scandinavian Area Studies, see special bulletin, *Programs in International Relations and Area Studies.*

Language Requirement—Candidates for the Master's degree in Scandinavian languages and literatures must have reading knowledge of one modern language other than the language of his major field. French or German would be acceptable.

Master's Degree—In Scandinavian, offered under both Plan A and Plan B; in Scandinavian Area Studies, only under Plan B.

Comparative Literature—For information on this program, see page 95.

Courses identified by the §§ 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. Emphasis on 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 1964-65 and alt yrs) Gustafson

218-219-220.* Studies in Late Nineteenth-Century Scandinavian Literature. (3 cr per qtr; offered 1965-66 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 △) Nelson

Art 141. Scandinavian Painting. (3 cr; prereq 9 cr in history of art or 9 cr in literature or history with △) Nelson

Art 142. Scandinavian Sculpture and the Minor Arts. (3 cr; prereq 9 cr in history of art or 9 cr in literature or history with △) Nelson

Ger 113. Gothic. (3 cr; prereq Ger 80 and 11 cr above Ger 69 or equiv; offered 1964-65) C Wood

Ger 114-115.† Methods of Comparative Germanic Linguistics. (3 cr per qtr; prereq Ger 113; offered 1964-65) C Wood

Phil 137.§§ Kierkegaard. Detailed examination of his major philosophical works. (3 cr; prereq one course from Phil 50-51-52 or ♯) Gustafson

Pol 145.*§§ Government and Politics of the Scandinavian Countries. (3 cr; prereq 6 cr or 12 cr in social science) Mohammed

Pol 146.§§ Social Legislation and Social Institutions in the Scandinavian Countries. (3 cr; prereq Pol 2 or 5 or Soc 1) Mohammed

Soc 117.*§§ Scandinavian Folk Movements: Their Social and Political Significance. (3 cr; prereq Soc 1 or ♯) Mohammed

SLAVIC AND ORIENTAL LANGUAGES

Associate Professor
Richard B. Mather

Professor
Thomas B. Irving

Associate Professor
Chun-jo Liu
Pearl C. Niemi
William R. Schmalstieg

Assistant Professor
Wassilij Alexeev
Edward M. Copeland, Jr.

The following are offered as courses in a minor program or as related fields (in linguistics and comparative philology, area studies, comparative literature), but, for the present, no graduate degrees are offered.

Arabic

Arab 101-102-103. Advanced Arabic. Reading and analysis of both early classical texts and modern writing. Structure, syntax, and style emphasized. (3 cr per qtr; prereq 73) Irving

Arab 105. Structure of Arabic. Descriptive analysis of the main structure of Arabic, both classical and colloquial. (2-3 cr; prereq Clas 56 or Arab 63 or ♯; offered when feasible) Irving

Arab 151-152-153.‡ For advanced students who wish to work on special problems. (1-3 cr per qtr; prereq 63 or ♯) Irving

Arab 161. Hispano-Arabic Literature and Culture: History of Islamic Spain. (3 cr; prereq ♯) Irving

Arab 162. Hispano-Arabic Literature and Culture: Arab Philosophy in Spain. (3 cr; prereq ♯) Irving

Arab 163. Hispano-Arabic Literature and Culture: Hispano-Arabic Literature. (3 cr; prereq ♯) Irving

Arab 191-192-193. 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 millenium B.C. to present. (3 cr per qtr; prereq 9 cr in literature or ♯...knowledge of Chinese required only of majors who will read assigned portions in original; offered 1964-65 and alt yrs) Liu

Chin 151-152-153.‡ Directed Readings. (1-3 cr per qtr; prereq 103 or ♯) Mather and staff

Chin 191H-192H-193H.‡ Honors Course: Research. (1-3 cr per qtr; prereq 153 or ♯) Mather and staff

Indic

Indc 101-102-103. Advanced Hindi. (3 cr per qtr; prereq ♯; offered when feasible) Staneslow and staff

Indc 105. Structure of Hindi. (3 cr; prereq Clas 56, Anth 180 or ♯) Staneslow

Indc 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

Indc 151-152-153. Directed Readings. (1-3 cr per qtr; prereq Indc 103 or ♯) Staneslow

Japanese

Jpn 101-102-103. Advanced Japanese. Readings in modern prose and poetry; introduction to the classical language. (3 cr per qtr; prereq 53) Copeland

Jpn 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 required only of majors who will read assigned portions in the original; offered 1965-66 and alt yrs) Copeland

Jpn 151-152-153.‡ Directed Readings. (1-3 cr per qtr; prereq 103 or ♯) Copeland

Jpn 191H-192H-193H.‡ Honors Course: Research. (1-3 cr per qtr; prereq 153 or ♯) Copeland

Lithuanian

Lith 105-106-107. Structure and History of Lithuanian. (3 cr per qtr; prereq at least 2 Upper Division courses in early Indo-European languages or ‡; offered when feasible) Schmalstieg

Oriental

196. Proseminar in East and South Asia. (See Anth 196, Hist 196, and Pol 196) (3 cr)

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 required only of majors who will read assigned portions in the original) Niemi

Russ 113-114-115. Soviet Russian Literature. (3 cr per qtr; knowledge of Russian required only of majors who will read assigned portions in the original) Alexeev

Slav 113-114-115. Old Church Slavic. Introduction to Slavic linguistics. Descriptive grammar of earliest Slavic texts and comparison of Old Church Slavic with other Indo-European languages. (3 cr per qtr; prereq Clas 56 or equiv; offered 1964-65 and alt yrs) Schmalstieg

Russ 125-126-127. Structure and History of the Russian Language. Linguistic analysis of development of Russian language from time of earliest records to present. (3 cr per qtr; prereq 6 or equiv; offered 1965-66 and alt yrs) Schmalstieg

Russ 131-132-133. Russian Poetry: Nineteenth Century. (3 cr per qtr; prereq 73 or ‡) Niemi

Russ 141-142-143. 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 ‡) Niemi and staff

Slav 161-162-163. Comparative Balto-Slavic Grammar. Philological and linguistic study of relations among the Baltic and Slavic languages. (2 cr per qtr; prereq Russ 6 or Lith 107; offered when feasible) Schmalstieg

SOCIAL WORK

Professor

John C. Kidneigh
Edward W. Francel
Gisela Konopka
Hyman S. Lippman
Elio D. Monachesi
Anne W. Oren
Henriette E. Saloshin
Lyndell N. Scott
Dorothy A. Whitmore

Associate Professor

Miriam R. Cohn
Beulah E. Compton
John A. Crane
Mayo K. Newhouse
Helen C. Yesner

Assistant Professor

Philip C. Hovda
Laurence F. Merl
Ida Rapoport

Instructor

James H. Bridges
Dagny Johnson

Prerequisites—An applicant of satisfactory scholastic record, character, and professional qualifications whose Bachelor's degree was granted by a recognized college or university may be admitted by the dean of the Graduate School upon recommendation of the Admissions Committee of the School of Social Work.

A candidate for admission to the School of Social Work must present 39 quarter credits in social sciences, i.e., in sociology, political science, economics, psychology, history, or anthropology, including one or more courses in at least three of these social sciences, and a course in statistics.

Application blanks and instructions regarding admission may be secured from the School of Social Work, 909 Social Science Building, University of Minnesota, Minneapolis, Minnesota 55455.

Applications and transcripts in duplicate must be filed at least 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 experience may be admitted at the quarter which makes progression from their previous training feasible.

An application for admission is considered first by the graduate faculty of the School of Social Work, then recommended to the dean of the Graduate School for approval and admission. Acceptance of candidates is based upon: evidence of ability to meet standards of graduate work as indicated by high grades, including psychological tests, and evidence of stability of personality and aptitude in interpersonal relationships.

Advanced standing may be granted for work done in other approved schools of social work, limited by the rules stated herein.

Language Requirement—For the Master's degree, a foreign language is not required, but is strongly recommended. (French, German, Scandinavian languages, and Spanish may be approved.) For the Ph.D. degree, two foreign languages with the option of substituting for one of these a special research technique or a collateral field of knowledge. Any combination of French, German, Japanese, a Scandinavian language, and Spanish would be approved.

Master's Degree—The degree of master of social work requires 2 years of graduate study and will be awarded to students who fulfill the following requirements:

1. Ninety credits including a 9 quarter-credit degree project (as indicated in the following) must be presented with an average grade of B or better.

2. A sequence must be completed in each of the groups of courses lettered B, C, D, and E including at least one course each in administration, casework, community organization, group work, and research.

3. A project of 9 quarter credits consisting of several seminar research papers or a single report which shows capacity for critical evaluation and analysis must be presented. Preferably all 9 credits should be earned under the supervision of one faculty member.

4. Not less than 45 credit hours must be earned in residence at the University of Minnesota with an average grade of B or better.

5. Not more than 45 credit hours will be accepted by transfer and then only if earned in an accredited school of social work. Credits accepted for transfer shall show an average of B or better.

6. Not more than 9 credit hours earned in extension courses will be accepted to apply on degree requirements and then only if the grade received is B or better and the course (a) was taught by a member of the graduate faculty, (b) is numbered 100 or above, (c) carries the same title and content as a corresponding course in the regular curriculum.

7. The candidate must pass a written examination or an oral examination conducted by a committee of three or more members of the graduate faculty.

8. All credits offered for the degree must have been earned within 7 years preceding the quarter in which the degree is conferred.

9. Following completion of 40 graduate credits, not less than 15 of which must have been earned at the University of Minnesota, and not later than the opening of the quarter preceding the quarter in which the degree is to be conferred, the student shall submit, through his major adviser, a program of all credits presented for the degree upon the appropriate degree program form.

Doctor's Degree—Students who have the Master's degree in social work from this school, or the comparable Master's degree from a school of social work accredited by the Council on Social Work Education, may, if their records are distinctly superior, become candidates for the Ph.D. degree in social work (requiring at least 2 years of post-Master's graduate work).

A. Special Topics and 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) Compton, Hovda, Rapoport, Bridges, Johnson, Bounous, Steinberg.

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

C. The Social Services

225-226-227. Social Policy and Programs I-II-III. Social policy and social work programs, public and private, in economic security, housing, health, rehabilitation, interpersonal and intergroup relations, education, recreation, corrections and protective functions and occupational and vocational functions indicating the role of the social work profession. (4-2-2 cr) Newhouse, Oren

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) Francel

243. International Social Welfare. (3 cr; prereq ‡) Francel

245x. General Seminar: 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-psychobiological factors associated with individual and group development as applied to social work practice. (3-2 cr; prereq ¶210 or ‡) Saloshin, Bounous, Hovda, Yesner

249A-B. Concepts of Human Growth and Behavior in Social Work Practice II. Socio-psychobiological factors associated with individual and group development as applied to social work practice. (2 cr per qtr; prereq ¶211 or ‡) Saloshin, Thomes

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) Rowe, 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, Bounous, Yesner

256x. General Seminar: Concepts of Human Behavior in Social Work Practice. (Cr ar; prereq grad social work students) Saloshin

E. Social Work Practice

260. Principles of Administration in Social Work. Technical study of the process of transforming social policy into social services. (2 cr) Kidneigh

261. Supervision in Social Casework. Principles applied to supervisory process in agencies offering casework services. (2 cr; prereq 260 and ‡) Scott, Whitmore

262. Supervision in Social Group Work. Principles applied to supervision of volunteers and others working in agencies offering group work services. (2 cr; prereq 260, 277) Cohn

263. Administration in Social Group Work. Principles applied to subexecutive positions in agencies offering group work services. (2 cr; prereq 260, 278) Cohn

264. Seminar: Social Work Administration. (Cr ar; prereq 226 and 260 or ‡) Kidneigh

265. Social Casework I. Philosophy and processes, methods and skills of social casework. (2 or 3 cr; prereq ¶210) Whitmore

266, 267. Social Casework II-III. Casework I continued: critical analysis of casework process and development of skill. (2 cr per qtr; prereq 265, ¶211-212) Whitmore

268, 269, 270. Social Casework IV-V-VI. Advanced casework method focused primarily on treatment methods. (2 cr per qtr; prereq 267, ¶215-216) Scott, Crane

271. Community Organization. Analysis of the process by which groups and individuals within a community work together to equate social services to community need and establish social policy for planning and co-ordination of social services. (2 cr) Francel

274. Seminar: Community Organization. (Cr ar; prereq 271) Francel

275. Social Group Work I. Method. (2 or 3 cr; fall qtr open to social work students only, spring qtr open to other grad students) Konopka, Cohn

276. Social Group Work II. Group Work I continued: role of worker in group process, group formation and social forces, focused on development of skill. (2 cr; prereq 275, ¶211) Cohn

277. Social Group Work III. Intensified understanding of individualization process in working with groups. (2 cr; prereq 276, ¶212) Cohn

278. Social Group Work IV. Advanced group work method. (2 cr; prereq 277, ¶215) Konopka

279, 280. Social Group Work V-VI. Group work with individuals in groups for treatment purposes, group therapy. (2 cr; prereq 278 or ‡) Konopka

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) Steinberg

282. Use of Programs in Groups II. Program planning and execution related to principles and practices of the discussion method. (1 cr; prereq 275) Steinberg

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: Social Work Methods. (Cr ar; prereq ‡) Scott, Konopka

298-299-300. General Seminar: Social Work. (Cr ar; prereq MSW degree) Kidneigh, Saloshin, Scott

SOCIOLOGY

Professor
Elio D. Monachesi
Roy E. Carter
Roy G. Francis
Edward Gross
Reuben L. Hill, Jr.
Arthur L. Johnson
Don A. Martindale
Arnold M. Rose
Gregory P. Stone
Murray A. Straus

Associate Professor
David A. Ward

Assistant Professor
Joan Aldous
John Forster
Walter M. Gerson
John D. Photiadis
Irving Tallman

Prerequisites—For major work, 18 quarter credits; for minor work, 12 quarter credits.

Language Requirement—For the Master's degree, one foreign language. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge. Routinely acceptable languages are Dutch, French, German, Italian, Japanese, Portuguese, Russian, and Spanish.

Master's Degree—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 three subareas at least two 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 266.

100. Contemporary Penology. More important developments in recent attempts at treatment of criminals and prevention of crime. (3 cr; prereq 1, 53, or ‡)

101. Criminological Theories: Historical and Contemporary. Evaluation of the major historical and contemporary theories of criminal behavior. (3 cr; prereq 1, 53, or ‡)

102. Adult Parole and Probation. Critical examination of problems and practices in supervision of adult criminals. (3 cr; prereq 1, 53 or ‡; offered 1964-65 and alt yrs)

103. Law and the Legal System for Correctional and Social Workers. Nature and effect of legal rules, constitutional, legislative, and judicial; the adversary process; the right to a hearing; the right to and function of counsel; fact determination under rules of evidence; concepts underlying criminal law and procedures; juvenile court; probation and parole. (3 cr; prereq ¶Sequence C or B or ‡) Pirsig

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 1965-66 and alt yrs)

105. Institutional Treatment of Juvenile Delinquents: Problems and Practices. Current problems of institutional treatment of juvenile offenders and contributions of different professions to treatment. (3 cr; prereq ¶Sequence C or B or ‡) Konopka

106. Planning. (Same as Arch 104 and Pol 123) Social, economic, political, geographic, and technical phases of city planning. (3 cr) Broek, Rose, Vivrett, Warp

107-108-109.† Proseminar in Delinquency Control and Treatment. (1 cr per qtr) Knudson

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 ‡)

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 ‡)

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, Gerson

124. Social Movement in a Changing Society. Factors underlying social change in the modern mass society. Recent researches on social movements, reform and revolution, culture contact, impact of rapid technological change. The individual and the social structure under conditions of rapid social change. (3 cr; prereq 1 or ‡) Rose

125. Opinion and Communication: Social Factors. Processes of opinion formation and change in relation to personality and social structure; analysis of flow of public communications through society and impact of selected types of mass communication on particular audiences. Recommended that this course be taken as a 3-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, Nelson

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

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 ‡) Stone

146. Industrial and Occupational Sociology. The occupational group; the factory and the business enterprise as social institutions; the contrasting functions of formal and informal organization; significance of co-operation, authority, communication, status, and group norms in the working situation. (3 cr; prereq 1 and 15 cr in sociology, psychology, political science, or economics) Gross

151. Comparative Social Organization. Demographic and ecological characteristics, stratification system, institutional organization, and forms of association in several modern nations other than the United States. (3 cr; prereq 20 cr in sociology, economics, or political science, or ‡)

152. Sociology of Medicine and Medical Institutions. Social factors associated with the incidence of physical and mental illness and its treatment. Social organization of medical institutions. Public needs and medical services. Sociology of aging, and social problems of the aged. (3 cr; prereq 1, or ‡) 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 ♯; offered when feasible)

160. Rural Community Organization. History, structure, and place of the rural community in American society; community demography, ecology, stratification, urbanization, and processes of co-operation and conflict. (3 cr; prereq 1 or ♯)

161. Rural Community Analysis. Offered on the St. Paul Campus for all persons interested in rural community organization, rural teaching, extension work, and related fields. Tools, techniques, and methods of making community field studies. (3 cr; prereq 1 or ♯) Photiadis

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 ♯) Photiadis

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, Nelson

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 cr per qtr; prereq 45 or 182 or ¶45 or ¶182) Francis, Stone

SEMINARS

201f-202w, 202s.°‡ Seminar: Research Problems in Crime and Social Conflict. (3 cr per qtr)

203-204-205.°‡ Seminar: Research Problems in Juvenile Delinquency. (3 cr per qtr; offered when feasible) Monachesi

210-211-212.°‡ Seminar: Problems in Population Research. (3 cr per qtr; offered 1964-65 and alt yrs) Francis

220-221-222.°‡ Seminar: Social Psychology. (3 cr per qtr) Rose

223-224-225.°‡ Seminar: Research in Problems of Modern Mass Society. (3 cr per qtr; offered when feasible)

226.° Seminar: Family Development Theory. (3 cr; prereq ♯; offered spring 1965 and alt yrs) Hill

227-228.° Seminar: Contemporary Research on Marriage and the Family. (3 cr per qtr; offered winter and spring 1965 and alt yrs) Hill

230-231-232.°‡ Seminar: Research in Group Structure and Function. (3 cr per qtr) Stone

233-234-235.°‡ Seminar: Methods for the Evaluation of Social Action Programs. (3 cr per qtr; offered when feasible)

238-239.°‡ Seminar: Principles of Sociology. (3 cr per qtr) Stone

241-242-243.°‡ Seminar: Research Problems in the Family. (3 cr per qtr; offered when feasible; Johnson

245-246.°‡ Seminar: Research in Urban Sociology. (3 cr per qtr; offered 1965-66 and alt yrs) Stone

247-248-249.° Seminar: Research in Large Scale Organization. (3 cr per qtr) Gross

251-252-253. Selected Problems in Comparative Sociology. (3 cr per qtr)

260-261-262.°‡ Seminar: Rural Sociology. (3 cr per qtr; offered when feasible)

263.° Seminar: Research Methods in Rural Sociology. (3 cr; offered when feasible)

270-271-272.°‡ Seminar: Social Theory. (3 cr per qtr) Martindale

280-281-282.°‡ Seminar: Recent Developments in Sociological Research Techniques. (3 cr per qtr; offered when feasible) Straus

284-285-286.°‡ Seminar: Statistical Theory in Relation to Social Theory and Practice. (3 cr per qtr) Monachesi

297-298-299.‡ General Seminar. (Cr ar) Graduate staff

SOIL SCIENCE

Professor
William P. Martin
George R. Blake
Paul M. Burson
Alfred C. Caldwell
Robert F. Holt
John M. MacGregor
Edwin L. Schmidt
Cornelius A. Van Doren

Associate Professor
Harold F. Arneman
Richard H. Rust

Assistant Professor
Russell S. Adams
Raymond R. Allmaras
Donald G. Baker
William C. Burrows
Charles E. Clapp
Rouse S. Farnham
Janis Grava
Raymond J. Kunze
Gordon C. Marten

Prerequisites—For major work, a good background in chemistry, including quantitative analysis, and college physics is desired. All students should have mathematics through analytic geometry or its equivalent, and instruction in calculus is advisable.

For a minor in soil science, the student must satisfy the graduate faculty that his preparation is adequate.

Major and Minor—A graduate student in soil science may concentrate on such areas as genesis and classification, chemistry and fertility, microbiology, microclimatology, or physics. The course of study will vary with the requirements of the area and the interests of the student under supervision of the major adviser. A minor will be selected usually in some allied field such as agronomy, botany, chemistry, microbiology, biochemistry, physics, geology, economics, forestry, agricultural engineering, and others.

A student minoring in soil science will take the courses acceptable to the minor adviser.

Language Requirement—For the Master's degree, none. For the Ph.D. degree, either (a) two foreign languages, or (b) one foreign language and the option of a special research technique or a collateral field of knowledge may be submitted. Acceptable languages are German and Russian or either of these paired with French or Spanish. Other combinations may be presented by petition.

Master's Degree—Offered under Plan A and Plan B. Students contemplating graduate work beyond the Master's degree will take Plan A.

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

119. Intermediate Soils. (Same as 19) Graduate students required to do extra work. Lectures and laboratory. (4 cr; prereq GeCh 5) Arneman, Martin

121. Soils of Minnesota. (Same as 21) Graduate students required to do extra work. Lectures and laboratory. (3 cr; prereq 1 or 3 or 19) Farnham

122. Soil Erosion and Conservation. Soil and water conservation as related to modern tillage and cropping practices. Effect of climate, soil type, slope, vegetation, and management on allowable soil loss. Federal and state soil conservation organizations and their procedures. (3 cr; prereq 1 or 3 or 19 or 119) MacGregor

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. Lectures and laboratory. (4 cr; prereq MicB 53, 8 cr in organic chemistry and ‡) Schmidt

128.° Soil Chemistry. Chemical composition of soils; organic matter; mineral matter; ionic exchange; plant nutrients and factors affecting their availability. (3 cr; prereq 3 or 19 or 119) MacGregor

128A. Soil Chemistry Laboratory. Methods of chemical analysis in soils. (2 cr; prereq analytical chemistry; offered 1965-66 and alt yrs) MacGregor

130x.° Special Problems in Soils. Research, readings, instruction. (1-5 cr per qtr, 10 cr max; prereq 1 or 3 or 19 or 119) Staff

131.° Physical Chemistry of Soils. Selected topics in physical chemistry as related to soils. Electrokinetic phenomena, colloidal behavior, interactions of organic and inorganic soil materials. Lectures and laboratory. (3 cr; prereq physical chemistry or ‡; offered 1965-66 and alt yrs) Rust

132.° Soil Fertility. Plant root-soil relationships; chemistry of essential elements in the soil and plant; diagnosing soil deficiencies. (3 cr; prereq 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) Farnham

202x. Research Problems in Soils. Individual laboratory or field work on special problems in a phase of soils other than student's major thesis. Arrangements must be made in advance. (2-5 cr) Martin, Burson, Caldwell, Blake, MacGregor, Schmidt, Arneman, Rust, Farnham, Baker, Adams

203x. Seminar: Soils. Assigned reading, reports, and discussions on soils topics. (1 cr) Staff

204x.° Advanced Soil Science. Recent advances in soil classification, chemistry, physics, microbiology. (3 cr; prereq ‡) Martin, Caldwell, Blake, MacGregor, Schmidt, Arneman, Rust, Farnham, Baker, Adams

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 THEATRE ARTS

Professor
Kenneth L. Graham
Paul H. Cashman
Norman J. DeWitt
Alan L. Downs
Francis E. Drake
Alrik Gustafson
Tyrone Guthrie
Ernest H. Henrikson
William S. Howell
John D. Hurrell
Frank M. Lassman
Robert E. Moore
Ralph G. Nichols
Robert L. Scott
Donald K. Smith
David W. Thompson
Frank M Whiting
Donald Z. Woods
E. William Ziebarth

Associate Professor
Arthur H. Ballet
Ernest G. Bormann
Paul H. Cashman
Frederic Darley
Wendell J. Josal
Robert D. Moulton
George L. Shapiro
Gerald M. Siegel
Robert P. Sonkowsky
Clark D. Starr

Assistant Professor
Lee H. Adey
Arnold E. Aronson
Frank T. Benson
Bernard L. Brock
Virginia M. Fredricks
Sheldon Goldstein
Rollie R. Houchins
J. Vernon Jensen
Richard R. Martin
Richard P. McDermott
Ronald M. Wendahl

Prerequisites—For major work, 18 credits in speech. A comprehensive entrance examination is a prerequisite for graduate work in theatre.

Language Requirement—For the Master's degree, one foreign language—French, German, Greek, Latin, Russian, Spanish, or Swedish, except for programs with a major in speech pathology and audiology, where there is no language requirement. For the Doctor's degree, either (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge. When two languages are offered they may be chosen from those listed.

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, theatre, voice science.

Additional reading requirements in dramatic literature for a candidate emphasizing theatre are to be selected with the approval of his adviser.

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

Doctor's Degree—In consultation with his major adviser the candidate will elect three of the following areas of study: theatre, 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, or a supporting program may be substituted with the approval of the major adviser and at least one other full member of the graduate faculty.

The student may earn the Ph.D. degree either in the field of speech pathology and audiology or in speech and theatre arts.

Additional reading requirements in dramatic literature for a candidate emphasizing theatre are to be selected with the approval of his adviser.

PUBLIC ADDRESS AND RHETORIC

101-102-103.°‡ Argumentation and Persuasion. Theories of modern motivational rhetoric. Analysis of persuasive speaking; practice in preparation and delivery of oral argument. (3 cr per qtr; prereq 5, Psy 2, 10 cr in social science) Brock, Howell, Scott

106.° Discussion. Co-operative thinking; recognition and definition of problems, critical analysis, examination of possible solutions. Planning, preparing for, participating in, and leading classroom, public, and radio and television discussions. (3 cr; prereq 5) Bormann, Cashman, Howell

109.° Classical Rhetoric. Greek and Roman theories of speech making; historical and philosophic context and influence on education. (3 cr; prereq 5, and △) Scott

110.° History and Criticism of British Public Address. British orators, their works, the historical setting, British rhetorical theory. (3 cr; prereq 5, and △) Jensen

124.° Experiments in General Speech. Correlates of speech skills, audience reactions, and speech improvement. (3 cr; prereq 5, Psy 2; offered when feasible) Bormann

126A.° History and Criticism of American Public Address. Survey of history and criticism of religious and reform speaking in the United States from 1620 to 1920. (3 cr; prereq 5, Psy 2) Bormann

126B.° History and Criticism of American Public Address. Survey of history and criticism of political speaking in the United States from the time of the Revolution to the present. (3 cr; prereq 5, Psy 2) Bormann

169.° Speech and Language in Human Behavior. Basic orientation on the place of speech and language in human behavior. Individual projects and collateral reading. (3 cr) Shapiro

201x.° General Seminar. Survey of current literature and general problems. (1 cr per qtr; prereq ♯) Shapiro

203-204.°‡ Debate Coaching. Literature concerning and methods of directing extracurricular interscholastic public speaking, discussion, and debate activities. (2 cr per qtr; prereq 5, Psy 2, 10 cr in social science) Brock, Howell, Scott

207-208-209.°† Seminar: Persuasion. Contemporary public address. Literature of persuasion, methods in study of persuasion. (3 cr per qtr; prereq 5, 101, 102, 103, Psy 2, 140, 10 cr in social science) Howell

234.° Seminar: History and Criticism of Public Address. Methods of rhetorical criticism. Application of method in individually selected research projects. (3 cr; prereq 126A, 126B, or △) Bormann, Scott

235.° Seminar: Small Group Communication. Research problems and methods. (3 cr; prereq 5, 106) Bormann

251.° Seminar: Listening Comprehension. Research problems and methods. Evaluation of published research. (2 cr; prereq undergrad speech major, ♯) Nichols

275-276-277.°‡ Seminar: Rhetoric. History and critical study of rhetorical theory. Examination of research in rhetoric. (3 cr per qtr; prereq 109 or ♯) Scott, Smith, Sonkowsky

INTERPRETATION

105.° Theory of Reading and Acting. Literature as an art; its forms; psychology of creative imagination; speech elements in literature; origins and nature of speech symbols and techniques of their use. (3 cr; prereq 83 and Psy 2) Fredricks, Thompson

107.° Platform Reading. Oral interpretation of selected poems and plays. Speech melody, rhythm, platform technique. Aesthetic analysis. Lecture recitals. (3 cr; prereq 81, 82, 83) Fredricks, Thompson

221-222-223.°‡ Seminar: Oral Interpretation of Literature. Problems of silent and oral reading. Speech in relation to language and types of literature. (3 cr per qtr; prereq 81, 82, 83, 105) Thompson

THEATRE ARTS

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 31L, 32, 33, 34, 90 or 92, 91 and ♯) Whiting

115-116. Playwriting and Production. Creative practice in dramatic construction. 115: The one-act play. 116: The full-length play. (3 cr per qtr; prereq 31L, 32 or △) Thompson

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, 31L or elementary education major, or ♯...Spch 32 recommended) Graham

132.° Children's Theatre. Selection, direction, and production of plays for children's audiences, co-ordinated with current productions of the Young People's University Theatre. (3 cr; prereq 5, 31L or ♯) Graham

171-172-173.°† History of the Theatre. Plays, arts, and crafts of the theatre from their beginnings to the present. Reports and projects. (3 cr per qtr; prereq 5, 31L, 122 or ¶122) Sonkowsky (171), Josal (172), Graham (173)

174. American Theatre. The theatre as an aspect of American culture from 1752 to the present. (3 cr; offered when feasible)

175. Theatre Symposium. Intensive study of art of theatre; productions and production methods of Tyrone Guthrie Theatre. Conducted by professional critics, actors, directors, and designers as well as University faculty members. (6 cr; Summer Session only) Ballet, staff

177-178-179.‡ Theatre Practicum. Individual creative projects meeting approval of a faculty committee in one or more of these areas: playwriting, directing, acting, or design. (2-6 cr per qtr; prereq △) Staff

190-191-192.°‡ Technical Stage Problems. 190: Theory of stage costume. 191: Scenic design. 192: Stage lighting. Special projects and reports. (3 cr per qtr; prereq 111, 112 or ♯) Moulton (190), Josal (191, 192)

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) Sonkowsky (211), Ballet (212, 213)

214-215-216.‡ Seminar: Stage Direction. Great plays and their potentials for meaningful and effective production in the modern theatre. (3 cr per qtr; prereq 111, 112, 113) Whiting, Moulton

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 theatre or ♯) Josal

218. Seminar: Theatre Planning. Principles in planning and design of stages, auditoriums, and associated facilities; their application to the educational theatre. Both building and equipment analyzed. (3 cr; prereq 191, 190 or 193 or equiv) Josal

SPEECH SCIENCES, PATHOLOGY, AND AUDIOLOGY

125. Speech for the Hearing Impaired. Differential effects of hearing impairment on speech. Analysis of speech disorders of persons with impaired hearing. Historical and current approaches used in development and improvement of speech of individuals with impaired hearing. (3 cr; prereq 67 or equiv) Houchins

127. Language for the Hearing Impaired. Language problems resulting from impaired hearing. Survey of approaches of developing and teaching language to the hearing impaired individual. (3 cr; prereq 152 or ♯) Houchins

140.° Introduction to Voice Science. Phonetic, anatomic, physiologic, and physical bases of speech. (3 cr; prereq 5, Psy 2) Wendahl

141.° Anatomy and Physiology of Voice Mechanism. Respiration, articulation, and phonation. (3 cr; prereq 5, 67, or ♯, Psy 5) Wendahl

142.° Physical Bases and Instrumentation of Speech. Relationship of 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) Wendahl

145. Basic Hearing Science. Nature of normal hearing. Historical backgrounds and issues; theories of hearing. Pitch, loudness, quality and their scaling; hearing limits; differential sensitivity. Combination tones, masking, adaptation, binaural effects and spatial localization. Some contemporary theoretical considerations such as information theory and signal detection theory. (3 cr; prereq 152 or ♯) Ward

149.° Speech Habilitation for Persons with Neuromuscular Disorders. Physiological, neurological, and psychological characteristics of persons with cerebral palsy and other types of neuromuscular disorders; methods used in their speech habilitation. (2 cr; prereq 161, 162, 163, or ♯) Greenberg

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) Greenberg

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, lipreading, 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.° Lipreading and Lipreading Methods. Schools and methods of teaching lipreading. Supervised practice in teaching lipreading 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) Houchins

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 153 and ♯) Lassman

160. Diagnosis of Speech Disorders. Consideration of research and clinical material pertinent to construction and use of diagnostic instruments. Participation in clinical diagnostic facilities. (3 cr; prereq 161 or ¶161 and ♯) Martin

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 △) Siegel, McDermott

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 5, 67, 161, 162, 163) Henrikson, Starr

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 67, 161, 162, 163, Psy 2, or ♯) Henrikson and staff

267-268-269. Seminar: Experimental Phonetics. Critical analysis of significant research in physiologic and acoustic phonetics. Examination of theory, method, instrumentation, and data. (2 cr; prereq 67 and 142) Wendahl

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

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, Darley

RADIO AND TELEVISION

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 △) Thompson

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 or 66, 69, 78, 111, 112 and ♯; offered when feasible) Goldstein

170.* Radio and Television Programming. Theory and practice. Principles of program effectiveness; program policies of the industry. Building and production of experimental programs; emphasis on talk and discussion. (3 cr; prereq 65 or 66, or ♯) Goldstein

241-242-243.*‡ Seminar: Radio and Television Research. Evaluation of research methods in mass communication by radio and television. Research literature. (2 cr per qtr; prereq ♯) Ziebarth

GENERAL

122.* Introduction to Research. Graduate research in speech: selection of topics and methods of investigation. Required of all graduate majors in speech. (3 cr; prereq 5, Psy 2) Bormann

181, 182, 183.* Readings in Speech. Directed reading and preparation of reports on selected subjects. (Cr ar; prereq 5 and 6 addtl cr and ♯) Staff

231-232-233.*‡ Seminar: Advanced Speech Problems. Evaluation of research methods in speech and theatre arts. (3 cr per qtr; prereq undergrad major in speech, or equiv, ♯) Staff

291-292-293.*‡ Research. Open to graduate students engaged in research on special problems. (Cr ar) Staff

STATISTICS

Associate Professor
Bernard W. Lindgren, *chairman*

Professor
Jacob E. Bearman
Oswald H. Brownlee
Robert J. Buehler
John S. Chipman
Raymond Collier
Ralph E. Comstock
Roy G. Francis
Leonid Hurwicz
Gopinath Kallianpur
Gayle W. McElrath
Richard B. McHugh
John Neter
Steven Orey
Edgar Reich
Merrill F. Roff
Paul C. Rosenbloom
Harold Ruben
Robert N. Shoffner
Milton Sobel

Associate Professor
William B. Brown
Charles Gates
Charles H. Kraft
Elmer W. Learn
James C. Sentz
Horace L. Thomas

Assistant Professor
Theophilos N. Cacoullos
William E. Pruitt
Constance van Eeden

General Viewpoint—Any candidate for an advanced degree with a major in statistics will be expected to become familiar with modern statistical theory, its supporting mathematics, and its applications.

Prerequisites—Mathematics through integral calculus.

Adviser—The chairman of the statistics graduate faculty, Professor Kallianpur, may be consulted for assistance in selecting an adviser from the above list.

Language Requirement—For the Master's degree reading knowledge of one foreign language is required; for the Doctor's degree reading knowledge of two foreign languages, or a reading knowledge of one foreign language and a special research technique or a collateral field are required. The languages are ordinarily chosen from Russian, French, German.

Master's Degree—Offered under both Plan A and Plan B. Both written and oral examinations are required.

Doctor's Degree—Most of the course work in a major program is to be chosen from the first list of courses below; some courses from the second list may be offered with the adviser's consent. A written preliminary examination is ordinarily given twice during each year; consult the chairman of the statistics graduate faculty to arrange for this examination. A major program should include at least Stat 201-202-203, and mathematics at least through advanced calculus and linear algebra; most candidates will also include in their programs Stat 221-222-223 and Math 222A,B,C. The minor may be in mathematics or in a field in which the candidate expects to apply statistics; if the minor is mathematics, the major program should include contact with the use of statistics in some field of application.

Minor in Statistics, Ph.D.—It should not be assumed that an arbitrary selection of courses will satisfy the minor requirements. A minimum requirement includes one of the sequences Stat 121-122-123 and Stat 131-132-133, and evidence of familiarity with least squares, regression, and analysis of variance at the same level as these courses. The minor program should be planned in advance; consult the chairman of the statistics graduate faculty. A written examination in the minor is not required.

Probability—Students are expected to acquire at least a basic knowledge of probability theory. Candidates for the Ph.D. degree will ordinarily include an advanced sequence in probability in their programs either as part of the major or as part of a mathematics minor.

101. Introduction to Decision Theory. Elements of probability; basic concepts in statistical decision theory; relationship to game theory and other types of decision problems; prediction and inference. (3 cr; prereq Econ 101A, or Math 40, or 42 or 13, or ♯)

110. Methods of Statistics. Not offered in the Statistics Department. Register for one of the following sequences: PubH 120, 121, 130, 131; Biom 100, 101, 201; Biom 100, AgEc 101, Agro 248; QA 191A, B, 193; EPsy 216, 217, 218, 216A, 217A, 218A. Credit is allowed for only one of these sequences; they differ somewhat in the number of credits, in the amount of laboratory work, and in the order of topics, but are at about the same mathematical level and overlap greatly in content.

121-122-123. Theory of Statistics. Univariate and multivariate distributions, law of large numbers, sampling, likelihood methods, estimation, hypothesis testing, regression and analysis of variance and covariance, confidence intervals, distribution-free methods. (3 cr per qtr; for nonmajors; prereq Math 10 for 121, Math 43 or equiv for 122, Math 44 or equiv for 123)

131-132-133. Theory of Statistics. 131: Probability models, univariate and bivariate distributions, independence, basic limit theorems. 132-133: Statistical decision theory, sampling, estimation, testing hypotheses, parametric and nonparametric procedures for one-sample and two-sample problems, regression, analysis of variance. (3 cr per qtr; prereq Math 44 or equiv for 132, ¶Math 107-108 or equiv for 132-133)

141. Sample Surveys. Not offered in the Statistics Department. Register for QA 171.

151. Quality Control and Sampling Inspection. Not offered in the Statistics Department. Register for IE 171, 177, or QA 181.

161. Design of Industrial Experiments. A course for students with a background of calculus and some statistical theory. Not offered in the Statistics Department. Register for IE 198-199.

171. Introduction to Stochastic Processes with Applications. Not offered in the Statistics Department. Register for Math 133B-134B.

178. Introduction to Probability Theory. Not offered in the Statistics Department. Register for Math 178A,B,C.

181A,B,C. Topics in Statistics. Topics vary according to needs and available staff; may be repeated for credit. (3 cr per qtr; prereq 123 or 133 or ♯)

191-192-193. Analysis and Design of Experiments. Theory and applications of the general linear model, regression, analysis of variance, and design of experiments. (3 cr per qtr; prereq 123 or 133, and matrix theory)

201-202-203. Theory of Statistical Inference. Topics in distribution theory, large sample theory, multivariate theory, sequential analysis, decision theory, nonparametric inference—more extensive and deeper coverage than in 131-132-133. (3 cr per qtr; prereq 133, or ¶132 and 123, and advanced calculus, or ♯)

221-222-223. Advanced Statistical Theory. Advanced topics in general inference and decision theory. (3 cr per qtr; prereq 203 plus a sequence in probability and Math 222, or ♯)

241A,B,C. Nonparametric Inference. Optimality properties of sufficiency, completeness, and invariance introduced and used to derive broad classes of procedures, e.g., those based on randomization, rank orders, runs, etc. Special limit theorems and measures of efficiency, tolerance intervals, Chebyshev inequalities, Kolmogorov-Smirnov statistics, and other tests of goodness of fit. (3 cr per qtr; prereq ♯)

251A,B,C. Multivariate Theory and Analysis. 251A: Marginal distributions, conditional distributions and independence. Transformations. Generalized variance and concentration ellipsoid. Multivariate regression. Simple, partial, and multiple correlation coefficients. Vector alienation and vector correlation coefficients. Some basic multivariate distributions. 251B,C: The multivariate normal distribution. Noncentral t, X^2 and F. Distribution and uses of sample correlation coefficients and of Hotelling's T^2. Discriminant analysis. Distributions of sample covariance matrix and generalized variance. Generalized analysis of variance. Independence and homogeneity tests. Component analysis. Canonical analysis. Distribution of eigenvalues. Functional analysis. (3 cr per qtr; prereq 203 or ♯)

258-259-260. Advanced Probability Theory. Not offered in the Statistics Department. Register for Math 258-259-260.

281A,B,C. Advanced Topics in Statistics. Topics vary according to needs and available staff; may be repeated for credit. (3 cr per qtr; prereq ♯)

284. Stochastic Processes. Not offered in the Statistics Department. Register for Math 284A,B,C.

293. Seminar: Stochastic Processes. Not offered in the Statistics Department. Register for Math 293A,B,C.

301. Seminar. Problems, current literature review, research. (1-3 cr per qtr; prereq ♯)

RELATED COURSES

(See statement above concerning statistics credit for these courses)

AnHu 204. Quantitative Inheritance II

CPsy 227. Multiple Factor Analysis

Econ 195B. Decision-Making and Operations Analysis

Econ 201A,B,C. Econometrics

Econ 301. Seminar: Econometrics and Statistical Inference

Econ 391A, B, C. Seminar: Workshop in Econometrics

EPsy 208. Methods in Educational Research

EPsy 219, 219A. Design and Analysis of Statistical Investigations

EPsy 220, 221. Advanced Theory of Measurements

EPsy 243. Problems in Statistics

Math 133A, 134A. Mathematical Methods of Operation Analysis

Math 241. Information Theory

PubH 150. Vital Statistics

PubH 201. Topics in Biometry

PubH 203-208. Research Design in Biometry

PubH 211. Seminar: Biometry

PubH 216-219. Biomedical Measurement Problems

PubH 250-251-252. Foundations of Biometry

QA 291A,B. Reading and Research in Statistics

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
Harvey H. Hoyt
George W. Mather
Benjamin S. Pomeroy
Jay H. Sautter
Dale K. Sorensen
Francis A. Spurrell
Clarence M. Stowe
Alvin F. Weber
Raimunds Zemjanis

Associate Professor

John M. Higbee
Robert K. Lindorfer
Donald G. Low
Robert A. Merrill
Edward A. Usenik

Assistant Professor

William J. Bemrick
Donald H. Clifford
Harold E. Dziuk
Ira M. G. Gourley
Griselda F. Hanlon
Keith I. Loken
Niels O. Nielsen
Victor Perman
Stuart Young

Clinical Assistant Professor

Robert H. Monahan

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 (German, Danish, French, Japanese, Norwegian, Russian, Spanish, or Swedish) is required. For the Ph.D. degree, either (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge. When two languages are offered, acceptable combinations are: German, Swedish, Norwegian, or Danish combined with Russian, Japanese, French, or Spanish *or* Russian or Japanese combined with French or Spanish.

Master's Degree—Offered under Plan A. In special circumstances 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 ‡)

102. Anatomy of Nonruminants. Anatomy of the horse, pig, and poultry as compared to the dog. (5 cr; prereq 101 or ‡)

103. Anatomy of Ruminants. Anatomy of the cow and sheep. (3 cr; prereq 102 or ‡)

106. Veterinary Surgical Anatomy. Topographical anatomy of domestic animals as applied to surgery and practice of veterinary medicine. (1 cr; prereq 103, VMC 101, ‡)

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 ‡)

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: Veterinary Anatomy. (1 cr; prereq 101, 151, ‡) 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, ‡) 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, ‡)

203. Experimental Comparative Veterinary Neurology. Principles, methods, and laboratory exercises in investigating the central nervous system of domestic animals. (3 cr; prereq 202, ‡)

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 1965-66 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 1964-65 and alt yrs) Weber

Veterinary Bacteriology and Public Health

101. General Veterinary Bacteriology and Immunology. Lectures and laboratory on classification, morphology, and physiology of bacteria; bacteriology of water, sewage, milk, and food. Basic principles of infection and immunity. (6 cr; prereq 10 cr in zoology, 13 cr in chemistry, ‡) Lindorfer, Loken

102. Pathogenic Bacteria and Fungi. Lectures and laboratory on animal pathogens; basic mechanisms of infection. (6 cr; prereq 101 or equiv, ‡) Loken, Lindorfer

103. Veterinary Virology. Basic techniques of virology; viral and rickettsial agents which cause animal diseases. (4 cr; prereq 102 or equiv, ‡) Lindorfer, Loken

125-126-127. Veterinary Public Health. Principles of epidemiology; selected diseases of man and of animals transmissible to man; principles and methodology of food hygiene; meat, poultry, milk, and other foods as related to animal and human health; veterinarians' relationship to public health and animal disease control agencies. (4 cr for 125, 3 cr for 126, 2 cr for 127; prereq 103, VPaP 153, ‡) Anderson

128x.° Problems in Veterinary Bacteriology and Public Health. (Cr ar; prereq 103 or equiv, ‡) Pomeroy, Anderson, Lindorfer, Loken

130. Poultry Hygiene. General anatomy of the fowl, physiology of digestion and reproduction, and the prevention and control of the more important diseases affecting poultry. (3 cr; prereq Biol 2, Poul 1, MicB 53; offered 1965-66 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, Loken

211. Seminar: Veterinary Bacteriology. (1 cr; prereq ‡) Pomeroy, Anderson, Lindorfer, Loken

221. Advanced Veterinary Public Health. Veterinary public health programs and selected diseases common to animals and man. (Cr ar; prereq 127, ‡) Anderson

Veterinary Medicine and Clinics

101. Veterinary Physical Diagnosis. Fundamentals of clinical veterinary medicine, procedures in physical diagnosis and restraint of animals. (4 cr; prereq ‡) Low

102. General Veterinary Medicine. Principles of general medicine, effects of disease processes on body systems and interrelationships of functional disturbances. (4 cr; prereq 101) Low

103. Large Animal Medicine. Diseases of the skin, musculoskeletal system, respiratory system. cardiovascular system, hemic and lymphatic system, and digestive system. (4 cr; prereq 102) Sorensen

104. Large Animal Medicine. Diseases of the urinary system, endocrine system, nervous system, and organs of special sense. Metabolic diseases, nutritional deficiencies, and toxic diseases affecting several systems or the body as a whole. (5 cr; prereq 103) Wass

106. Small Animal Medicine. Diseases of the skin, musculoskeletal system, respiratory system, cardiovascular system, hemic and lymphatic system, and digestive system. (5 cr; prereq ‡) Mather

107. Small Animal Medicine. Diseases of the urogenital system, endocrine system, nervous system, and organs of special sense. Infectious diseases, nutritional deficiencies and toxic diseases affecting several systems of the body as a whole. (4 cr; prereq 106) Mather

130. Veterinary Jurisprudence and Business Methods. Business and legal procedures applicable to veterinary practice. Responsibilities of the veterinarian to the client, the public, and the profession. (3 cr) Hoyt

131. Infectious Diseases of Large Animals. Bacterial, mycotic, viral, and rickettsial diseases of large animals, affecting the body as a whole; pathogenesis, symptomatology, differential diagnosis, treatment, prevention, and control procedures. (5 cr; prereq 104) Hoyt

132. Preventive Veterinary Medicine. Principles and application of preventive medical procedures for specialized practice. (5 cr) Hoyt

137. Animal Diseases and Poisonous Plants. Important plants poisonous to animals: identification, toxicology, diagnosis, and treatment. (3 cr; prereq 104) Johnson, Kommedahl

201x.* **Advanced Veterinary Medicine.** Detailed discussions of the diseases of organs or systems in animals. One of the following etiologic group—prenatal, metabolic, toxic, infectious, or physical influences—will be selected for discussion for any quarter. (Cr ar; prereq 104, 131, ‡) Hoyt, Mather, Sorensen, Low

202x.* **Advanced Diagnosis and Therapeutics of Animal Diseases.** Detailed examination, discussions, and treatment of cases of animal diseases. (Cr ar; prereq 104, 131, ‡) Hoyt, Mather, Sorensen, Low

203x.* **Seminar.** (Cr ar; prereq ‡) Hoyt, Sorensen

204x.* **Medical Conference.** Medical, surgical, or obstetrical cases supported by anatomic, bacteriologic, pathologic, physiologic, pharmacologic, and radiologic evaluations whenever applicable. (Cr ar; prereq 104, 131, ‡) 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 VMC 101, 113, ‡) Zemjanis

201x. Advanced Diagnostic Methods. Detailed discussion and laboratory practices of methods for determination of fertility status of female and male animals. (3 cr; prereq 102 or equiv) Zemjanis

204x. Special Problems in Animal Reproduction. Detailed discussion and laboratory study of specific reproductive disorders. (Cr ar; prereq 102, 201) Zemjanis

206x. Comparative Physiology of Reproduction. Physiological variations of reproduction within and between species. (Cr ar; prereq VPP 109, VObs 102) Zemjanis and staff

210, 211, 212. Advanced Endocrinology of Reproduction. Physiological aspects of endocrinology involved in sex function. 210: Pituitary and pregnancy gonadotrophins. 211: Gonadal hormones. 212: Interaction between endocrine and nervous systems. (1 cr per qtr; prereq VPP 109, MdBc 100, 101) Zemjanis and staff

Veterinary Pathology and Parasitology

101. Veterinary Parasitology. Biological study of protozoan and arthropod parasites of animals; their relationships to disease and principles of parasite control. (5 cr; prereq VPaP 151, ‡) Griffiths, Bemrick

102. Veterinary Parasitology. Helminth parasites and parasitic diseases of animals; principles of control. (5 cr; prereq ‡) Griffiths, Bemrick

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, Nielsen

152-153. Special Veterinary Pathology. Diseases of respiratory, cardiovascular, digestive, urinary, genital, endocrine, nervous, integumentary and locomotor systems. (5 cr; prereq 151, ‡) Sautter, staff

154. Veterinary Clinical Pathology. Application and interpretation of laboratory tests used in clinical diagnosis. (2 cr; prereq 153, ‡) Perman

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, ‡) Young, Sautter

158x.* **Veterinary Surgical Pathology.** Neoplasms, surgical biopsies, postmortem material; review of pertinent literature. (1-3 cr; prereq 153, ‡) Sautter, staff

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, staff

203x.* **Neoplasms of Domestic Animals.** (Cr ar; prereq ‡) Sautter, staff

205f,w,s,su. Advanced Veterinary Clinical Pathology. Methods, application, and interpretation of special laboratory techniques used in clinical diagnosis. (1-3 cr; prereq ‡) 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, Bemrick

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 MdBc 103, ‡; students may register for lect without lab) Good, Dziuk, Sullivan

109. Physiology of the Endocrine and Reproductive Systems. Function and regulation of endocrine organs and reproductive system in domestic animals. (3 cr; prereq 108, ‡) Sullivan, Good

120.° Seminar: Animal Physiology. (2 cr; prereq 109, ‡) Good, Dziuk

130x.° Problems in Animal Physiology. (Cr ar; prereq 109 or Phsl 106, 107, ‡) Good, Dziuk

151. Veterinary Pharmacology. Local and general anesthetics, analgesic, antipyretic, analeptic, and autonomic drugs. (5 cr; prereq 108 or equiv, ‡) Stowe, Hammond

152. Veterinary Pharmacology. Cardiovascular, chemotherapeutic, anthelmintic, and gastrointestinal drugs. (3 cr; prereq 151, ‡) Stowe, Hammond

153. Veterinary Pharmacology. Diuretics, fluid therapy, toxicology, and vitamins. (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

201. Digestive Physiology of Domestic Animals. Lectures in physiology and pathophysiology of the alimentary canal of animals. (3 cr; prereq ‡) Dziuk

205. Physiological and Pharmacological Research Techniques in Large Animals. Student participation in laboratory procedures involving the cardiovascular system, drug distribution, and renal function. (2 cr; prereq 108 or ‡) Dziuk, Good, Hammond, Stowe

211, 212. Comparative Pharmacology of Domestic Animals. Effects, metabolism, and indications of drugs in domestic and wild animals. (1 cr per qtr; prereq ‡) Stowe

Veterinary Surgery and Radiology

101. Principles of Veterinary Surgery. General fundamentals of surgery as applied to systems of the body; discussion of inflammation with relation to tissue repair; principles of anesthesia, preoperative evaluation, and postoperative care. (5 cr; prereq VMC 101, ‡) Arnold, 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. Lectures in surgical procedures for large animals; laboratory exercises covering selected large animal operations. (5 cr; prereq 101, ‡) Arnold, Clifford, Usenik

104. Lameness of Domestic Animals. Etiology, diagnosis, and treatment. (1 cr; prereq 103, ‡) Spurrell

121. Veterinary Radiology. Preparation and interpretation of radiographs and fluoroscopic examinations in veterinary medicine; radiant energy as a therapeutic agent; protective measures against radiation hazards. (3 cr; prereq VMC 113, ‡) Spurrell, Hanlon

131. Heredity in Animal Disease. Application of genetic principles to animal disease problems; specific inheritable and familial conditions in domesticated species. (3 cr; prereq VMC 104, ‡) Spurrell

210x.° Advanced Veterinary Radiology. Lecture and laboratory. Radiological diagnostic procedures and interpretation as applied to veterinary medicine. (2 cr; prereq 121 or equiv, ‡) Spurrell

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, Gourley

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, Gourley

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, Jr.
Walter J. Breckenridge[1]
Huai-Chang Chiang[2]
Alexander C. Hodson[2]
William H. Marshall[2]
Magnus Olson
Sheldon C. Reed
A. Glenn Richards[2]
Otto H. Schmitt
Grover C. Stephens
Franklin G. Wallace

Associate Professor

V. Elving Anderson
Marion A. Brooks[2]
David J. Merrell
Dwain W. Warner[1]

Assistant Professor

Robert M. Benolken
Alan B. Hooper
Robert K. Josephson
Norman S. Kerr
Roger D. Price[2]
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. It is strongly recommended that students have a background in chemistry, mathematics, and physics.

Language Requirement—For the Master's degree, one foreign language. For the Doctor's degree, two foreign languages, one of which must be German.

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

Doctor's Degree—Every candidate for the Ph.D. in zoology is expected to complete a period of residence at a marine biological station.

Biophysics, Genetics—For information on these programs, see index.

100f, 101w, 102s. Basic Zoology. These course numbers are specially arranged to enable making up certain deficiencies in background course work. (Cr ar; majors must consult major advisers, others consult department chairman)

107s. Protozoology. Introduction to taxonomy, morphology, physiology, development and genetics of free-living protozoa. (4 cr; prereq ‡) Kerr

108w. Comparative Neurology. Comparative study of morphology and physiology of nervous systems; evolutionary trends in invertebrate phyla. (5 cr; prereq 10 cr in biology and ‡) Josephson

110s. Animal Behavior. Survey of effector mechanisms, their nervous and endocrine control, and behavior patterns of animals. (3 cr; prereq 91 or 92 or equiv and ‡) Stephens

112f. Advanced General Physiology. Topics of current interest in physiology. (3 cr; prereq 91 or 92 or equiv and ‡) Josephson

114s. Sensory Physiology. Survey of general properties of receptor organs; visual, auditory, and mechano receptor units. (3 cr; prereq 92 or equiv and ‡; offered 1965-66 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. (6 cr; prereq 15 cr; offered at Itasca Biology Session only)

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[1] Offices in Museum of Natural History, Minneapolis Campus

[2] Offices in Department of Entomology, Fisheries, and Wildlife, St. Paul Campus

116s. Population Ecology. General principles of population, covering population dynamics and trophic relationships. (3 cr; prereq 94 or ♯...Bot 50 or 130 or equiv recommended; offered 1965-66 and alt yrs) Underhill

Ent 118f. 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. (6 cr; prereq 15 cr incl Biol 2 or equiv; offered at Itasca Biology Session only) Underhill

121f. Ichthyology. Taxonomy and habits of North American fishes, especially those of upper Mississippi drainage. (3 cr; prereq 15 cr incl Biol 2 or equiv)

Ent 125f. Insect Morphology. Comparative studies of external and internal anatomy and histology of insects; phylogeny and function. (4 cr; prereq 74, ♯) Cook

Ent 126w. Embryology and Development of Insects. Reproductive behavior, embryology and post-embryonic development of insects. (4 cr; prereq 125, OrCh 42 or 62, ♯) Brooks

Ent 127s. Insect Metabolism and Co-ordination. Homeostasis, permeability, circulation, metabolic systems and products, properties of muscles and nerves, sensation, behavior. (4 cr; prereq 126, ♯...BioC 106 or MdBc 101 recommended) Richards

Ent 130s. 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

135su. Field Ornithology. Field and laboratory studies of ecology and life histories of birds in Itasca Park region. (6 cr; prereq 15 cr; offered at Itasca Biology Session only)

138f,w,s. Seminar: General Physiology and Biophysics. (Cr ar; prereq special requirements) Schmitt, Benolken

Ent 140w. Biological Microscopy. Necessary elements of optics, use and limitations of various types of microscopes, interpretation of microscopical data. Laboratory; demonstration plus project in field of student's interest. (4 cr; prereq 15 cr in zoology, entomology, or botany, and ♯; offered when demand warrants) Richards

143su. Animal Parasites. Parasites of local fauna with special reference to helminths. (6 cr; prereq 15 cr incl Biol 2 or equiv; offered at Itasca Biology Session only)

144f. Medical Entomology. Principal arthropods noxious to man and animals. Emphasis on those that serve as vectors of pathogenic organisms of man and animals. (3 cr; prereq 15 cr incl 74 or equiv, ♯) Price

145w.° Parasitic Protozoa. Structure, life histories, and economic relations of protozoal parasites of man and animals. Laboratory diagnosis. (3 cr; prereq 15 cr incl Biol 2 or equiv and ♯) Wallace

146s.° Helminthology. Worm parasites of man and animals, their structure, life histories, and biological relationships. (3 cr; prereq 15 cr incl Biol 2 or equiv and ♯) Wallace

153s. Molecular Biology. Quantitative analysis of cellular processes which may be treated on a molecular basis: osmotic pressure, Brownian motion, ion distribution, phase separation, intermolecular forces. (3 cr; prereq 51, Phys 9 or equiv and ♯; offered 1964-65 and alt yrs) Benolken

155f-156w-157s. Biophysics. Theoretical and experimental aspects of biology that can be studied by quantitative physical means. 155: Tissue ultrastructure (biostatics) as revealed by hypermicroscopy, birefringence, X ray, electron and radioactive means, and by colloidal and micellar phenomena. 156: Dynamics of biophysical systems; excitatory state, contraction, secretion, synthesis. 157: Integrative biophysical systems; stability of systems, transmission of information, sensory mechanisms. (3 cr per qtr; prereq 28 cr distributed between physics and biology, ♯...physical chemistry and general physiology recommended; schedule ar) Schmitt, Benolken

Ent 162su.° Vertebrate Ecology. Field work on populations and their relationships to local environments; habitat analysis and ecological research methods. Individual and team research projects, field trips, and lectures. (6 cr; prereq Bot 50 and Zool 94; offered at Itasca Biology Session only) Marshall, Tester

170f. 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 66, or ♯) Reed, Anderson, Merrell

171w. Genetics and Speciation. Application of genetic principles to problems of speciation and evolution. (3 cr; prereq 15 cr incl 66, or ♯) Merrell

175s. 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 66 or ‡) Reed

176w. 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

182s. Experimental Embryology. Growth, differentiation, and metabolism of developing organisms. (5 cr; prereq 52 and 92 or equiv and ‡) Spratt

195su. Special Problems in Ornithology, Ecology, and Limnology. Advanced work on special topics adapted to needs of individual students. (Cr ar; prereq Biol 2 or equiv and ‡; offered at Itasca Biology Session only) Staff

Ent 196su. Special Problems in Entomology and Vertebrate Ecology. Advanced work in entomology and ecology and ample opportunity for individual research, especially in various faunistic studies. (Cr ar; prereq ‡; offered at Itasca Biology Session only) Cook, Marshall, Tester

197f, 198w, 199s.* Advanced Work. Individual work in some special discipline. (Cr ar; prereq Biol 2 or equiv or ‡) Staff

Ent 201w.* Experimental Ecology Laboratory. Laboratory companion course of Ent 118. (2 cr; prereq Ent 118 or ¶Ent 118) Chiang

Ent 202s.* Insect Ecology. Dispersal, distribution, abundance, natural control, and related problems. (3 cr; prereq Ent 118 or ‡) Chiang

Ent 203f.* Insect Physiology. General and comparative physiology. Organ systems and their functioning. Research methods and evaluation of data. (Cr ar; prereq ‡) Richards

209w. Topics in Comparative Physiology. Intensive coverage of comparative animal physiology: neuromuscular mechanisms, invertebrate endocrinology, biological rhythms, related topics. (2 cr; prereq 91 or 92 or equiv or ‡; offered 1964-65 and alt yrs) Stephens

211f, 212w, 213s.* Research: Ecology. Hodson, Underhill, Chiang

214s. Field Ecology. Field work in major and minor communities in Minnesota; extended field trips to neighboring states. (3 cr; prereq 94 or ‡...Bot 50 or 130 or equiv recommended; offered 1964-65 and alt yrs) Underhill

217f, 218w, 219s.* Research: Physiology. Richards, Stephens, Josephson, Hooper

221f, 222w, 223s.* Research: Biophysics. Schmitt, Benolken

224f, 225w, 226s.* Research: Ornithology. Warner

229f, 230w, 231s.* Research: Histology. Olson

233f, 234w, 235s.* Research: Embryology. Spratt

237f, 238w, 239s.* Research: Cytology.

Ent 241f, 242w, 243s.* Research: Entomology. Chiang, Cutkomp, Haydak, Hodson, Holdaway, Richards, Brooks, Cook, Peterson, Price

244f, 245w, 246s.* Research: Protozoology. Kerr

251f, 252w, 253s.* Research: Genetics. Reed, Merrell, Anderson

261f, 262w, 263s.* Research: Parasitology. Wallace

270w-271s. Cytology. Organization of cells and their components. Ultrastructure, cytochemical analysis, and genetic aspects. (2 cr per qtr; prereq 51, ‡)

272w-273s. Cytology Laboratory. Practical work in various types of microscopy, staining, cytochemistry, individual research projects. (2 cr per qtr; prereq ‡)

283f, 284f, 285f. Physiology of Development. Organization, presentation, and evaluation of results of research in experimental embryology. 283: Chemical embryology, metabolic aspects of growth, differentiation, and morphogenesis. 284f: Embryonic differentiation including neuroembryology. 285f: Endocrines in development, including sex differentiation. (4 cr per qtr; prereq 182 or equiv and ‡; 285 offered 1964-65, 283 offered 1965-66, 284 offered 1966-67) Spratt

291f, 292w, 293s. General Seminar

296f, 297w, 298s.* Seminar: Special Research Fields

Note—For additional courses in the related economic fields, see section on Entomology, Fisheries, and Wildlife in this bulletin.

GRADUATE OFFERINGS, DULUTH CAMPUS

Majors in Education, Curriculum and Instruction, Educational Psychology, English, and Chemistry

The Graduate School offers at the University of Minnesota, Duluth a full program for the master of arts degree with majors in education, curriculum and instruction, educational psychology, English and an M.S. degree in chemistry. 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 chemistry major is for students preparing to teach in colleges and junior colleges.

Graduate work at Duluth is under the jurisdiction of the dean of the Graduate School and is identical in admission, candidacy, and degree requirements with the parallel program on the Minneapolis Campus. Blanks for use in applying for admission may be secured by writing to the Academic Dean, University of Minnesota, Duluth, Duluth, Minnesota 55812.

Inquiries regarding counseling and testing, scholarships, fellowships and loan funds, living accommodations, employment, and placement should be addressed to Student Personnel Services, Kirby Student Center, University of Minnesota, Duluth, Duluth, Minnesota 55812.

Professor
Thomas W. Chamberlin
Addison M. Alspach
Lyda C. Belthuis
John A. Dettmann
Henry J. Ehlers
Wendell P. Glick
Ruth E. Green
John E. Hafstrom
Howard G. Hanson
Robert W. House
Harry C. Johnson
Blanchard O. Krogstad
Maude L. Lindquist
Ellis N. Livingston
James F. Maclear
William R. McEwen
Cecil H. Meyers
R. Dale Miller
Frances B. Moore
James C. Nichol
Theron O. Odlaug
Ruth Palmer
Moses Passer
Arvid N. Pearson
Robert F. Pierce
Valworth R. Plumb
Lewis J. Rickert
William A. Rosenthal
Richard O. Sielaff
Arthur E. Smith
Albert Tezla
Gerhard E. Von Glahn
Ward M. Wells
Julius F. Wolff
Chester W. Wood

Associate Professor
John B. Carlson
Edward J. Cowles
Dean A. Crawford
William M. Crockett
Joseph E. Duncan
C. Lindsley Edson
Edward Flaccus
Francis J. Glick
Moy Fook Gum
Robert C. Hart
Harold L. Hayes
Leverett P. Hoag
Arthur J. Larsen
Lewis D. Levang
Hubert M. Loy
Cyril M. Milbrath
Paul H. Monson
James R. Murphy
Glenn C. Nelson
Robert R. Owens
Robert G. Schmidt
Dorothy D. Smith
James E. Smith
Anna Lee Stensland
Armas W. Tamminen
John E. Verrill
Gordon O. Voss
Philip G. Walther
Frederick T. Witzig

Assistant Professor
Sylvan D. Burgstahler
Kenneth N. DeYoung
John L. Gergen
John F. Helling
J. Dorrance Kiser
Rudolph I. Schauer
Larry C. Thompson

Prerequisites—For all majors except chemistry, 6 quarter credits in psychology and a total of not less than 18 quarter credits of undergraduate work in education (including Ed 71, 81 or equivalent). The applicant should indicate whether his emphasis within the major field is (a) elementary teaching, (b) secondary teaching, (c) elementary principalship, or (d) rural education. Ordinarily, applicants should already hold a teaching certificate, and for the field of educational psychology, teaching experience is strongly advised.

Applicants for the major in English must be high school teachers, or those entering this teaching field. Teacher certification requirements must be completed before the M.A. degree will be awarded. Details concerning prerequisites for this major and the chemistry M.S. degree may be obtained from the academic dean, University of Minnesota, Duluth.

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 except for the major in chemistry, which is a Plan A program.

Examinations—Final examinations, and all other work for the degree, are conducted by the graduate faculty at Duluth.

Note—Some of the courses listed below are scheduled in the late afternoon and on Saturday mornings to enable teachers in the Duluth area to carry graduate work during the academic year.

Except in cases where course descriptions are included here, course descriptions will be found in the departmental listings in this bulletin.

Education and Psychology

GENERAL COURSES

AgEd 154. Rural Education and Community Leadership. (3 cr; prereq 10 cr in education) Milbrath

ArEd 151. Curriculum Building in Art Education. (3 cr; prereq ‡) A Smith

ArEd 171. Implementing the Instructional Program in Art. (3 cr; prereq ‡) A Smith

ArEd 183. Advanced Course in the Teaching of Art. (3 cr; prereq ‡) A Smith

ArEd 190. Development of Art Education in the Twentieth Century. Effect of various 20th-century art movements on teaching of art in public schools. (3 cr; prereq ‡) A Smith

ArEd 295.° Problems in Art Education. Independent projects under staff guidance; may include advanced studio practice or technical problems requiring experimental or library research. (Cr ar; prereq consent of major adviser) A Smith

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 71, 81, or equiv) Loy

EdAd 116. The Teacher and School Administration. (3 cr; prereq tchg exper or ‡) Cramer, Wood

EdAd 117. Schools in Rural Areas. (3 cr; prereq ‡) Milbrath

EdAd 123. Organization of Community School Programs. (3 cr; prereq 117 or ‡)

EdCI 105. Audio-Visual Materials in Education. Characteristics, advantages, limitations, and practical use of audio-visual materials of nonprojected and projected types; practice in the operation of audio-visual equipment. (3 cr; prereq 9 cr in education or ‡) Wells

EdCI 109. Audio-Visual Materials and Equipment Laboratory. (3 cr; prereq 105 or ‡) Wells

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, H Johnson, Lindquist, Plumb, A Smith, Crawford, Wells, Wood, Verrill, Walther, R Green, Stensland, Milbrath, Voss

EPsy 110. Educational Measurement in the Classroom. (3 cr; prereq Psy 58 or ‡) H Johnson, Plumb

EPsy 116. Statistical Methods in Education. (3 cr; prereq ‡) Tamminen

EPsy 140. Instruments and Techniques of Measurement. (3 cr; prereq 110 or 116) 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

EPsy 208. Methods in Educational Research. (3 cr; prereq 116 or equiv) De Young

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 ‡)

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, Erickson

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 ‡) H Johnson

EdCI 143. Teaching and Supervision of Reading in the Elementary School. (3 cr; prereq 64 or equiv or ‡) D Smith

EdCI 149. Teaching and Supervision of Mathematics in the Elementary School. (3 cr) H Johnson

EdCI 150. Supervision and Improvement of Instruction. (3 cr; prereq ‡) H 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 55 or tchg exper) R Green

EPsy 182. Education of Exceptional Children. (3 cr; prereq Ed 71, 81 or equiv; offered at Duluth summer only)

EPsy 183. Education of Gifted Children. (3 cr; prereq 9 cr in education; offered at Duluth summer only)

EPsy 184. Education of Mentally Retarded Children in the Elementary Schools. (3 cr; prereq 182 or ‡; offered at Duluth summer only)

MuEd 150. Administration and Supervision of School Music. (3 cr; prereq 61, 62 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. Material Laboratory for Social Studies Teachers. Printed and audio-visual materials useful in social studies classes. (3 cr; prereq tchg exper, ‡, and 89 or equiv) Crawford

EdCI 168. Current Developments in the Social Studies. (3 cr; prereq 89 or ‡) Lindquist

EdCI 169. Student Organizations and Activities. (3 cr; prereq ‡) Wood

EdCI 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 110 or 116, 133 and ‡) Gum

EPsy 233.* Problems in Guidance and Personnel Work. (1-9 cr; prereq ‡) Tamminen, Gum

EPsy 282B. Supervised Practicum in Counseling. (3 cr; prereq ‡) Gum

HEEd 194A. Adult Education in Home Economics. (3 cr; prereq HE 88, EdT 82A) Palmer

Ind 101. Tests in Industrial Subjects. (3 cr)

Ind 102. General Shop. (3 cr)

Ind 106. Industrial Education Workshop. (3 or 6 cr [may be repeated for a maximum of 6 cr]; prereq tchg exper or ‡) Voss

Ind 107. Co-ordination. (3 cr; prereq 62, or ‡) Voss

Ind 109. Conference Leading for Industry. (3 cr; prereq ‡) Voss

Ind 111. Instructional Materials Laboratory for Nonmajors. (3 cr; prereq tchg exper or ‡)

Ind 150. Vocational Education Surveys. (3 cr; prereq ‡) Voss

MuEd 105. Advanced Topics in Instrumental Music Education. (3 cr; prereq ‡) Murphy, House

MuEd 151. Practical Operation of School Music. (3 cr; prereq Mus 61, 62, or ‡) House

Humanities

Art 100. Seminar: Art. For senior and graduate art majors; discussions, readings, reports in the area of arts and aesthetic interest. (3 cr; prereq △) A Smith

Art 110. Advanced Problems in Design. Opportunity to apply design to creative aesthetic problems on an advanced experimental level. (3 cr per qtr [may be repeated for a maximum of 9 cr]; prereq 99 or equiv and ‡) Schauer

Art 150. Problems in Painting. (3 cr per qtr [may be repeated for maximum of 9 cr]; prereq 96 or ‡) 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 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 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 120. The Interpretation of Poetry. Certain technical aspects of poetry in relation to poetic meaning; analysis of a number of short poems. (3 cr; prereq ‡) Tezla

Engl 128. Modern British Drama. Historical study of British drama from 1900 to the present: Shaw, Synge, O'Casey, Fry, Osborne, Beckett, Pinter, and others. (3 cr; prereq 6 cr of literature in this dept) Duncan

Engl 130, 131, 132. Victorian Prose and Poetry. English literature from 1832 to 1901. 130: Carlyle, Thackeray, Browning, and others. 131: Darwin, Arnold, Eliot, and others. 132: Hardy, Wilde, Hopkins, and others. (3 cr per qtr; prereq 6 cr of literature in this dept) Crockett

Engl 135. Literary Criticism. Reading and analysis of selected critical writings from Aristotle to Arnold. (3 cr; prereq ‡) Tezla

Engl 151, 152, 153. English Novel. Development of British novel. 151: Eighteenth century. 152: Nineteenth century. 153: Twentieth century. (3 cr per qtr; prereq 6 cr of literature in this dept) Owens (151), Crockett (152), Rosenthal (153)

Engl 154, 155. American Novel. History of the American novel in relation to patterns of American thought. 154: Nineteenth century. 155: Twentieth century. (3 cr per qtr; prereq 6 cr of literature in this dept) W Glick (154), Hart (155)

Engl 156. American Drama. Historical study of American drama from Godfrey to O'Neill. (3 cr; prereq 6 cr of literature in this dept) W Glick

Engl 162. Milton. (3 cr; prereq 21, 22) Rosenthal, Duncan

Engl 165. Introduction to Modern English. Word stock, inflections, and structural patterns of standard American-written English. (3 cr; prereq 6 cr in literature in this dept or ‡)

Engl 166. History of the English Language. History of sounds, word stock, and structures of the English language; changes in the language since the Renaissance. (3 cr; prereq 165 or ‡)

Engl 187, 188, 189. Eighteenth-Century Literature. English life and letters from 1700 to 1798. (3 cr per qtr; prereq 6 cr of literature in this dept; offered 1965-66 and alt yrs) Owens

Engl 192, 193, 194. Sixteenth-Century English Literature. Sixteenth-century English literature, excluding Shakespeare's drama. 192: More, Ascham, Skelton, and others. 193: Wyatt, Surrey, Lyly, Greene, Deloney, and others. 194: Spenser, Sidney, Marlowe, Daniel, Chapman, Raleigh, Drayton, and others. (3 cr per qtr; prereq 6 cr of literature in this dept) Levang

Engl 197, 198, 199. Seventeenth-Century Literature. English literature from 1600 to 1700. 197: Donne, the Metaphysical poets, Webster, Browne, and others. 198: Burton, Bacon, Jonson, Herrick, Denham, and others. 199: Dryden, the Restoration Wits, Congreve, and others. (3 cr per qtr; prereq 6 cr of literature in this dept; offered 1964-65 and alt yrs) Duncan

Mus 101. Creative Expression: Conducting, Arranging, Composition. Serious work in any one or more of the above-named fields. The entire class shall constitute a performing ensemble for conducting experience and laboratory trial of student arrangements and compositions. Group assignments and/or individual projects required according to needs and concentrations of students. A file of student's accomplishments will be kept. (3 cr, may be repeated for a max of 9 cr; prereq 2 yrs of music theory and performing ability)

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 9 or equiv) Miller, J Smith, Murphy, Beverley

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 9 and 66 or ‡) Miller, J Smith

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

Spch 105. Theory of Reading and Acting. (3 cr; prereq 81, 82 or ‡) Hayes, Meitzer

Spch 106. Discussion. (3 cr; prereq 3 or ‡) Hayes

Spch 119. Speech Improvement and Management of the Speech Handicapped in the Classroom. (3 cr; not open to speech correction majors) Pierce

Spch 131. Creative Dramatics. (3 cr; prereq 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. Flora of Minnesota. (4 cr; prereq 52 or ♯) Monson

Chem 103. Qualitative Organic Analysis. Identification of pure organic compounds; separation of mixtures and identification of their components. (3 cr; prereq 63) Passer

Chem 111. Advanced Organic Chemistry I. Physical methods for structure determination. (3 cr; prereq 63, 142) Cowles, Passer

Chem 112. Advanced Organic Chemistry II. Mechanisms of organic reactions. (3 cr; prereq 63, 142) Cowles, Passer

Chem 113. Advanced Organic Chemistry III. Organic reactions with their applications in synthesis. (3 cr; prereq 63, 142) Cowles, Passer

Chem 121. Instrumental Analysis. Theory and practice of various instrumental methods of analysis. (3 cr; prereq 142 or ¶142) Moore, Thompson

Chem 124-125. Quantitative Analysis. Theory and practice in classical and instrumental methods of chemical analysis. (5 cr for 124, 4 cr for 125; prereq 50, 142) Moore

Chem 130, 131. Inorganic Chemistry. 130: Atomic structure and properties of elements based thereon. Chemistry of the co-ordination compounds. 131: Acids and bases; nonaqueous solvents; oxidation-reduction reactions; mechanism of selected inorganic reactions; survey of the chemistry of the representative elements. (3 cr for 130, 2 cr for 131; prereq 2 yrs chemistry or ♯) Cowles, Thompson

Chem 133. Inorganic Chemistry Laboratory. Preparation of typical inorganic compounds, illustrating special and more advanced techniques. (1 cr; prereq 130 and 131 or ♯) Thompson

Chem 140-141-142.† Physical Chemistry. (Formerly 140-141-142 and 143-144) Quantitative treatment of physical principles and theories underlying chemistry. Laboratory, physicochemical measurements. (3 cr each for 140 and 141, 5 cr for 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 142) Nichol

Chem 148. Introduction to Quantum Theory. Electronic structure and spectra of atoms, principles of wave mechanics, and theoretical aspects of the chemical bond. (3 cr; prereq 142) Harris

Chem 149. Introduction to Molecular Structure. Physical methods of determining molecular structure. (3 cr; prereq 148) Harris, Thompson

Chem 151. Chemical Kinetics. Reaction velocity and mechanism of reactions in gases and in solution. Absolute reaction rate theory, relationship between kinetics and thermodynamics, catalysis. (3 cr; prereq 146) Harris, Nichol

Chem 152. Solutions of Electrolytes. Experimental behavior, thermodynamic properties, modern theories of strong and weak electrolytes, determination of activity coefficients and dissociation constants, polyelectrolytes. (3 cr; prereq 146 and 151) Nichol, Thompson

Chem 154. Transport Processes in Solution. Transport phenomena in solution; viscosity, diffusion, electrophoresis, and sedimentation. (3 cr; prereq 146 and 151) Nichol

Chem 161. Advanced Inorganic Chemistry. Structure and bonding of inorganic compounds and mechanisms of inorganic reactions. (3 cr; prereq 146 and 149) Thompson

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 60; offered 1965-66 and alt yrs) McEwen

Math 101-102-103. Topics in Applied Mathematics. Ordinary and partial differential equations, series and numerical solutions, the Laplace transform; special functions; vector calculus and matrix theory; finite differences, numerical analysis, sources and control of error. (3 cr per qtr, §81, §88, §91; prereq 27 and △) Burgstahler

Math 109. Theory of Numbers. Elementary properties of integers; prime and composite numbers; Euclid's algorithm; congruences; the theorems of Fermat and Wilson; primitive roots; indices, Diophantine equations. (3 cr; prereq 26 or 72; offered 1964-65 and alt yrs) Hafstrom, McEwen

Math 131-132. Linear Algebra. Vector spaces over a field, linear dependence of vectors, dimension; matrices and systems of linear equations; special matrices and canonical forms; characteristic values and vectors; diagonalization of quadratic and Hermitian forms; applications.

(3 cr per qtr, §64; prereq 72 or 27 and △; offered 1964-65 and alt yrs) Burgstahler, Hafstrom, McEwen

Math 151-153. Advanced Calculus I and II. I: Functions of several variables, partial differentiation, implicit functions, extrema, transformations, Jacobians, integrals depending on a parameter. II: Infinite series, power series, uniform convergence, computation with series. Improper integrals. Orthogonal functions and Fourier series. (3 cr per qtr, §107, §108; prereq 72 or 27 and △; offered 1965-66 and alt yrs) Burgstahler, Hafstrom, McEwen

Math 174. Complex Variables. Complex numbers, derivatives and integrals of analytic functions, elementary functions and their geometry, Cauchy's integral theorem and formula. Laurent expansions, evaluation of contour integrals by residues. Fundamental theorem of algebra. (3 cr, §84; prereq 72 or 27 and △; offered 1964-65 and alt yrs) Burgstahler, Hafstrom, McEwen

Math 178. Introduction to Mathematical Probability. Axiomatic development of probability; random variables and their probability distributions with emphasis on the binomial and Poisson distributions; applications to games of chance and discrete stochastic processes. (3 cr; prereq 72; offered 1964-65 and alt yrs) Hafstrom, McEwen

Math 180. Finite Groups. Permutation groups, Cayley's theorem; groups related to geometrical configurations; the Jordan-Hölder theorem, abelian groups, quotient groups, applications. (3 cr, §63; prereq 72; offered 1965-66 and alt yrs) Burgstahler, Hafstrom, McEwen

Phys 106-108-110. Modern Physics. (3 cr per qtr; prereq 50 or equiv and ¶Math 27) Hanson

Phys 113-115-117. Theoretical Physics. Theoretical course in mechanics, electricity, and magnetism to prepare students for advanced work. (3 cr per qtr; prereq 9 or 50, ¶Math 27) Gergen

Zool 123. Advanced Insect Biology. (3 cr; prereq 60 or equiv)

Zool 146. Helminthology. (3 cr; prereq 62 and ♯) Odlaug

Social Sciences

BE 105A. Intermediate Accounting I. Review of accounting processes, measurement of income, accounting treatment of inventories and plant assets. (3 cr, §71; prereq 33 or 35 or ♯) Dettmann, Sielaff

BE 105B. Intermediate Accounting II. Accounting treatment of cash, receivables, investments, intangible assets, and applications of actuarial mathematics. (3 cr, §72; prereq 105A or ♯) Dettmann, Sielaff

BE 105C. Intermediate Accounting III. Accounting treatment of stockholder's equity; interpretation and analysis of financial statements. (3 cr, §73; prereq 105A or ♯) Dettmann, Sielaff

BE 115A. Cost Accounting. Practices, principles, and procedures of handling production costs for use in inventory valuation and income determination. Job order, process, and standard cost systems. Brief introduction to standard cost as a tool of cost control. (3 cr, §74; prereq 33 or equiv) Dettmann, Sielaff

BE 115B. Cost Accounting. Use of cost information in managerial decision-making. (3 cr, §75; prereq 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, §78; prereq 105B or ♯) Dettmann, Sielaff

BE 157. Marketing. (3 cr; prereq 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, 3 or ♯) Meyers, Sielaff

Econ 166. Economic Analysis: Income and Employment. Determinants of national income, employment, and price level, with particular attention to aggregate consumption and investment. (3 cr; prereq BE 1, 2, 3 or ♯) Meyers, Sielaff

Econ 168. Economics of Public Finance. (3 cr; 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 10) Witzig

Geog 102. Central Europe. Physical and cultural geography of the central European countries studied regionally and by individual countries. (3 cr; prereq 10) Witzig

Geog 105. Mediterranean. (3 cr; prereq 10) Witzig

Geog 107. Soviet Union. (3 cr; prereq 10) Chamberlin

Geog 110. South America. (3 cr; prereq 10) Hoag

Geog 112. Western Anglo-America. (3 cr; prereq 10) Belthuis

Geog 113. Eastern Anglo-America. (3 cr; prereq 10) Belthuis

Geog 126. Australia and New Zealand. (3 cr; prereq 10) Belthuis

Hist 103A, 104A, 105A. Renaissance and Reformation. (3 cr per qtr; prereq 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 20, 21, 22) Lindquist, Larsen

Hist 141D, 142D, 143D. History of American Foreign Relations. 141D: Revolution to 1860. 142D: 1860 to 1920. 143D: 1920 to present. (3 cr per qtr; prereq 20, 21, 22; offered 1964-65 and alt yrs) Livingston

Hist 182, 183, 184. Readings in American History in the Nineteenth Century. 182: Development of American nationality, 1789-1824. 183: Jacksonian democracy and manifest destiny. 184: Civil War and Reconstruction, 1860-1880. (3 cr per qtr; prereq ‡) Larsen

Pol 137. American Political Parties. (3 cr; prereq 6 cr or 12 cr in social sciences) Wolff

Pol 160. American Political Thought. (3 cr; prereq 6 cr or 12 cr in social sciences or ‡) Wolff

Pol 162. Recent Political Thought. (3 cr; prereq 6 cr or 12 cr in social sciences or ‡) von Glahn

Pol 163. Political Theory and Utopia. (3 cr; prereq B or 9 cr in social sciences or ‡) von Glahn

Pol 164. Development of Political Thought: Ancient. (3 cr; prereq 6 cr or 12 cr in social sciences or ‡) von Glahn

Pol 165. Development of Political Thought: The Middle Ages. (3 cr; prereq 6 cr or 12 cr in social sciences or ‡) von Glahn

Pol 166. Development of Political Thought: Early Modern. (3 cr; prereq 6 cr or 12 cr in social sciences or ‡) von Glahn

Soc 141. The Family. Evolution of the family, development of family unity or disunity, roles of the several members, methods of investigation of the family. (3 cr; prereq 1, or ‡) Pearson

Soc 145. Urban Sociology. (3 cr; prereq 1 or ‡) Schmidt

Soc 151. Sociology of Education. Social structure of the school; the classroom as a social system; educational roles; impact of social classes on education; the school and community power structure. (3 cr; prereq 1 and 15 cr in social sciences, education, or psychology, or ‡)

Soc 161. Rural Community Analysis. (3 cr; prereq 1, or ‡) Pearson

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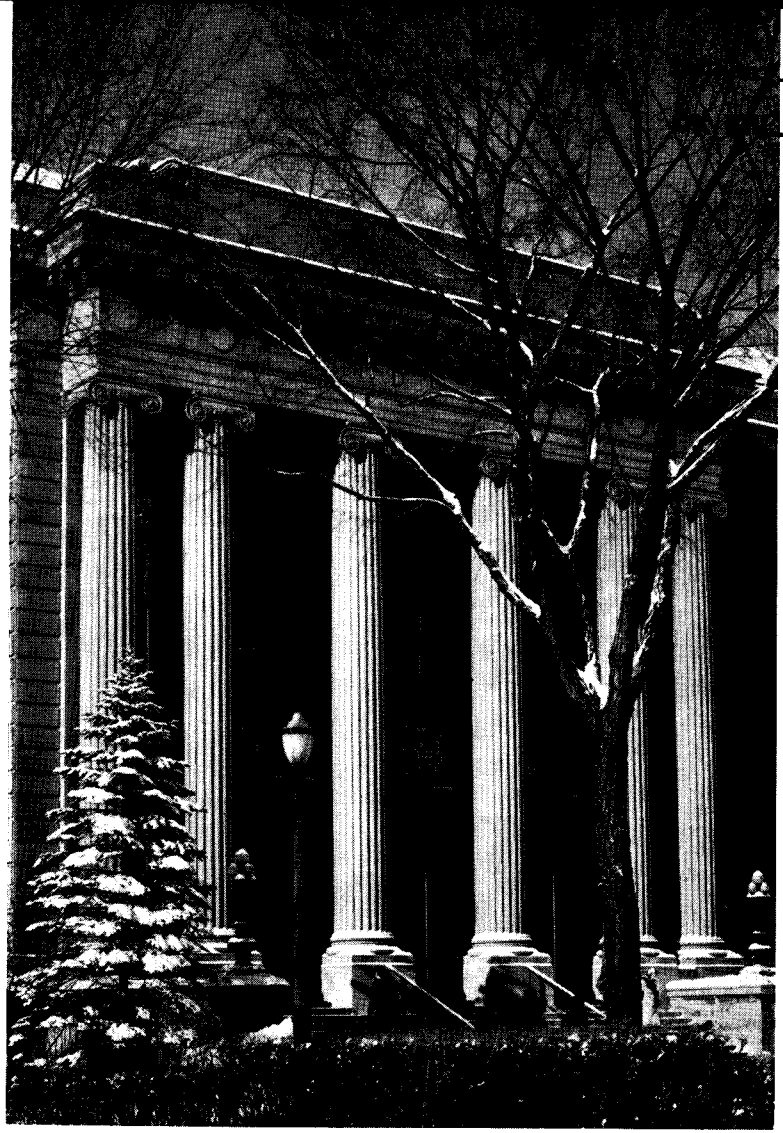

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LIBRARY SCHOOL

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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 Liberal Arts. In accordance with the standards of the American Library Association, it offers as the basic, minimum preparation for a professional career, a calendar-year program of study leading to the M.A. degree. It offers a 15-credit minor in librarianship to undergraduates in the College of Liberal Arts and a 24-credit minor 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, Minnesota 55455.

Opportunities in Librarianship—The importance of libraries in our society is increasingly recognized each year. New types of libraries are being established, particularly by business and industry. Rural areas, previously without library service, are now establishing regional libraries requiring librarians capable of organizing and directing larger institutions of this kind. With the increasing enrollments in public schools and the recognition that modern education requires greater school library services, the demand for school librarians is great. Cities which have not previously had school library supervisors are now establishing such high-level positions. Specialists in technical and scientific library work are scarce and in great demand. College and university libraries must grow rapidly in the next decade to meet the needs of the large numbers of students expected. Young men and women who have an interest in books, people, and ideas find a challenging lifework in the rapidly expanding field of librarianship. Salaries of 1963 graduates averaged $5,800.

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 Liberal 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, Minnesota 55455. (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 2 million volumes in these libraries. Library methods and practices may be observed, not only in the University libraries, but also in the public, school, and special libraries of the metropolitan area of the Twin Cities.

Summer Session—The Library School offers a selection of courses in two 5-week terms for which resident credit is given. 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 7 years. 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.

Scholarships—Several scholarships are available. Applications should be submitted by February 15 for the following year.

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)

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 $2,136 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, 100 Wesbrook Hall, or from the Student Housing Bureau, 209 Eddy Hall. Information about private rooming houses may be obtained from the Student Housing Bureau. Single students under the age of 21, whether undergraduate or graduate, must have approval of the Student Housing Bureau to live in an apartment.

Food Services and Restaurants—Several restaurants and food services are available to students in Coffman Memorial Union. Largest is the cafeteria, on the ground

floor. There is also a soda fountain, a lunch counter, and a commuters' lunchroom for students who bring lunches from home. There are also several privately operated restaurants near the campus.

Tuition and Fees—During the academic year, full-time graduate students pay $111 per quarter if they are residents of Minnesota, or $265 per quarter if nonresidents. Foreign students are required to pay a health fee of $5 per quarter.

Summer students, whether resident or nonresident, pay a tuition fee of $46.50 per 5-week term if carrying 1 to 4 credits, or $59.50 per 5-week term if carrying more than 4 credits. All students pay an additional $11 incidental fee per term.

Admission for Undergraduates—Undergraduate students at 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 55—Library Administration (3)
Lib 62—Reference I (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.

Prerequisites—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 55—Library Administration (3)
Lib 62—Reference I (3)
Lib 70—Selection of Library Materials (3)
Lib 83—Cataloguing and Classification (3)

The prerequisite requirement can be met in one of three 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.

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.

CURRICULAR REQUIREMENTS

Master of Arts Degree

Foreign Language—Reading knowledge of a foreign language, modern or ancient, preferably French, German, or Russian, is required of all candidates for the Master's degree in library science. Students should consult the language department of their choice for information about meeting this requirement.

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 two 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, six of the eight 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 eight library science courses, with no mark below C and at least four marks of B or better.

Planning Your M.A. Program

1. The first step is to apply for admission to the Graduate School at least 6 weeks before you wish to attend classes. You do not need to have any previous study of library science to make application.

2. When the content of the introductory courses has been mastered, you will be asked to choose a type of library and a kind of library work that appeals to you and you will be assigned an adviser who will help you to plan a *program* of study leading to the M.A. degree. The typical program will consist of nine graduate courses in library science; six graduate courses in related fields, for example, history, sociology, mass communications, audio-visual work, education, English, etc.; and the preparation of research papers in connection with three graduate courses. (Lib 168, Research Methods in Librarianship, will give you the necessary background to formulate problems and design research projects to meet this requirement.) If you wish to do Plan A (with thesis), you must submit a thesis proposal for faculty approval.

3. Your adviser will help you to choose related academic courses, to plan to meet the foreign language requirement, and to choose graduate library courses that prepare you for specific positions. For example, if you plan to do reference work in a college library, you might be advised to register for Lib 155, College and University Libraries; Lib 258, Problems in College and University Librarianship; two or three literature courses, one or more advanced cataloguing or bibliography courses,

SAMPLE PROGRAMS IN SPECIAL LIBRARIANSHIP

	Law	*Science and Technology*
Required:	*Five basic courses at the undergraduate level required of all librarians:* Lib 50—History of Libraries and Librarianship Lib 55—Library Administration Lib 62—Reference I Lib 70—Selection of Library Materials Lib 83—Cataloguing and Classification	*Five basic courses at the undergraduate level required of all librarians:* Lib 50—History of Libraries and Librarianship Lib 55—Library Administration Lib 62—Reference I Lib 70—Selection of Library Materials Lib 83—Cataloguing and Classification
Strongly Recommended:	*21 graduate credits of library science* Lib 140—Information Retrieval Lib 156—Special Libraries Lib 160—Literature of the Social Sciences Lib 166—Advanced Reference Lib 168—Research Methods Lib 181—Advanced Subject Cataloguing with papers where appropriate on law libraries	*27 graduate credits of library science* Lib 140—Information Retrieval Lib 156—Special Libraries Lib 162—Literature of the Natural Sciences Lib 165—Advanced Bibliography Lib 166—Advanced Reference Lib 168—Research Methods Lib 181—Advanced Subject Cataloguing Lib 281—Theories of Bibliographical Organization with papers where appropriate on science and technology libraries
Electives:	*One of the following:* Lib 153—History of Books and Printing Lib 165—Advanced Bibliography Lib 175—Publishers and Publishing Lib 176—Communication Media and the Library Lib 281—Theories of Bibliographical Organization	*One of the following:* Lib 153—History of Books and Printing Lib 175—Publishers and Publishing Lib 176—Communication Media and the Library
Minors	*12 semester hours (16 quarter hours) of law* Law 101—Contracts Law 106—Legal Research *9 credits of political science from one of the following sequences:* Pol 101-102-103—Principles of the American Constitution Pol 116-117-118—Local Government Pol 131-132-133—Public Administration Pol 207-208-209—Seminar: Jurisprudence	*Depending on undergraduate background, 18 credits in two or more of the following fields:* Science (e.g., chemistry, physics, biology, etc.) Mathematics or statistics Language (German, Russian, or French) Engineering

Special librarians should note that the emphasis in education for special librarianship is upon a carefully planned and integrated *program* of 60 quarter credits of study, rather than upon two or three *courses* which might be called, for example, *Law Librarianship* or *Law Bibliography*. The medical librarian with a major in biology plans a *program* similar to that of the science and technology librarian but chooses term paper topics related to medical librarianship and medical literature. The education, music, business, or historical librarian builds a program based upon his undergraduate studies and experience.

and two or three other courses depending upon your interests. In most of these courses you would choose term paper topics related to your interests and plans.

For example, if your undergraduate major is Spanish, and you want to prepare for college library work in Latin America, you might choose to write a paper on Spanish language publishing in Lib 175, Publishers and Publishing; in Lib 155, College and University Libraries, you might prepare a term paper on college libraries in Peru; in Lib 160, Literature of the Social Sciences, you might write a paper on social science literature available in Spanish. In planning such a program you might choose related graduate courses in Latin American political science, history, or literature, and in these courses also you might choose term papers which would increase your background for librarianship in Latin America.

To prepare for public library work your adviser would help you plan a program that included Lib 154, The Public Library, Lib 173, Reading Guidance for Adults, Lib 131, Public Library Extension and Development, Lib 259, Public Library Problems, and other suitable graduate courses in library science and related fields.

For work in special libraries the sample programs on the facing page are *illustrations only*. The choice of special library programs at Minnesota is almost without limit, for in every graduate library course and in the graduate related courses your use of the literature of the field and the term papers you choose to write will prepare you for work as a special librarian.

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, Hemming

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, Freeman

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, Samanisky

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

140. Information Retrieval. Theory, characteristics, systems, data processing, etc., applied to libraries. (3 cr; prereq 83 or ‡) Simonton

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) McDiarmid

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, Van der Boom

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, Kingsley, Van der Boom

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

167. Descriptive Bibliography. Special problems in bibliographical research, with emphasis on bibliographical problems encountered in the acquisition, cataloguing and description of antiquarian books. (3 cr; prereq 83 and 165 or ‡) Parker

168. Research Methods in Librarianship. Evaluation of research reported in library literature. (3 cr; prereq ‡) McDiarmid

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, censorships, 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, Samanisky

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, McDiarmid

259. Problems in Public Librarianship. Critical evaluation of the ingredients of public library service: personnel, materials, buildings. Case studies, readings, field research when possible. 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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LAW SCHOOL

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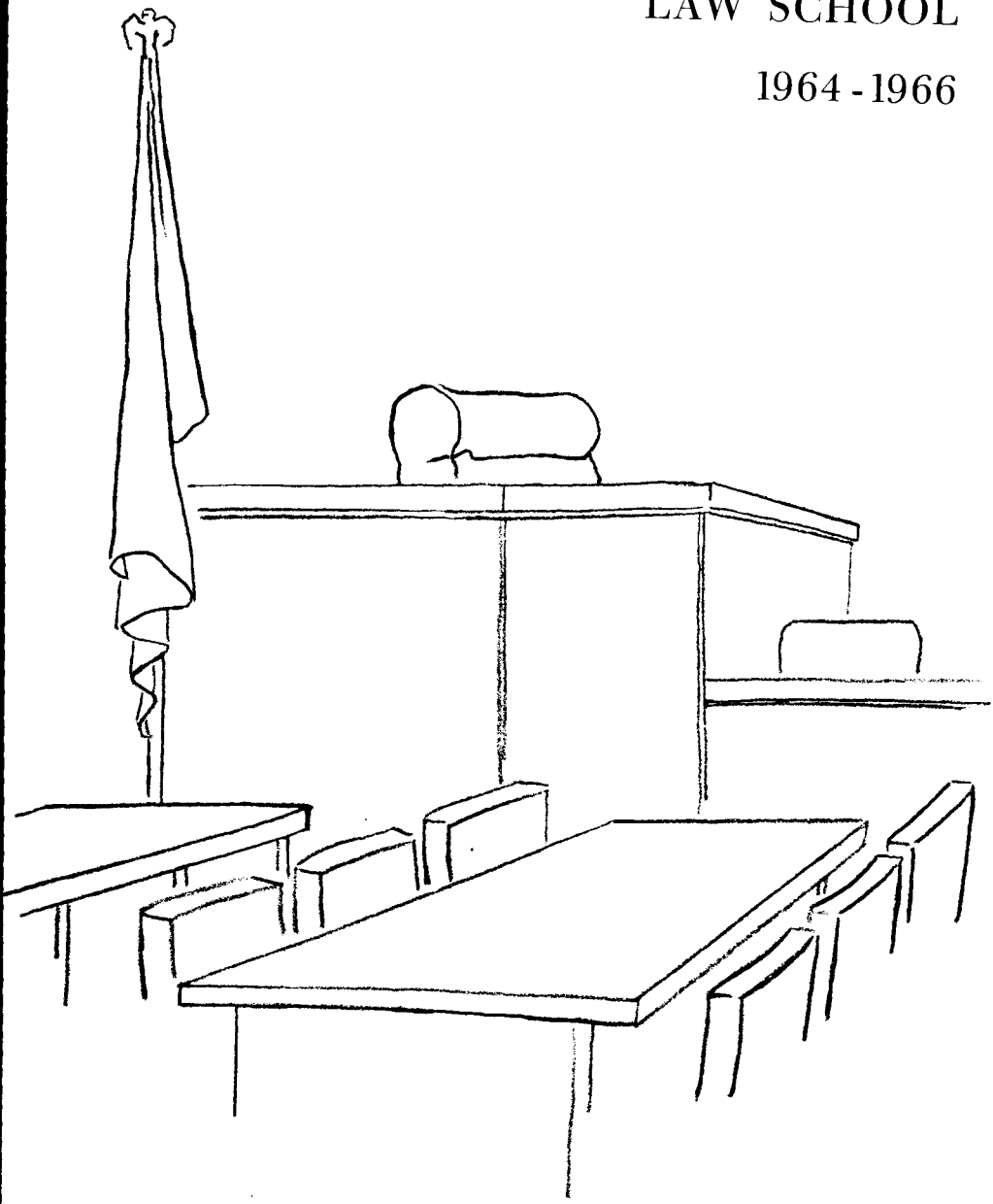

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The Law School

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 22 resident, full-time professional law teachers who devote their time to teaching, research, and public service in their respective fields. The procedure courses are taught by men trained and experienced in actual litigation, who now devote full time to their Law School responsibilities. In addition, outstanding practicing lawyers are used for lectures in fields of their specialties and for parts of the Law School's tutorial program.

The Law School Building

The Law School is housed in Fraser Hall, located between the East River Road (of the Mississippi River) and 15th Avenue Southeast, on the Minneapolis Campus of the University. All Law School administrative and faculty offices, student lounges and offices, and library facilities are located in Fraser Hall. All Law School classes are held in Fraser Hall.

Library Facilities

THE LAW LIBRARY

The library of the Law School, containing almost 300,000 volumes, and extensive areas for study and research, ranks fifth among law school libraries in the United States and is an outstanding legal research center. It is administered by a director who is a graduate of an American law school as well as a European law school and of an American school of library science. He is assisted by a staff of several experienced law librarians.

Because of its exceptionally strong collection of American and British statutes, session laws, law reports, periodicals, treatises, publications of administrative agencies, appeal papers, digests, encyclopedias, and other legal materials, scholarly research in practically any field of Anglo-American law can be carried on in this library. The Rare Book Room contains over 3,000 volumes of early English and American statutes, reports, and treatises. The document collection contains large numbers of British Commonwealth publica-

tions as well as American federal and state government publications and United Nations documents.

The Anglo-American collection includes an outstanding collection of legal materials of former British Commonwealth countries such as India and Pakistan. The library also has extensive sections in foreign (especially for Western European countries) and international law, and a good working collection of literature in related social science fields.

Law students may use the law library 24 hours a day, 7 days a week, a privilege rarely extended to any entire student body elsewhere. While the primary function of the library is to serve the faculty and students of the Law School, its services are available also to the faculties and students of other departments of the University, to members of the bar, and to all persons who have a real need for legal materials. When needed, special office facilities are provided for visiting lawyers, judges, and scholars from other institutions.

OTHER LIBRARY AND RESEARCH FACILITIES

Law students also make use of the general library system of the University which contains over 2,000,000 volumes. The Walter Library building, which houses the principal collection, is conveniently located immediately across the street from the Law School. In addition, students may obtain permission to use the facilities of the Minnesota State Law Library in the Capitol Building in St. Paul, where a vast collection of American legal materials is also available.

PREPARATION FOR LAW STUDY

The Law School does not prescribe any special prelaw college program. Its principal concern is that before entering Law School students have a college education of considerable breadth and, at the same time, one in which the student has dug deeply into advanced courses in areas of special interest to him. Such an education is assured by the major sequence requirement and the cultural distribution plan of most liberal arts colleges. The major sequence insures penetration of one field in considerable depth, while the cultural distribution plan insures a reasonable grounding in such diverse areas as science and mathematics, philosophy and humanities, literature and composition, and the social sciences. It is for this reason that the Law School requires for admission a B.A. degree or its equivalent, 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 prelaw majors. While many law students major in economics, history, or political science, other departmental majors provide good backgrounds for law study and practice. These include such areas as philosophy, the humanities, English, sociology, psychology, mathematics, the physical sciences, anthropology, geography, journalism, speech, classics, and modern languages. The Law School welcomes and encourages a variety of educational backgrounds

among its students. It is important that each student's education be as broad as is consistent with the completion of the major requirements. Therefore, a student should ordinarily endeavor to take his electives in areas not too closely related to his major. For example, a student majoring in mathematics or physics would do well to take his advanced electives in such areas as economics, political science, or history.

The Law School attaches special importance to work that will train a student to express himself in the English language forcefully, effectively, and accurately. A lawyer's whole professional career, whatever his specialty, requires hourly communication of ideas through words, oral and written. Success in Law School, as well as in later years of practice, depends in a considerable measure on development of the capacity for effective verbal expression. Therefore, the student should seize every opportunity to take courses that require independent thought and writing. A student should also develop, through courses or activities, his capacities for expressing himself orally.

Students in high school, who intend to qualify for later admission to the Law School, should study in a penetrating manner such courses as history, English, higher mathematics, natural science, and courses dealing with current social problems.

REQUIREMENTS FOR ADMISSION

Academic Program Requirements

Admission to the Law School requires the bachelor of arts degree or its equivalent. The degrees bachelor of science and bachelor of business administration with a well-balanced program will be accepted as the equivalent of the B.A. degree.

A few students are admitted after 3 years if, among other requirements, they have completed their major and will receive the B.A. degree from their college upon the successful completion of the first year in Law School. The Law School discourages students from seeking to enter Law School before completing 4 years of college education. Those with 4 years of good college work are better prepared, both for law studies and for practice of law than the few who enter after 3 years of college. They have twice as much upper division or senior college work in which they gain experience in independent, critical thinking, and a much broader educational base in preparation for their private and public responsibilities as a lawyer.

Any student who expects to seek admission after only 3 years of college should seek advice from the dean's office, where he can obtain full particulars on the requirements for admission after 3 years.

Law School Admission Test

Each applicant for admission is required to take the Law School Admission Test given by the Educational Testing Service of Princeton, New Jersey.

The test is given in a single day and is divided into three parts. In the morning, the student takes an aptitude test designed to measure some of the qualities of mind which make for successful performance in the study of law.

The two afternoon parts are designed to test writing ability and general background. At the time of preparation of this bulletin, the score from the morning part of the examination was the only score used in making most admissions decisions. Nevertheless, a student should do as well as possible on all parts of the examination since this policy could change without notice.

The test is given in August, November, February, and April at selected centers throughout the United States and in some foreign countries. One of these centers is at the University of Minnesota. Normally the test should be taken in November or February of the senior year in college.

Application forms and information bulletins about the test can be obtained from the University of Minnesota Law School, Minneapolis, Minnesota 55455, from your college office, or from the Educational Testing Service, Princeton, New Jersey.

The completed application form, together with the required fee of $12, must be received in Princeton about 2 weeks before the test date. Early inquiry should be made to obtain the exact dates for the tests.

If the student has taken the Law School Admission Test, but did not arrange to have the results sent to the University of Minnesota at the time he took the test, a duplicate test score can be sent to the Law School. Write the Educational Testing Service, give them if possible the date and your examination number, ask to have a duplicate transcript of your score sent to this Law School, and enclose $1 with your request.

Qualitative Requirements for Admission

Admission is limited to applicants who show reasonable prospects for success in law study and in the profession; however, not all who are qualified by this standard can be admitted. In order to avoid detriment to the quality of professional training given by the Law School, only the number of qualified applicants within the capacity of the building facilities and academic staff will be admitted.

The Law School makes a careful study of each application for admission. All relevant factors are taken into consideration. Admissions decisions are not made merely by applying mechanical criteria; however, the experience of the admitting officers is that an excellent academic record from a good college or university is the best indicator of the probability for success in law school.

Procedure for Application

Obtain the application forms from the Law School or the University Office of Admissions and Records. The application will be complete when the Law School has received the application, transcripts from each college attended (have two copies from each college sent to the Office of Admissions and Records, University of Minnesota, Minneapolis, Minnesota 55455), and the Law School Admission Test Score. Each nonresident applicant is required to remit $5 for the credential examination fee. There is no other fee or deposit to be made.

Application should be made by March 1 or earlier if possible. Applications received after that date will be considered, but the prospects for admission are not as good for late applications as for applications filed before March 1.

Registration with Bar Association Officials

A number of states require a student to register with bar admission officials prior to commencement of law studies. A student should ascertain whether this is required in the state where he intends to practice. Such registration is not required in the state of Minnesota.

Advanced Standing

A candidate for graduation must spend the required time in residence, either at this Law School or at some other school which is a member of the Association of American Law Schools. A student coming from such other school must have the preliminary education required for admission to this school and must spend at least 1 year in attendance at this school before he can qualify for a degree. Advanced standing will be given only to students with satisfactory records, and credit may be withdrawn because of poor work in this school. Candidates should forward a transcript of their records in both prelaw and law work.

PROGRAM OF INSTRUCTION

Summary of Requirements

The Law School program leading to the bachelor of laws degree requires 3 academic years, 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 one-third of an academic year. They are ordinarily earned by attending 1 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.

Summer School

The Law School regularly offers at least 42 quarter credits of advanced courses in summer school. These courses extend without interruption through the 2 University terms of Summer Session. Students who have completed 1 year at a law school which is a member of the Association of American Law Schools are eligible for admission to this summer school. Information on the Summer Session is available each year after March 1 through the dean's office.

Purpose and Method

The curriculum of the Law School has three objectives: (1) to provide a thorough and basic training in the law and legal techniques required for successful practice of law and for scholarly work in law; (2) to create an understanding of and appreciation for the role of the lawyer and legal tribunals in the administration of justice; and (3) to prepare the Law School graduates for the lawyer's responsibility to improve the administration of justice and to provide governmental and community leadership. Emphasis is placed on an understanding of the history, principles, and purposes of legal institutions, the operation of these institutions in the modern world, and the development of the skills of legal craftsmanship.

The Law School uses a variety of teaching methods. The basic form of instruction is the case and problem method, which centers around the critical study and discussion of decisions by courts and administrative agencies. The decisions selected for study reflect both the evolution of the law and the efforts to arrive at satisfactory solutions to difficult current problems. Instructors also make use of textual and legislative materials. Decisions, texts, and legislation are supplemented with hypothetical or real problems put to students for consideration and solution.

These decisions and other legal materials give the student a realistic understanding of the history and current state of the law. But the more important purpose for using actual decisions as the basic teaching tool is to pose factual problems out of real life for which the student must seek satisfactory solutions. The primary value of this method of study is the experience gained by the student himself in seeking the best solution for the problem posed, not simply the understanding he acquires concerning the decision actually reached by the court. For the end product sought by the Law School is a lawyer qualified to resolve new and difficult legal problems, thoroughly grounded in his knowledge and understanding of past legal tradition and present law.

Tutorial instruction is used extensively at Minnesota to develop the student's ability to solve problems. In the first year every student is given specific problems to resolve. He engages in independent research and study upon each problem and prepares a legal memorandum, opinion letter, or brief. His analysis and writing are then closely scrutinized by an outstanding lawyer with *Law Review* editorial experience. After a conference, he prepares a second, or even a third draft, with the same procedure for scrutiny and discussion.

In the second year, the tutorial program consists of an appellate moot court, with tutorial assistance in the preparation of briefs. The cases are also argued orally.

Tutorial and small group work designed to develop the individual continues in the senior year. The student participates in a seminar in which a small group of students examines intensively a special area of interest under a faculty expert in that area. Each senior must prepare a substantial piece of written work aimed at exploring and solving a legal problem, under the guidance of a faculty member. Each senior is also given experience in the basic method of resolving controversies; he prepares and tries 2 cases in the practice court, 1 to a judge and 1 to a jury. Members of the judiciary preside at these trials, held in the courtroom of the Law School.

Courses of Study

The normal course load is 16 hours per week in the first and second years and 15 hours per week in the third year. Additional work cannot be taken without the dean's approval. Attendance at all classes and all special lectures is required. All courses in the first year are required.

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.

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) Cound, Enker, 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) Enker, Kamisar, Ellingston

103. Legal Process. Introduction to methods and processes of legal decision-making by judicial, legislative, and administrative agencies; illustrated by examining how these agencies dealt with a problem of wide public concern, the allocation of the burden of industrial accidents. (4½ cr) Auerbach, Choper, Sandalow

106. Legal Research. Books and other tools of the legal profession; preparation of memorandums of law on the basis of facts supplied by practicing attorneys; tutorial instruction in legal analysis and legal writing. (3 cr) Greene and instructors in legal research

107. Property I. Fees, life estates, concurrent tenancies, landlord and tenant, reversions, remainders, uses, executory interests, powers of appointment, class gifts, rule against perpetuities. (6 cr) Graven, Hogg, 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. (Same as BA 85) Bookkeeping techniques; financial statement analysis; recognition of revenue; matching of costs and revenues; inventory and depreciation methods; costs of borrowed capital; accounting for various forms of business association; relationship to legal problems. (3 cr; for law students with inadequate background in accounting; exemption from course is given to students with extensive background in accounting and to others by examination) Berryman

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) Graven

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

140. Administrative Law. Function of administrative agencies in our society; administrative powers and procedures; legislative, judicial, and executive control of administrative agencies; interrelations of legislative, judicial, executive, and administrative agencies in development of public policy. (4½ cr) Auerbach

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. Seminar: Criminal Law. Problems of criminal law administration and of the juvenile court; includes reports prepared by members on selected topics in the field, lectures by invited specialists, attendance at a juvenile court hearing, and an inspection trip to a penal institution; a limited number of advanced students from related fields may participate. (3 cr) Pirsig, Ellingston

145. Estate Planning. A study of arrangements for the devolution of private wealth, application of principles of the law of wills, trusts, future interests and federal income, estate and gift taxation to the development of such arrangements; consideration of

the role of life insurance and employee benefits in the development of such arrangements; consideration of drafting techniques. (4½ cr; prereq 128 and 127) Hogg, Waterbury

146. Seminar: Estate Planning and Drafting. A research and writing or drafting seminar focusing on specific problems; either legal problems for research and writing in the areas of federal tax and related property, partnership and corporate law; or research for and drafting of specific provisions for insertion in wills, trusts or business purchase agreements, designed to achieve specific estate planning objectives of general interest. (3 cr; prereq 128, 127, 145 [145 may be taken concurrently]) Waterbury

147. Independent Research. Preparation in depth of a major paper on a difficult legal problem. (3 cr) All faculty

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 representative cases and unfair labor practice cases; negotiation of collective agreements; mediation and conciliation processes; legislative committee hearings. Emphasis is placed on actual practice sessions. (1½ cr; prereq 155) McCoid

157. Standards of the Legal Profession. Examination of the ideals of the profession and their enforcement; includes the content and role of professional ethics. (1½ cr) Pirsig

158. Legislation. Legislative organization and procedure; textual authenticity; statutory interpretation. (3 cr) McClure

159. Local Government Law. Place of local government units in the governmental structure; sources of and limitations upon the power of local governments; legislative control; home rule; relationship to other local government units and to the federal government; role of the judiciary; organization, annexation, consolidation, and dissolution. The planning function; eminent domain; zoning; subdivision regulation; financial aid and tax incentives for private business. (4½ cr) 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

163. Practice. Rules of civil procedure including pretrial and posttrial motives, parties, pleading and discovery, appeals; legal medicine; practice trials including court and jury cases. (12 cr) Hetland

164. Seminar: Regulated Industries. The various aspects of the regulation of public utilities—the legal controls over price, supply, and service—in the context of the problems of a related group of utilities—the rail, motor, water, and air transport industries; emphasis on the interaction between the legislature, the administrative agencies, and the courts in the development of regulatory policy, and the relationship between the regulatory policy and the relationship between the regulatory and 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. Seminar: Supreme Court. Work of the United States Supreme Court during its current term; special emphasis on important recent decisions, jurisdiction, practice. (3 cr) Choper

170. Seminar: Judicial Administration. Relates primarily to the administration of justice in the civil field; includes problems of civil procedure, evidence, court organization, the legal profession and its organization, the qualification and selection of judges and court personnel, jury trial, use of expert testimony, calendar delays, etc. (3 cr) Pirsig

173. Taxation II. Federal income taxation of corporations and shareholders; current problems in business planning. (3 cr; prereq 128 and 123) Scallen

175. International Law. Nature and sources of international law, jurisdiction of states over persons and property, recognition of states and government, the law of treaties. (4½ cr) Christie

177. International Commercial Transactions. Problems of foreign trade and investment. (4½ cr) Hogg

179. Directed Research. (1½ cr) Ar

180. Federal Jurisdiction. Distribution of power between federal and state courts; structure and function of the federal judiciary; original jurisdiction of the district courts; removal jurisdiction; law applied by federal courts; actions against state officials. (4½ cr) Sandalow

182. Seminar: Secured Transactions. Chattel secured credit; pledges, field warehousing, chattel mortgages, conditional sales, assignment of receivables, trust receipts, and factors' liens; Uniform Commercial Code. (3 cr; prereq 126) McClure

184. Unfair Competition. Copyrights, trademarks, and unfair competition; trade libel, disparagement, interference with contractual relations, and other business torts. (4½ cr) Miller

185. Jurisprudence. Philosophies of law; theories of justice; analysis of legal language; legal reasoning as a means of social control; law and the social sciences. (4½ cr) Christie

186. Family Law. Analysis of the common law and statutory doctrines relating to the creation, functioning, and deterioration of family status; illegitimacy, marriage, juvenile protection, divorce, support. (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. Seminar: Criminal Procedure. Study of what are—and ought to be—the procedural rights and liabilities of those accused of crime with emphasis on constitutional dimensions of criminal procedure. (3 cr) Kamisar

195. Clinical Seminar: Family Law. 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. Seminar: Family Law. Participation in the legal, social, and behavioral aspects of neglected child and illegitimacy cases, parental termination proceedings and the

adoption process; and the procedure and aims of a family court in divorce, separation, and custody cases. (3 cr; prereq 186) Levy

196. Seminar: Trusts and Estates. Builds on the materials covered in the basic Trusts and Estates course; specific content varies from year to year. (3 cr; prereq 127) Hogg

198. Seminar: Multiparty Litigation. A study in depth of the procedural problems involved in actions with more than two parties, particularly permissive joinder, impleader, and class actions; the law of indemnity and contribution. (3 cr) Cound

200. Seminar: Legal Problems in Minnesota Public Affairs. Participants study and seek solutions to selected problems of importance faced by Minnesota legislators, legislative interim commissions, municipalities, and other public agencies; both factual and legal exploration is used, aimed at producing a recommended course of action or solution to be submitted to the governmental officials involved, together with draft legislation or other appropriate governmental action. (3 cr) Graven

201. Seminar: Equity in Modern Society. Intensive analysis of the distinctive powers and doctrines of equity and how they are being molded to meet present-day social, economic, and political problems; examination of the use of injunctions, declaratory judgments, and class actions in various areas of the law to meet changing conditions of recent years. (3 cr) Miller

202. Seminar: Land Planning. Examination of selected problems of governmental control of development and use of land; emphasis on the legal means for effectuating planning in metropolitan areas, including zoning, subdivision regulation, urban renewal, housing and building codes. (3 cr) Sandalow

203. Seminar: Impact of Law on Social Development. Joint seminars for anthropology and law students; the interplay between law and anthropology. (3 cr) Auerbach, Hoebel

HOUSING

All Law Students

Numerous apartment houses (and for single students, rooming houses) are available within walking distance of the Law School. Vacancies in houses, duplexes, apartments, and rooming houses are reported to the Student Housing Bureau, 209 Eddy Hall, University of Minnesota, Minneapolis, Minnesota 55455. Normally, it is best to look for this type of housing in person in the early summer. However, at the time of preparation of this bulletin, there is no shortage of housing near the University.

Married Students

Permanent apartments for married students with 1 to 3 children are maintained on the St. Paul Campus of the University. There is convenient bus service to the Minneapolis Campus. The apartments are unfurnished; 1 bedroom, $70 per month; 2 bedrooms, $80 per month; all utilities except telephone included. Stoves and refrigerators are provided. Since the waiting list is long, an interested student should get his name on the list as soon as he is admitted to the University. Contact either the Student Housing Office, 209 Eddy Hall, University of Minnesota, Minneapolis, Minnesota 55455, or Commonwealth Terrace, 1295 Gibbs Avenue, St. Paul, Minnesota 55108.

Single Students

The best facilities available for single male students are in sections of Centennial Hall used for graduate and professional students. The cost for room and board for the academic year is $780 to $900. The higher figure is for a "deluxe" single room. Contact either the Student Housing Bureau, 209 Eddy Hall, University of Minnesota, Minneapolis, Minnesota 55455, or Centennial Hall, University of Minnesota, Minneapolis, Minnesota 55455 for information.

For those who prefer to live with law students, the Gamma Eta Gamma law fraternity provides good housing for single students. Contact Gamma Eta Gamma Law Fraternity, 1126 5th Street S.E., Minneapolis, Minnesota 55414.

EXPENSES

Tuition and fees, academic year—residents	$375
Tuition and fees, academic year—nonresidents	795

In order to be classified as a resident, the University of Minnesota ordinarily requires bona fide residence for a period of 1 year and evidence of intent to be a permanent resident of Minnesota. The University Office of Admissions and Records makes these determinations. An appeal from such a determination may be taken to a committee.

The Law School has made careful estimates of living and educational expenses for students attending the Law School. The estimated expenses for a law student who is a resident of Minnesota are $1,820 per year ($1,175 for a Twin Cities commuter living at home). The expenses for a nonresident are $420 greater. Details may be obtained from the dean's office.

Financial Planning

Students are responsible for making adequate financial arrangements to carry them through each year of law school. The importance of sound financial planning cannot be underestimated. Lack of it accounts for or contributes to as many dropouts as outright scholastic failure, especially during the first year. Some students supplement their income with outside employment, but this is generally discouraged, particularly for first-year students. Excessive outside employment is never permitted. It is well to consider, for planning purposes, that employment in jobs ordinarily open to students is likely to impair academic work and be an unreliable source of continuing income.

As indicated in the loan and scholarship sections of this bulletin, there are several sources of financial assistance for students. Of special interest to second- and third-year students is the loan program of a local bank which will normally provide for their needs up to $1,000 annually. Reliance should not be placed, however, on the availability of loans and scholarships until applications have been approved or definite arrangements made.

In the absence of a definite commitment or arrangement for future years, the fact that a scholarship or loan has been approved for 1 year does not assure that additional funds will thereafter be made available. Normally, such assistance is continued if needed, although in the case of scholarships the student

is expected to maintain a B average in order to qualify for the following year. The University and the Law School provide emergency loan services, which are liberally administered but may not be available under all circumstances. It is advisable, therefore, for students whose financial resources are marginal to arrange with an individual or bank in their home town for extension of credit in the event their financial plans are disrupted.

Part-time Employment

Employment opportunities in Minneapolis and St. Paul are substantial. However, the faculty is gravely concerned over the effect outside work has on the student's performance in Law School. It is strongly recommended that the student engage in no outside work. All students engaged in outside employment are required to submit a statement concerning the number of hours of work and to counsel with one of the deans. If individual circumstances require a substantial amount of employment, arrangements must be made through the dean's office to reduce the amount of Law School work accordingly.

Fraternity or residence hall counseling provides room and board plus a small amount of cash for the academic year. Nonresidents are also given the benefit of paying resident tuition rates. The time required for counseling duties is substantial. For more information, contact Mr. Harold R. Marquardt, Coordinator of Residence Counseling Program, 8 Temporary North of Mines, University of Minnesota, Minneapolis, Minnesota 55455.

FINANCIAL AIDS

Scholarships

Almost all Law School scholarships require a showing of financial need. Scholarships are available to first-year students as well as to advanced students. The stipends vary with the financial need, but usually cover the cost of tuition and books for residents, and tuition for nonresidents.

Application forms may be obtained from the dean's office of the Law School. Entering students should apply by March 1. Students currently in Law School should apply by late May. A scholarship applicant does not apply for a particular scholarship.

Law Firm Scholarships—Annual scholarships are supported by each of the following law firms and individual lawyers.

Altman, Geraghty & Mulally, St. Paul
Arriola, Joaquin C., Agana, Guam
S. H. Bellman, Minneapolis
Erling Berg, Duluth
Best, Flanagan, Lewis, Simonet & Bellows, Minneapolis
Blethen, Ogle, Gage & Krause, Mankato
Briggs & Morgan, St. Paul
Lyman A. Brink, Hallock
Bundlie, Kelley & Torrison, St. Paul
Arthur A. Burck, New York, New York
Butchart, Fredin & Eaton, Duluth
Cant, Haverstock, Beardsley, Gray & Plant, Minneapolis
John F. Dablow, Cambridge
Doherty, Rumble & Butler, St. Paul
Dorsey, Owen, Marquart, Windhorst & West, Minneapolis
Erickson, Popham, Haik & Schnobrich, Minneapolis
Faegre & Benson, Minneapolis
Faricy, Moore, Costello & Hart, St. Paul

Felhaber, Larson & Fenlon, St. Paul
Robert H. Ford, Chicago, Illinois
Helmer A. Frankson, Hibbing
I. R. Galob, Hibbing
Cassius E. Gates, Seattle, Washington
Gislason, Reim, Alsop & Dosland, New Ulm
James E. Gottlieb, Minneapolis
Grannis & Grannis, South St. Paul
Hall, Smith, Hedlund, Juster, Forsberg & Merlin, Minneapolis
H. G. Haugland, Minneapolis
Hultstrand, Abate & Wivoda, Hibbing
Hvass, Weisman & King, Minneapolis
Jevne & Jevne, Minneapolis
Robert G. Johnson, Willmar
Kueppers, Strong & Kueppers, St. Paul
Sheldon S. Larson, Winthrop
Leonard, Street & Deinard, Minneapolis
Levitt, Palmer & Bearmon, Minneapolis
Lindquist, Magnuson & Glennon, Minneapolis
Mackall, Crounse, Moore, Helmey & Holmes, Minneapolis
Maslon, Kaplan, Edelman, Joseph & Borman, Minneapolis
Maun, Hazel, Green, Hayes, Simon & Aretz, St. Paul
McCabe, Van Evera, Mundt & Hall, Duluth
Meagher, Geer, Markham & Anderson, Minneapolis
Merchant, Merchant & Gould, Minneapolis
Montague, Applequist, Lyons, Nolan, Donovan & Knetsch, Duluth
Moses, Friedell, Share & Solomon, Minneapolis
Murphy & Preece, Grand Rapids
Nelson & Oyen, Montevideo
Neville, Johnson & Thompson, Minneapolis
Allen I. Nilva, St. Paul
O'Brien, Ehrick & Wolf, Rochester
O'Connor, Green, Thomas & Walters, Minneapolis
O'Leary & Trenti, Virginia
Herbert E. Olson, Bemidji
Oppenheimer, Hodgson, Brown, Wolff & Leach, St. Paul
Padden & Dickel, Crookston
Richard H. Plunkett, Rochester
E. E. Ranta, Minneapolis
Harvey T. Reid, St. Paul
Rice & Efron, Minneapolis
Arthur Roberts, Duluth
Robins, Davis & Lyons, Minneapolis and St. Paul
Millard Ruud, Austin, Texas
Walter R. Severson, San Francisco, California
Paul M. Shaw, Deer River
Silver, Goff, Ryan & Cochrane, St. Paul
Lee H. Slater, St. Paul
J. M. Sogard, Great Falls, Montana
Spellacy, Spellacy & Lano, Marble
Stacker & Stacker, St. Paul
C. A. Stark, Minneapolis
M. C. Steen of Cleary, Gottlieb, Steen & Hamilton, New York, New York
Stringer, Donnelly & Sharood, St. Paul
Sturtz, Peterson, Sturtz & Butler, Albert Lea
Sullivan & Cromwell, New York, New York
Sullivan, McMillan, Hanft & Hastings, Duluth
Paul C. Thomas, St. Paul
Van Valkenburg, Moss & Flaherty, Minneapolis
Vennum, Newhall, Ackman & Goetz, Minneapolis
Charles T. Wangensteen, Chisholm
James L. Wanvig, San Francisco, California
John P. Weber, Grand Rapids
West & Gowan, Rochester
Wright & West, Minneapolis
Yates, Hobart M., 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 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—A gift of $10,000 to endow a scholarship in memory of The Honorable Homer B. Dibell, a Minneapolis Supreme Court Justice and member of the Law School faculty.

James E. Dorsey Scholarship Fund—A fund of about $9,000 created by friends, associates, and family of James E. Dorsey to be used for scholarships as determined by the faculty.

Henry J. Fletcher Memorial Aid Fund—See section on Loan Funds. The income from this fund may be used for scholarship assistance to deserving and needy students.

General Mills Law Scholarship—An annual gift of $500 for a promising law student with financial need.

Curtis Lloyd Jensen Scholarship—A fund of $10,000 bequeathed by Verna Blanche Jensen in memory of her brother, Curtis Lloyd Jensen, LL.B. '35, the income to be used for scholarships for Law School students of high character, all-around promise, and need.

Sidney J. Kaplan Legal Scholarship Endowment Fund—A growing endowment fund of over $9,000 created in memory of Sidney J. Kaplan of Minneapolis by associates, friends, and family to provide annual scholarships on the basis of aptitude for outstanding performance in legal studies, and not on the basis of need.

Law Faculty Scholarship Fund—A fund of $19,000 donated by members of the Law School faculty for scholarships in the Law School, augmented by current faculty gifts.

Law Student Wives' Association Scholarship Fund—An annual scholarship for a married law student based primarily on merit, taking into consideration both academic achievement and service to the Law School.

Garwood Lippincott Scholarship—Established in memory of Garwood Lippincott, president of the Student Editorial Board of the *Minnesota Law Review*, 1941-42, who gave his life in the service of his country. The scholarship is awarded annually to a member of the Student Editorial Board of the *Minnesota Law Review* who has completed 1 year's work on the board, such member to be selected by the student officers of the board for that year.

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.

Ronald J. Nemer Scholarship Fund—A growing fund created by classmates and friends in memory of Ronald J. Nemer to provide scholarship aid for promising law students.

Northern States Power Company Law Scholarship—An annual $500 scholarship for a promising student with financial need.

F. H. Peavey & Company Law Scholarship—An annual scholarship for an outstanding student with financial need.

John S. Pillsbury Family Law Scholarship—An annual $500 scholarship for a promising and needy law student.

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.

Judge Betty W. Washburn Scholarship Fund—An endowment fund of $10,000 established by Mrs. Anton Hulman, Sr. in memory of Judge Betty W. Washburn of Minneapolis to provide annual scholarships for promising law students.

Loans

Law students of good character and dependable scholarship with financial need may borrow from various loan funds. Repayment of loans is expected on a reasonable periodic payment basis after graduation.

National Defense Loans—All law students meeting the general requirements for loans are eligible for loans through the University under the National Defense Education Act. All students who know they will need to borrow should make an application for these funds by May 15 of the academic year preceding the year when the funds will be needed. The terms are 0 per cent interest while the student is in school and for 1 year after graduation; 3 per cent thereafter. Applications are available through the dean's office, or the University Bureau of Student Loans and Scholarships.

First National Bank of Minneapolis Loans—The Law School has an arrangement with the First National Bank of Minneapolis to provide loans at low interest and liberal repayment terms for second- and third-year law students. Guarantee funds for the plan are provided by the Law Alumni Association and contributors to loan guarantee funds. Students have up to 4 years to make repayment after the bar examination.

Federal Cartridge Foundation Guarantee Loan Fund—Gifts to make financial aid in the form of loans available to law students, to be used to furnish security for loans or as direct loans to students.

Henry J. Fletcher Memorial Aid Fund—Approximately $20,000 given by Charles L. Horn, LL.B. '12, and others, to perpetuate the memory of the late Professor Henry J. Fletcher and to assist students attending Law School.

Bernard M. Heinzen Guarantee Loan Fund—A gift in memory of Bernard M. Heinzen of the class of 1928 to make financial aid in the form of loans available to law students, to be used to furnish security for loans or as direct loans to students.

Frank B. Kellogg Loan Fund—A bequest by the late Frank B. Kellogg now valued at over $39,000.

Albert P. Krost Loan Fund—A fund of $10,000 to be loaned to worthy law students, established by the bequest of Clara B. Krost in memory of her husband, Albert P. Krost.

Law Alumni Loan Fund—Approximately $45,000 donated by alumni and friends of the Law School. Loans are without interest until graduation or termination of law studies.

Gustavus Loevinger Memorial Aid Fund—Gifts of $4,000 from friends and relatives of the late Judge Gustavus Loevinger.

Vernon W. Olson, Jr., Memorial Loan Fund—Over $1,000 in gifts by family and friends in memory of Vernon W. Olson, Jr., '52, to provide interest-free loans for deserving members of the *Minnesota Law Review*.

Robins, Davis & Lyons Guarantee Loan Fund—Gifts to make financial aid in the form of loans available to law students, to be used to furnish security for loans or as direct loans to students.

Wheeler, Fredrikson & Larson Loan Fund—A growing fund to provide loans interest free until graduation.

Wheeler, Fredrikson & Larson Guarantee Loan Fund—A gift to make financial aid in the form of loans available to law students, to be used to furnish security for loans or as direct loans to students.

University of Minnesota Loan Funds—These funds are used primarily for first-year law students who have previously attended the University of Minnesota. Eligible students are referred by the dean's office to the University Bureau of Student Loans and Scholarships.

STUDENT ACTIVITIES AND HONORS

Minnesota Law Review

The Minnesota Law Review, established in 1917, is a legal periodical of the Law School. It publishes leading articles by experts in their fields, as well as notes and comments on recent developments of the law prepared by an editorial board consisting of students who are elected on the basis of their high scholastic achievements. Successful service on the *Law Review* is the highest honor recognized by the Law School. It is an experience in research, legal analysis, and writing of unexcelled value in the development of professional and technical skills.

Law School Council

The Law School Council consists of representatives from each class. The council, as representative of the student body, plays an important role in the administration of the Law School. It supervises the functioning of the honor system under which examinations in the school are written. It serves as an important medium for the exchange of views and suggestions between staff and students with respect to questions arising in the course of Law School operations, and supervises the operation of the Henry Rottschaefer Student-Faculty Lounge. It arranges for special lectures and Law School convocations. It has charge of social functions involving the school as a whole, such as the activities of Law School Day and the annual Law School Dance.

The council, as representative of the student body, is a member of the American Law Students Association sponsored by the American Bar Association.

Legal Aid Clinic

The Legal Aid Clinic is conducted in co-operation with the Minnesota State Bar Association. Second- and third-year students act as student attorneys in interviewing students, employees, and staff of the University who are financially unable to obtain private counsel. The student attorneys determine whether the client has a legal problem. If it is decided that he does, the students do the necessary research and arrange for the client to have an interview with a practicing attorney who confers with the student attorneys and refers to their research work before approving any advice which is to be given to the client. If it becomes necessary to litigate the client's problem, the student at-

torneys do all of the necessary investigation and filing of papers under the supervision of the practicing attorney to the ultimate conclusion of the case. Included in this work is attendance at the trial as assisting counsel.

In co-operation with the Minnesota State Bar Association, the members of the clinic do research and submit articles on common interest points of the law for a column which is printed in several suburban newspapers. The clinic also supplies scripts for a radio program on common interest points of the law.

Court-appointed counsel for the District Court (Federal) in Minneapolis and St. Paul are invited to use the services of the clinic to perform investigation and research work in the defense of indigent defendants. Members of the clinic work on these cases and follow them to their final disposition with the court-appointed attorneys.

Order of the Coif

The Law School has a chapter of the Order of the Coif, a national honorary society of law students. Election to this society is made by the faculty at the close of the senior year from the 10 per cent of the graduating class highest in scholarship.

Degrees with Honors

Honor students receive their degrees *cum laude, magna cum laude,* and *summa cum laude* in accordance with standards established by the faculty.

Other Honors

Each year recognition is given to students with A averages and to those with B averages by placing them on the Dean's List. Recognition is also given to the student in each class who makes the greatest improvement in his academic work over the preceding year.

Associate Membership, Minnesota State Bar Association

A student in his senior year may become an associate member of the Minnesota State Bar Association upon payment of $1 dues. This entitles him to all the privileges of full membership except the right to vote. He may attend meetings and receives copies of *Bench and Bar,* an association publication. Lectures by leading practitioners are sponsored by a committee of the association on topics of special interest to those about to enter the legal profession. Membership is voluntary but is favored by the school.

PLACEMENT

The Law School maintains a placement office for the benefit of its students and graduates. The assistant dean in charge of placement and the placement secretary render assistance to law students seeking part-time or summer employment. The primary work of the office is concerned with placement of seniors and graduates. Law firms, corporations, and government agencies from

all over the United States and Minnesota come to the Law School almost daily to interview students. The placement service strives to provide guidance to students, graduates, and employers on placement matters.

SPECIAL PROGRAMS

Graduate Study in Law

The Law School has no regular program for graduate study in law. 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.

Graduate Studies for Foreign Trained Lawyers

The Law School and the Graduate School of the University of Minnesota have approved a program leading to the degree of Master of Arts in American Legal Institutions. The program calls for meeting the requirements of Plan B under the rules of the Graduate School with concentration in a field of law.

The program of work leading to this degree is designed to familiarize the foreign student who has studied law in his own country with American legal institutions. Only foreign graduate law students, therefore, may be awarded this degree.

The program of work will be selected to suit the particular needs of each foreign student. Normally, at least 3 quarters of graduate study is required with concentration in the field of law. Courses accounting for at least 21-27 quarter credits must be taken in the Law School. The required 18 quarter credits outside the field of concentration may be taken in other departments of the University. Within the limits indicated, the number of quarter credits to be taken in the Law School and the courses to be taken outside the Law School will be agreed upon by the student and the appropriate Law School committee. The courses to be taken outside the Law School will be selected to enable the foreign student to put his studies in the Law School in their proper social, economic, political, and cultural framework.

Combined Programs Leading to LL.B. and M.A. or M.B.A. Degrees

A law student may take a course leading to both the professional LL.B. degree and the M.A. or M.B.A. degree. Details may be obtained from the dean's office.

Training Project in Delinquency Control

The Law School jointly sponsors with the Department of Sociology and the School of Social Work a program for the training of personnel working in

the field of juvenile delinquency (Sequence C in Sociology). A member of the Law School faculty gives a course, Soc 103, Law and the Legal System for Correctional and Social Workers, which is required of students in Sequence C. The seminar on criminal law is open to graduate students in the School of Social Work and the Department of Sociology upon approval of the seminar instructors and of the dean of the Law School.

Those interested in pursuing the undergraduate program should consult the Department of Sociology.

Family Law Clinical Seminar

The Family Law Clinical Seminar is designed to teach the use of practical skills necessary to adequate counseling and advocacy by exposing students to actual domestic relations cases as they are presented to the practicing lawyer; to apprise students of the methods and activities of the social service facilities of their community; to make law students aware of the problems of classes of society with which they might have had little contact; and to encourage them to take a continuing interest in these problems, their solutions, and the improvement of the social service facilities of their community.

The students enrolled in this seminar spend the year engaged in various activities in the courts and public social service agencies of Minneapolis which deal with problems of the family. Their experiences include participation with a Welfare Department social case worker in evaluation of an adoption application; active participation with a social case worker in a "child protection" (neglect) case; appearance as counsel in the Juvenile Court in a case in which the Welfare Department is seeking to terminate parental rights; collaboration with social case workers attached to the Family Court in making custody evaluations ordered by the court; interviewing a prospective divorce client under the observation of other students and a psychiatrist consultant to the program; assistance in the representation of the client if a divorce is sought.

During the second semester, the students attend regular seminar sessions with graduate students in social work. The seminar meetings consider both the cases in which the students participated and the teaching materials which pose, in the context of actual court, agency, and lawyers' office files, the various problems of professional responsibility which lawyers must face in the field of domestic relations law.

UNIVERSITY CALENDAR

The annual calendar will be found in the *Bulletin of General Information* which may be obtained from the Office of Admissions and Records, University of Minnesota, Minneapolis, Minnesota 55455. The Law School operates on a semester system with the fall semester beginning at the same time as fall quarter of the University. The Law School calendar is available as part of the registration material each fall.

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