

*The Bulletin of the*

UNIVERSITY OF MINNESOTA

*Graduate School*

1952 - 1954

## 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 "Description of Courses" 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 hope to earn (for the Master's degree, pages 7-13, for the Ph.D. degree, pages 13-19).

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

*The Bulletin of the University of Minnesota*

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# GRADUATE SCHOOL

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General Information  
Description of Courses

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## GRADUATE SCHOOL

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 eight 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 1950, the Graduate School had awarded 2,359 Ph.D. degrees and more than 9,780 Master's degrees.

Central to the purposes of the Graduate School are 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; Languages and Literature; Medical Sciences; Philosophy, Music, Psychology, Child Welfare, Education, Speech Pathology; Physical Sciences, Mathematics, Engineering; and Social Sciences. Together with the dean, the assistant dean, and the secretary, 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 eight hundred, teaches both in the Graduate School and in the several undergraduate and professional colleges.

A limited amount of graduate work is open to students of Education at the Duluth Branch of the University. Graduate students who begin their work at the Duluth Branch must ultimately include in their program the equivalent of one quarter of residence and study on the Minneapolis and St. Paul campuses in day school work. This graduate work is administered under joint adviserships, and examining committees include representatives from the Minneapolis Campus and one from the Duluth Branch who will have served as joint adviser with a member of the Minneapolis graduate faculty.

In the following pages detailed information is given 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 more than eighty-five majors, and a list of the courses offered.

### ADMISSION

Any student with a Bachelor's degree or its equivalent from a recognized college or university may apply to the dean of the Graduate School for admission. An applicant of satisfactory scholastic record from an approved college or university may be admitted, with the approval

of the major department concerned, for graduate work involving a major in that department.

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 does not designate a major may be admitted to take work for which he is qualified, but if at a later time he chooses a major he must meet the requirements of that department for acceptance to do major work.

An applicant of unsatisfactory scholastic record and qualifications will be refused admission to the Graduate School, but may be advised, if a resident of Minnesota, to register for a probationary period as an adult special student in the appropriate undergraduate college. Such an adult special student must complete successfully a minimum of one quarter's work in courses acceptable for credit by the Graduate School before being permitted to transfer his registration to the Graduate School. Upon successful completion of this probationary work the student may petition to transfer all work of graduate quality taken while registered as an adult special student to the records of the Graduate School and will be granted residence and credit in the Graduate School for it.

College graduates who desire simply to take additional work of undergraduate character without a view to ultimate preparation for an advanced degree should apply, not for admission to the Graduate School, but to the Office of Admissions and Records for admission as special students in the college giving the work.

Certain departments require the student to complete the Miller Analogies Test, Form H, as part of the application. These are: American Studies, Child Welfare, Economics and Business Administration, Mechanical Engineering, Physics, Political Science including Public Administration, Psychology, Statistics, and Zoology. The Graduate School itself may ask the student to take this and other tests, and in such cases the student will be notified where and when the tests will be given.

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

All inquiries concerning admission should be addressed to the dean of the Graduate School, 316 Johnston Hall, University of Minnesota, Minneapolis 14, Minnesota. Applications should be sent to the dean of the Graduate School at least four weeks before the opening of the quarter in which the student matriculates, and must be accompanied by official transcripts in duplicate of undergraduate work and single official transcripts of any graduate work that may have been taken.

## 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. No student will be admitted to candidacy until he has been in residence for at least one quarter or one Summer Session and has removed any deficiencies that may have conditioned his admission to the Graduate School. The procedure in applying for candidacy is included with the description of the requirements for the various degrees.

## ADVANCED STANDING AND TRANSFERS OF CREDITS

**From an Undergraduate College**—Credits for advanced courses earned while the student is registered in an undergraduate college, even though in excess of the credits required for the baccalaureate degree, can be transferred to the Graduate School only under the following conditions:

1. If not more than 9 quarter credits of undergraduate credit are lacking (taking into account required and sequence courses), a limited amount of graduate work may be carried (approved courses numbered above 99) 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.

2. Undergraduates lacking not more than 6 quarter credits (taking into account required and sequence courses) may register in the Graduate School.

**From Other Institutions to Apply toward the Master's Degree**—The University of Minnesota will allow transfer of a maximum of 9 quarter credits of graduate work satisfactorily completed at other approved graduate schools toward the Master's degree requirements, provided that not more than 6 quarter credits be transferred to the major field and not more than 3 quarter credits to the minor field under Plan A, and that under Plan B none of the transferred credits be substituted for the required 9 credits in starred courses.

Transfer of the maximum of 9 credits may reduce the residence requirement for the Master's degree by one Summer Session for students whose Master's degree programs include Summer Session study. All such transfer of graduate credit and of residence from another institution must be recommended by the appropriate graduate group committee at the University of Minnesota.

Work at other institutions will not be transferred either for credit or in lieu of residence for the Master's degree under the above provisions until the student has completed satisfactorily at least 15 credits in the Graduate School of the University of Minnesota.

No more than 9 quarter credits may be transferred in combination of the foregoing rules and those relating to transfer of credits in courses earned through the Extension Division of the University of Minnesota

(see below for these rules) for the Master's degree under Plan A and 12 quarter credits under Plan B.

**From Other Institutions to Apply toward the Ph.D. Degree**—See Requirements for the Doctor's degree, page 13 of this bulletin.

**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 6 quarter credits under Plan A or 9 quarter credits under Plan B in courses numbered above 99 offered by the Extension Division of the University of Minnesota in the Twin Cities area, and taught by approved members of the graduate faculty. Such transfers of extension credits will not give residence credit. No graduate credits earned in any other institution through extension courses may be transferred.

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

## REGISTRATION

Directions for registration may be obtained at the Graduate School when the student arrives at the University. The essential documents for a graduate student, an official transcript in duplicate of the student's undergraduate record and a single official transcript of graduate work, should be sent to the Graduate School at least four weeks before the opening of the quarter in which the student enters the Graduate School, together with a formal application for admission stating his major for graduate study.

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. At the time of the student's first registration in the Graduate School for more than 5 credits of work, he must report with his receipted fee statement to the Student's Health Service of the University of Minnesota for a physical examination.

## FEES

Tuition fees for residents (except in dentistry, pharmacy, clinical medicine) per quarter	
6 credits or less, or thesis only .....	\$19.00
More than 6 credits .....	38.00
Tuition fees for nonresidents per quarter	
6 credits or less, or thesis only .....	50.00
More than 6 credits .....	100.00
Incidental fee .....	18.85
Matriculation deposit (first quarter in residence) .....	3.00
Special deposit for chemistry laboratory .....	10.00
Graduation fee .....	10.00
Fee for binding Master's thesis .....	2.50
Fee for microfilming Ph.D. thesis .....	35.00

*Candidates for advanced degrees must pay not less than the full normal tuition for three quarters before receiving the degree.*

All Ph.D. candidates are required to register in the quarter in which their final oral examination is taken.

All the fees above mentioned apply to the regular session. For the Summer Session fees, see *Bulletin of the Summer Session*.

Registration blanks filled out by the student and approved by his ad-

viser and by the Graduate School office must be turned in at the Office of Admissions and Records to obtain a statement of fees before the close of the first week of each academic quarter. Fees must be paid not later than the close of the first week of each quarter. After the close of the first week of each quarter, the fee for the privilege of late registration, or late payment of fees, is \$2 through the third day of the following week; on the fourth day the fee is \$2.50 and then increases 50 cents per day to a maximum of \$5. For the dates when Summer Session fees are due, see the *Bulletin of the Summer Session*. See the *Bulletin of General Information* for estimates of living expenses.

### ATTENDANCE AT COMMENCEMENT

Candidates upon whom degrees are to be conferred are required to be present at commencement unless especially excused by the dean of the Graduate School.

### REQUIREMENTS FOR THE MASTER'S DEGREES

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

**Application for Admission to Candidacy**—Following the completion of 9 to 15 graduate credits, at least 3 of which must be in the major, the student who expects to obtain a Master's degree should apply for admission to candidacy for that degree on a blank secured from the Graduate School office. This application should be submitted as soon as a student has earned sufficient credits to be eligible for candidacy.

The application for candidacy will be reviewed by an appropriate committee normally from the major department, division, or college. This committee will recommend to the dean, through the appropriate graduate group committee, the acceptance or rejection of the application for candidacy. The dean or the reviewing committee may require any evidence pertinent to the consideration of the application.

### THE TWO PLANS FOR THE MASTER'S DEGREE

**Preliminary Statement**—It is assumed in the plans outlined below that the student who is adequately prepared and giving full time to study will, if he meets the requirements for quality in class, thesis, and final general examinations, complete the requirements for the Master's degree in one academic year\* or its equivalent in Summer Sessions. Those who lack adequate preparation, hold assistantships involving considerable service to the University, or who do other work in self-support will find

\* Certain programs for the Master's degree, including the program in social work, require more than one academic year.

§ 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 certain requirements in the College of Education and secure the approval of its dean at the outset of their program.

the period in residence proportionately lengthened. It is not usual for the ablest, sturdiest, and best-prepared students to absolve the requirements satisfactorily within one year, even when the departmental service is limited to three hours weekly in conducting quiz and discussion divisions of large elementary courses or ten hours weekly in laboratory supervision or its equivalent in reading quiz papers. Assistants must expect completion of the thesis and examinations to extend beyond the minimum one-year period. The same limitations apply to those who lack satisfactory command of spoken and written English or reading knowledge of those modern languages that are necessary tools in so many fields of graduate work.

In all courses *open to graduates only*, the student may receive a mark of "pass" or "satisfactory." This indicates the instructor's approval of the quality of the student's work on the graduate level. It signifies a letter grade of B at least. In courses open to both graduates and undergraduates the system of marking by letters is normally used. No graduate credit is allowed for course work of D quality.

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.

The student will indicate at the time of matriculation his intention to be a candidate for the Master's degree and choose the plan he proposes to follow. After admission to candidacy, he shall present either the title of his Master's thesis or his Plan B program, which must be approved by an adviser or committee acting for the major department and confirmed by the group committee in which the major department falls. Appropriate forms may be secured from the Graduate School. Before approving the student's choice of plan and his program, the adviser must receive from the student a statement of his undergraduate record and any additional credits.

#### PLAN A: THE MASTER'S DEGREE WITH THESIS

**Major and Minor Work**—In choosing a field for major or minor work, the candidate 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 department 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.

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 six years after the initiation of the degree program, except in social work where the time limit is eight years for the master of arts with a major in social work.

**Language Requirement**—Reading knowledge of a foreign language, modern or ancient, the language to be determined by the major depart-

ment, 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. Reading knowledge of French or German is normally expected. For further information, consult the Graduate School office and the major department. Blanks for making application for the language examination may be obtained in the Graduate School office. The candidate shall present to the dean of the Graduate School, not later than the close of the second quarter of residence, a certificate of proficiency in the designated language, signed by the professor in charge of the corresponding language department or his representative.

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 three years old when the student enters this Graduate School cannot be transferred.

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

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

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

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

**Master's Thesis**—Following admission to candidacy, the student shall submit the title of his thesis and a complete program of the work to be offered for the degree on a special blank secured at the Graduate School office. The thesis title must be approved by his adviser and by the corresponding group committee. It 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. One copy must be upon red-ruled twenty-pound linen stock of 75 per cent rag content and the

others may be carbon copies on bond paper. The original and first copy must contain all illustrative material. Ample margins should be left for binding purposes. Samples in the dean's office of the papers to be used should be examined before the thesis is typewritten. The body of the thesis should be double spaced, but footnotes may be single spaced.

The thesis must be finished, certified by the adviser as complete on a form secured in the Graduate School office, and must be registered in the office of the dean of the Graduate School *at least seven weeks* (for June commencement *eight 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 Graduate School. The student's adviser will, as a rule, be the chairman of this committee. Unanimous approval by this committee will be necessary for the acceptance of the thesis.

If the thesis is accepted, the candidate must pay to the bursar, *at least three weeks* (for June commencement *four weeks*) before commencement, two dollars and a half for binding the two copies of his thesis which will be cataloged 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. No special examination in the field of the minor is required, but this does not excuse the candidate from the regular course examinations. Besides the usual course examinations, where such are given, the candidate for the Master's degree must pass a final written examination in the major and, after acceptance of the thesis, a final oral examination.

The final written examination will be held *not later than four weeks* (for June commencement *five weeks*) before the end of the quarter in which he takes his degree. It will cover the work of the candidate in the field of the major, and may include any work fundamental thereto. This examination will be held by his instructors in the major department, the adviser acting as chairman.

If the final written examination is satisfactory and the thesis accepted, and any language requirement absolved, the final oral examination of the candidate will be held *not later than four weeks* (for June commencement *five weeks*) before the end of the quarter in which he takes his degree. The thesis committee, with the adviser as chairman, conducts the oral examination. The chairman may invite to the examination any instructors with whom the candidate has had work. The head or chairman of the department in which the major work is done is an ex-officio member of the committee. Any member of the graduate faculty may attend as a visitor. The final oral examination (normally of not more than one hour's duration) will cover all the work offered for the degree, and may include other work fundamental thereto. At the close of the examination, the committee will vote upon the candidate, taking into account all of his work. 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.

See tabular summary of requirements for the Master's degree with thesis below:

Requirements	Under the Direction of	Date
Program, major and minor	Adviser and dean of the Graduate School	On entrance
Approval of candidacy	Committee, normally from the major department, division, or college, and dean	After completion of 9 to 15 credits
Approval of thesis subject	Adviser and group committee	After approval of candidacy for degree
Language requirement	Adviser and language department	Before close of second quarter
Registering of thesis	Graduate School office	Seven weeks before graduation (in June eight weeks)*
Approval of thesis	Thesis committee	Before admission to final oral examination
Final written examination in major	Major department members of the graduate faculty	Not later than four weeks before commencement and before final oral examination (in June five weeks)
Final oral examination on all work	Committee	Not later than four weeks before commencement (in June five weeks)
Filing of thesis	Graduate School office	Not later than four weeks before commencement (in June five weeks)
Graduation fee and fee for binding thesis	Office of Admissions and Records	Not later than four weeks before commencement

Candidates eligible for the "preliminary examination" for the Doctor's degree may substitute this examination for the final oral examination for the Master's degree, if all other requirements for the preliminary examination (see page 18) have been met.

**Reports**—Special blanks are provided for signed reports concerning the thesis and the final oral examinations. All reports must be filed in the office of the dean of the Graduate School *four weeks* (in June *five*) before the end of the last quarter.

Candidates meeting the requirements outlined above will be reported by the dean to the Executive Committee of the Graduate School, who will by vote recommend to the Board of Regents those approved for degrees.

#### PLAN B: THE MASTER'S DEGREE WITHOUT THESIS

The requirements under this plan in matters of admission, residence, transfer of credits from other institutions, 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 also 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 20.) While it does not permit an indiscriminate scattering of courses over unrelated departments, it does not stress concentration on one major and one minor field. It is understood that more than one field will be included outside

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

the field of concentration. Programs that simply represent more hours distributed between a major and a minor will be especially scrutinized by the graduate group committee. Insofar as it has a professional aspect, the Master's degree under Plan B is less a test of research interest and more adapted to teachers or school administrators who will profit by a broader range of knowledge in the fields they teach or supervise. 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. Transfer from one plan to the other may be made with the approval of the adviser or the major department committee supervising the student's work.

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, and not more than 27, of the 45 credit hours should be in a single field of concentration. Not less than 18 of the 45 credits should be offered in at least two related fields. At least 9 quarter credits either in the field of concentration or in related fields must be in advanced courses, courses identified in this bulletin by an asterisk, seminars, or independent work under faculty supervision and requiring the preparation of written reports representing the quality but not the range of the Master's thesis.

All requirements for the Master's degree under Plan B must be completed within seven years after the initiation of the degree program, except in social work where the time limit is nine years for the master of arts with a major in social work and seven years for the degree of master of social work.

The student's program, recorded on a blank provided by the Graduate School, shall be approved by a major adviser and shall be submitted following admission to candidacy and before the final quarter or final summer term. The program will be reviewed by the appropriate group committee. Intelligent planning of the student's program requires that he present to his adviser a statement of all college work completed with credit. In planning the student's program the adviser should not include in "related fields" any course from the field of concentration.

Under this plan the graduate group committee in charge of his field of concentration shall appoint a committee of not less than three to test each candidate by oral or written examination or both. The adviser will make available to the examining committee for their review the papers prepared in starred courses to fulfill the requirement of nine hours of independent work. At their option the group committee may call for and examine these written reports submitted to meet the nine-hour requirement.

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

See tabular summary of requirements for the Master's degree without thesis, below:

Requirements	Under the Direction of	Date
Program, major, and related fields .....	Adviser and dean of the Graduate School .....	On entrance
Approval of candidacy .....	Committee, normally from the major department, division, or college, and dean .....	After completion of 9 to 15 credits
Filing program of all graduate work, with credits showing field of concentration, etc. ....	Adviser and group committee .....	Following approval for candidacy and before final quarter or summer term
Language requirement .....	Adviser and language department .....	Before close of second quarter
Final examinations, written or oral or both .....	Adviser and committee .....	Not later than four weeks before commencement (in June five weeks)
Graduation fee .....	Office of Admissions and Records .....	Not later than four weeks before commencement

### REQUIREMENTS FOR THE DOCTOR'S DEGREE

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

Candidates for the Doctor's degree must spend at least three years<sup>§</sup> of graduate study in approved subjects. The first two years or the last year must be spent in residence at the University of Minnesota.

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

#### PROGRAM OF STUDY

**First Year**—Upon entrance to the Graduate School, the student shall select his adviser with the approval of the dean. With his adviser's approval he shall submit to the dean a program covering the work of the first quarter.

**Second and Third Years**—Before beginning the work of the second year, the student shall secure from the Graduate School office the doctoral program blank in triplicate. On this blank he must submit to his adviser, his minor department, the group committee, and the dean, for approval, a complete statement of all work to be offered for the degree:

<sup>§</sup> This time requirement will be met in three years only by students who devote full time to graduate study. Students who devote to graduate study the intervals between periods of professional or other regular employment will need to extend their total period of work over a longer time. Residence credit for such work will be given in proportion to the amount of graduate work completed.

(1) a list of all courses already completed in the major and minor, (2) an outline of proposed additional course work in the major and minor, (3) courses offered as a collateral field or a special research technique when one of these has been approved as a substitute for a foreign language, (4) a detailed list of graduate courses taken elsewhere if the candidate wishes to present such work toward the Ph.D. degree from the University of Minnesota. Transfer of credit from other institutions will be considered in acting on the doctoral program; no petition for transfer is necessary. Transfers of credit toward the Ph.D. will not become final and official until the student has passed his preliminary examination. The student shall also file with his adviser's approval the title of his Doctor's dissertation on a blank that he obtains in the Graduate School office.

#### LANGUAGE REQUIREMENTS

The following regulations are effective for all new Ph.D. candidates and for all other Ph.D. candidates who can comply with them. The reading knowledge of one foreign language is always required.

#### General Regulations

1. The Ph.D. candidate shall, with the approval of his major adviser, file in the Graduate School office by the end of the second quarter of his Ph.D. program his plans for meeting the requirements of the foreign language and the research technique or the collateral field of knowledge. Graduate School Form 79 for this purpose is available in the Graduate School office. The second quarter of the Ph.D. program is the second quarter in residence after completion of the M.A. or M.S. degree, or its credit equivalent in those cases where the individual proceeds directly toward Ph.D. candidacy.

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

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

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

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

approved institutions are transferable to the Minnesota record in accordance with existing regulations governing transfer of credits for the Ph.D. degree.

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

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

8. In no case may the special research technique subject or the collateral field of knowledge be one that has regularly or traditionally been included in the major or minor fields of study of similar candidates in the past. The special research technique subject should represent the acquisition of any special skill that will effectively contribute to the research proficiency of the candidate. The collateral field of knowledge is expected to broaden the candidate's scholarly and scientific background by permitting exploration of knowledge in fields related to the major and minor. The collateral field of knowledge may include in this sense any work now available or to be developed in the preparation for college teaching, including supervised instruction at the college level.

9. The burden of proof of the significance or relevance of options other than the foreign language rests upon the candidate and his major adviser. The group committee under whose jurisdiction the major field falls shall review the recommendations of the major adviser and in turn recommend action to the dean of the Graduate School.

10. The foreign languages in which proficiency may be demonstrated are: German, French, Spanish, Italian, Portuguese, the Scandinavian languages, the Oriental languages, Russian, Greek, or Latin.

11. A special research technique is defined as not less than 9 credits in approved Senior College or graduate courses, completed with a grade not lower than C.

12. A collateral field of knowledge is defined as not less than 15 credits of work in courses numbered above 99, completed with a grade not lower than C.

### Major Field Requirements

1. Departments or major fields requiring two foreign languages, one of which must be German:

Agricultural Biochemistry	Chemistry, Inorganic	Geography
Biological Science	Chemistry, Organic	Pharmacognosy
Botany	Chemistry, Physical	Philosophy
Chemical Engineering	Civil Engineering	Physics
Chemistry, Analytical	Entomology and Economic Zoology	Zoology

2. Departments or major fields requiring two foreign languages without further specification:

American Studies	English	Mathematics and Mechanics
Anthropology	German	Physiological Chemistry
Applied Plant Physiology	History	Physiological Hygiene
Art	Linguistics and Comparative Philology	Plant Pathology and Agricultural Botany
Classics	Mathematics	Romance Languages
Comparative Literature		

3. Departments or major fields permitting the fulfillment of the requirements by (a) two foreign languages or (b) one foreign language and the option of a collateral field of knowledge:

Anatomy	Internal Medicine	Pediatrics
Bacteriology	Neurology and Psychiatry	Pharmacology
Biochemistry	Obstetrics and Gynecology	Physical Medicine
Biophysics	Ophthalmology and Otolaryngology	Physiology
Cancer Biology	Pathology	Public Health
Dentistry		Radiology
		Surgery

4. Departments or major fields permitting the fulfillment of the requirements by (a) two foreign languages or (b) one foreign language and the option of a special research technique:

Economics and Business Administration	Geology	Metallurgy
Electrical Engineering	Mechanical Engineering	Pharmaceutical Chemistry
	Metallography	Speech
		Statistics

5. Departments or major fields permitting the fulfillment of the requirements by (a) two foreign languages or (b) one foreign language and the option of either a special research technique or a collateral field of knowledge:

Aeronautical Engineering	Educational Administration	Political Science
Agricultural Economics	Educational Psychology	Poultry Husbandry
Agronomy	Forestry	Psychology
Animal Husbandry	Home Economics	Social Science
Biostatistics	Horticulture	Social Work
Child Welfare	Journalism	Sociology
Dairy Husbandry	Music	Soils
Education	Plant Genetics	Speech Pathology
		Veterinary Medicine

#### THE MAJOR WORK

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

While working for the Doctor's degree, a student shall spend at least two thirds of his time on the major subject, including work on the thesis. Distribution of time is based on a week of 15 credit hours.

#### THE MINOR WORK

The minor work must be selected in a department in which the student is prepared to pursue courses included in the group designated "for undergraduate and graduate students," and numbered above 99.

The minor must be in a department the work of which can be logically related to that of the department in which the student is doing his major work.

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 or in two related departments.

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

## DOCTOR'S THESIS

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

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

The thesis\* must be typewritten in quadruplicate, to facilitate reading by the thesis committee. When it has been certified by the adviser as complete on a form to be secured in the Graduate School office, the thesis must be registered in the dean's office and four copies distributed to the thesis committee *not later than seven weeks* (for June commencement *eight weeks*) before the commencement at which the candidate expects to receive the degree.

The thesis will be examined by a committee of not less than four, appointed by the Graduate School. The student's adviser will as a rule be chairman of this committee. Unanimous approval of the thesis by the committee is necessary, and the chairman of the committee will report the results to the Graduate School office.

When he submits his *thesis report form* and *final oral examination report*, the candidate will sign in triplicate 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 \$35. If he wishes his thesis to be copyrighted he will pay an additional \$5 plus 1¼ cents per page for two positive microfilm copies of his thesis, which will be deposited in the Library of Congress.

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

Each candidate for the Doctor's degree shall submit with the bound copies of his thesis an abstract of about 600 words, approved by his adviser, embodying the principal findings of the research. Such abstracts will be published in *Microfilm Abstracts*, which announces the availability of the thesis for distribution.

## PUBLICATION OF THESES

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

## EXAMINATIONS

**Written Examination**—A written examination in the major subject shall be given by the graduate faculty in the major department prior either to the preliminary or to the final examination or to both, as the

\* Instructions for typing and registration of the thesis may be obtained in the Graduate School office.

department may decide. This examination shall cover all the work done in the major, and *may include any work fundamental thereto*.

**Preliminary Examination**—At least seven months before the degree is conferred, following the completion of the minor and the language requirements, a preliminary examination of the student shall be given by the thesis committee plus at least two members appointed by the dean. The student's adviser will act as chairman. The chairman or head of the major department is *ex officio* a member of any examining committee for an advanced degree. This committee must not be fewer than six, of whom five shall constitute a quorum. To pass the preliminary examination requires a two-thirds affirmative vote of the examining committee with a minimum of four affirmative votes. The examination shall cover the graduate work taken by the student, and *may include any work fundamental thereto*, except the thesis and the special field reserved for the final examination. This examination shall be in addition to the usual course examinations. Only after passing this examination may the student be enrolled as a candidate for the Doctor's degree. Students failing this preliminary examination may be excluded from candidacy for the degree and in any case shall not be re-examined until at least one quarter has passed. Preliminary examinations will not be given during the period of final examination for the June commencement—normally from about April 8 to May 6—or during the second term of the Summer Session. They must be scheduled in the office of the Graduate School one week in advance.

**Final Oral Examination**—After successful completion of the written examinations and acceptance of the thesis and *not less than four weeks* (for June commencement *five weeks*) before graduation, the final oral examination shall be given. This examination shall be conducted by a committee consisting of the adviser as chairman, the members of the thesis committee, and at least two other members of the graduate faculty appointed by the dean. At least one member of this committee shall represent the University outside the major and minor fields of the student. This examination covers the thesis and the field of the candidate's special studies and shall not exceed three hours. The final oral examination must be scheduled in the office of the Graduate School *one week* in advance.

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, and a unanimous affirmative vote of the members shall be necessary for recommendation of the candidate for the degree. The chairman of the committee will then report the result of the vote to the Graduate School office.

All Ph.D. candidates are required to register in the quarter in which their final oral examination is taken.

**Reports**—Special blanks are provided for signed reports on the preliminary examination, the thesis, and the final oral examination. The thesis and final oral reports must be filed in the office of the dean of the Graduate School *at least four weeks* (for June commencement *five weeks*) before graduation.

Candidates meeting the requirements as above outlined will be reported by the dean to the Executive Committee of the graduate faculty,

who will by vote recommend to the Board of Regents those approved for degrees.

#### TABULAR SUMMARY OF REQUIREMENTS FOR THE DOCTOR'S DEGREE

Requirements	Under the Direction of	Date
<b>First Year</b>		
Selection of major .....	Adviser and dean of Graduate School	
Selection of minor .....		
<b>Second Year</b>		
Doctoral program .....	Adviser, minor department, appropriate graduate committee, and dean of Graduate School .....	Before beginning work of second year
Thesis title .....	Adviser, appropriate graduate committee, and dean of Graduate School .....	Before admission to preliminary examination
Completion of minor .....	Course instructors .....	Before admission to preliminary examination
Language requirement .....	Adviser and language departments .....	Before admission to preliminary examination
Written examination .....	Graduate faculty of the major department .....	Before preliminary oral or before the final oral examination or both
Preliminary examination, oral .....	Committee .....	At least seven months before degree is to be conferred
<b>Third Year</b>		
Filing of completed thesis certified by adviser .....	Graduate School office .....	Seven weeks before graduation (in June eight weeks)*
Approval of thesis .....	Thesis committee .....	Before admission to final oral examination
Final oral examination .....	Committee .....	Not later than four weeks before commencement (in June five weeks)
Two bound copies, abstract of thesis, and payment of \$35 for microfilming thesis .....	Graduate School office .....	Not later than four weeks before commencement (in June five weeks)*
Release card .....	Graduate School office .....	Not later than four weeks before commencement (in June five weeks)
Graduation fee .....	Office of Admissions and Records .....	Not later than four weeks before commencement

#### GRADUATE WORK IN THE SUMMER SESSION

Graduate work in many fields of special interest to teachers is open in the Summer Session. Students interested in graduate summer study for purposes other than teaching will find offerings in such fields as agriculture, home economics, child welfare, and economics, as well as in the College of Science, Literature, and the Arts, the College of Education, and the Institute of Technology. Announcement of these courses may be found in the *Bulletin of the Summer Session*.

Students who desire graduate credit for work in the summer must register through the office of the Graduate School. If not previously admitted they must apply at least four weeks in advance of the summer term they wish to enter.

Work of graduate character done in the Summer Session of the University of Minnesota may be counted for residence credit for the Master's

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

degree, except in the case of candidates for the master of science with field named in a clinical branch of medicine. Candidates for these degrees are required to spend a minimum of nine *academic* quarters in residence.

A limited amount of graduate work done in the Summer Session may be counted for residence credit for the doctoral degree, except in the case of candidates for the doctor of philosophy with field named in a clinical branch of medicine. Candidates for these degrees are required to spend a minimum of nine *academic* quarters in residence.

#### MASTER'S DEGREE, PLAN A

*Course work* for the Master's degree, Plan A (see page 8), may be completed in four summer terms of six weeks each. The candidate may be permitted to register for thesis and carry *in absentia* thesis work to complete the equivalent of three quarters. All requirements for the Master's degree under Plan A must be completed within six years after initiation of the degree program except in social work where the time limit is eight years for the master of arts with a major in social work. Students working for the Master's degree under Plan A in summer terms must secure approval of candidacy after earning from nine to fifteen quarter credits and must file the subjects of their theses before completion of the first half of the required work. Theses of Summer Session students must be completed at least *eight weeks* before the end of the session in which they take the degree. (See page 9.)

#### MASTER'S DEGREE, PLAN B

All requirements for Plan B may be completed in six summer terms of six weeks each and must be completed within seven years following the initiation of the degree program except in social work where the time limit is nine years for the master of arts with a major in social work and seven years for the degree of master of social work. (See page 11.)

### GRADUATE PROGRAM IN AMERICAN STUDIES

The program in American Studies at the University of Minnesota is based on the proposition that a sound knowledge of the civilization of the United States, in its relations both to its own regions and to its neighbors throughout the world, contributes to human understanding and to the eventual achievement of world peace.

The program is designed for teachers (in the fields of history, literature, the fine arts, and the social sciences), journalists and creative writers, librarians, social workers, and public servants. An interdepartmental curriculum in this field leads to the degrees of M.A. and Ph.D. The prerequisite for graduate work in American Studies is an undergraduate major in one of the departments concerned, an undergraduate major in American Studies, or other preparation which the Committee on American Studies considers adequate.

Candidates for the M.A. degree distribute their courses among four fields: history, literature, fine arts and philosophy, social sciences. Candidates for the Ph.D. degree study foreign civilization in addition to the four fields just named.

For the bulletin of the Program in American Studies and other information, address the Chairman of the Program in American Studies, 101 Temporary South of Folwell, University of Minnesota.

For course descriptions, see page 46.

### GRADUATE PROGRAM IN COMPARATIVE LITERATURE

Committee: Professors Norman J. DeWitt (Classics), Chairman, Huntington Brown (English), Alrik Gustafson (Scandinavian); Associate Professor Frank H. Wood (German); Assistant Professor Guy Desgranges (Romance Languages).

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, although it has no formal department of comparative literature, 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 departments.

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 a career in teaching literature and the humanities in general, to writing, to criticism, translating, or editorial work.

**Language Requirement**—Applicants for admission to this program will be expected to pass, during the first quarter of residence, a special sight-reading examination in two foreign languages. These examinations will be administered by the foreign language departments, and will require a level of achievement above that necessary for the use of language as a tool for research.

**General Literature Requirement**—Each applicant will designate, in his initial proposal, three or more languages, the literatures of which will form the core of his study. He must have sufficient linguistic competence to deal with two of these literatures in their original language. The third and any additional literatures he may offer in translation.

**Special Field**—Each applicant will also designate in his proposal a special field of study for which a logical case can be presented in the light of his linguistic preparation. For instance, this field may be either a chronological period or a literary type, such as: the Renaissance, the Age of Reason, Romanticism, the Late Nineteenth and Twentieth Centuries, Drama, Fiction, Poetry, Literary Criticism, etc.

The designated special field will be that of the thesis or (in the case of candidates for the M.A. under Plan B) the focus of the program. The program may include some work in relevant fields (history, philosophy, art, etc.) and must fulfill the general requirements of the Graduate

School, including that of a minor field. A listing of courses approved for programs in the several special fields may be secured from committee members (listed above) or from the departmental offices.

**Minor Field**—One of the three literatures designated for the student's program, together with its related language, shall be regarded as a minor.

**Advisory Committee**—When the plan of study presented to the Committee on the Program in Comparative Literature is approved by it and by the group committee of the Graduate School, the student will proceed in the regular manner toward the degree (as described elsewhere in this Bulletin).

**Comparative Literature as a Minor for the Ph.D. Degree**—A candidate for the Ph.D. degree in any of the cooperating departments may offer comparative literature as a minor on condition (1) that he fulfill the language requirement as stated above, (2) that he designate two literatures other than his major, one of them involving reading on the level specified for the language requirement, and (3) that he designate a special field of study as defined above.

### GRADUATE WORK IN DENTISTRY

Graduate work in dentistry is offered to meet the need in two areas: preparation of qualified teachers and investigators in the various branches of dentistry and preparation of fully trained specialists for the various fields of dentistry. The course of study leads to the degree of M.S. in dentistry, a combination of the conventional work for the master of science degree plus achievement of proficiency in some phase of clinical dentistry. Applicants must be graduates of accredited schools of dentistry who have achieved superior scholastic records both in pre-dental and dental requirements. They must also present or acquire sufficient training in the basic sciences, such as bacteriology, anatomy, pathology, physiology, and physiological chemistry, to enable them to apply these disciplines to research in some of the problems facing dentistry as one of the health sciences. Minimum training to meet this requirement at the University of Minnesota is in general the equivalent of that required of graduate students in the fields of clinical medicine. Basic science courses necessary as a foundation for advanced study are outlined under the departmental offerings in the *Graduate Medical Bulletin*. When full time is devoted to study, two to three years in residence are needed to complete the program for the master of science in dentistry degree. Although a reading knowledge of German is recommended as highly desirable, candidates for the Master's degree in dentistry are exempted from the foreign language requirement.

### GRADUATE WORK IN FOOD TECHNOLOGY

Committee: Professors William F. Geddes (Agricultural Biochemistry), Chairman, Ancel B. Keys (Physiological Hygiene), Harold Macy (Dairy Bacteriology), Edgar L. Piret (Chemical Engineering), James D. Winter (Horticulture).

Through an all-university committee, the various colleges of the University are cooperating to provide an integrated program of teaching and research that will meet the diversified needs of the many academic

and industrial fields in which a knowledge of food technology and of the underlying fundamental sciences is required.

Graduate study in food technology, leading to the M.S. degree, is offered under Plan A or Plan B to qualified students who have a broad background in basic and applied sciences substantially equivalent to that required for the B.S. degree in food technology. (See Announcement of Courses for the years 1951-53 in the *Bulletin of the College of Agriculture, Forestry, Home Economics, and Veterinary Medicine*, pages 29-30.) The course and research programs of graduate students in this field will be arranged by the committee in accordance with their special interests and the general requirements for the M.S. degree.

### INTERNATIONAL RELATIONS AND AREA STUDIES

Candidates for graduate degrees may, in consultation with advisers, plan interdepartmental programs in international relations or area studies. General regulations of the Graduate School for admission and graduation apply, except that an equivalent program will replace the normal major and minor requirement. The following programs are available.

**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:** Professors Jan O. M. Broek (Geography), Harold C. Deutsch (History), Werner Levi (Political Science), Harold S. Quigley (Political Science); Associate Professor Charles H. McLaughlin (Political Science).

**Prerequisites**—Ordinarily an undergraduate major in international relations, an area study, or one of the social sciences. 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.

**Language Requirement**—For the M.A. degree a reading knowledge of either French or German. For the Ph.D. degree a reading knowledge of both French and 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 field 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, and philoso-

phy. At least 6 credits should be in seminars, proseminars, or readings courses.

**PLAN B.** Students will present a minimum of 45 credits of graduate course work, including a field 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, and philosophy. At least nine 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 three 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 fields of study, ordinarily completing a minimum of 12 credits in graduate courses or seminars in each field, including in each case at least 3 credits in a seminar or course based upon individually assigned reading or research. The six fields should be distributed among not less than three social science departments and may include one or two fields in journalism, art, language and literature, philosophy, or humanities. An area of concentration consisting of two fields within a single social science department shall be included. Definition of fields 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

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: Scandinavia, Western and Central Europe, Russia, East and South Asia, Latin America.

Advisers: Scandinavia, Professor Alrik Gustafson (Scandinavian); Western and Central Europe, Professor Lawrence D. Steefel (History); Russia, Professor Lowry Nelson (Sociology); East and South Asia, Professor Jan O. M. Broek (Geography); Latin America, Professor Raymond L. Grismer (Romance Languages). In addition to these advisers, who are the chairmen of the area committees, students may consult any other member of a committee whose field of specialization corresponds with the student's field of interest. For committee lists see the special bulletin, *Programs in International Relations and Area Studies*.

**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. No specific prerequisite in foreign languages is imposed, but a working knowledge of one or more languages appropriate to the area chosen is considered especially important.

**Programs 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 fields, including the social sciences, literature, art, 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, 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.

**Programs for the Ph.D. Degree**—It is not at present recommended that candidates for the Ph.D. degree 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. 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: Professors Harold S. Quigley, Asher N. Christensen; Associate Professor Charles H. McLaughlin (Political Science).

A specific graduate major in preparation for the Foreign Service is not offered, but candidates for a graduate degree may obtain much of the instruction usually recommended for this purpose as a part of an international relations or an area major, or may take some relevant work in conjunction with a departmental major. They may also undertake training for the Foreign Service without candidacy for a graduate degree.

#### INTELLIGENCE RESEARCH TRAINING PROGRAM

Adviser: Professor Tom B. Jones (History).

The University inaugurated in 1951 a program designed to provide basic training in intelligence research at the graduate level. Candidates for the M.A. or Ph.D. degrees may combine this training with a graduate major in area studies or international relations, or one of the social science majors. Certificates of proficiency in intelligence research will be awarded to students who successfully complete the prescribed work. Two years of graduate study are usually required to complete the program in conjunction with an M.A. degree. Foreign language competency, research skill and command of methods, and area specialization are stressed.

Those admitted to the program must be able graduate students with a genuine motivation toward careers in intelligence research or related work. They will be expected to have satisfactory reading knowledge of at least one foreign language and a reasonable familiarity with the cultural area chosen for specialization. They should also have completed undergraduate courses in statistics and cartography, but in appropriate

cases deficiencies in these skills may be removed during the first year of training.

Programs must be planned in consultation with the adviser. They will consist in general of a foreign area study, or a combination of area training with a major in a social science discipline. In addition the program will include the following required courses:

1. Library Instruction 62, 63, 164. **Reference I, II, III.** 7 cred.
2. 9 credits of seminar work in the major field.
3. I.R.T. 200-201-202. **Intelligence Research Training Seminar.** Prereq.: registration in the intelligence research training program and permission. 9 cred. 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 Supplement to the special bulletin, *Programs in International Relations and Area Studies*.

### GRADUATE WORK IN MEDICINE

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

### GRADUATE WORK IN 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 staff 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. They 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 staff. All candidates, however, must enroll in the graduate seminar in public administration. Candidates for the degree under Plan A must receive a grade of B or better in at least two thirds of their course work and a grade not lower than C in all other courses offered for the degree.

**Internships**—Internships in appropriate governmental departments or agencies—national, state, or local—will be arranged for students who desire them.

**Other Requirements**—Candidates for this degree must have a reading knowledge of a foreign language or a working knowledge of the principles of governmental accounting or statistics. A foreign language is recommended for those who expect to do further graduate study.

**Examinations**—All candidates will be required to pass a final comprehensive written examination in public administration and a final oral examination covering all course work offered for the degree and the thesis.

Advanced graduate students who wish to major in public administration with a view to teaching or government service are advised to become candidates for the doctorate in political science, with public administration as the field of specialization 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 Director of the Public Administration Center, 354 Ford Hall, University of Minnesota, Minneapolis 14, Minnesota.

## GRADUATE WORK IN STATISTICS

The Graduate School has authorized a program of study leading to the Master's degree and to the degree of doctor of philosophy with a major in statistics and, for the Ph.D., has also authorized a minor in this field in association with a major in some other area. A special faculty committee on Ph.D. programs in statistics has been appointed: Professors W. L. Hart, W. W. Cochrane, L. Hurwicz, P. O. Johnson, A. E. Treloar.

**Prerequisites**—Candidates for an advanced degree with the major in statistics are expected to present differential and integral calculus.

### MAJOR IN STATISTICS—MASTER OF ARTS

Either Plan A or Plan B may be followed. When Plan A is chosen, the major shall be in statistics and the minor in mathematics or in some field of application. Under Plan B, the field of concentration may be statistics or statistics and mathematics, with the related fields selected from the several fields of application, or from mathematics, or from the several fields of application and mathematics.

**Approval of Program**—Programs of study for these degrees are supervised by the Committee on Statistics.

**Language Requirement**—There is no language requirement under either plan except as recommended in special cases by the student's adviser and approved by the Committee on Statistics.

## MAJOR IN STATISTICS—DOCTOR OF PHILOSOPHY

**Major**—The course work for the major should normally be chosen from the courses listed below, including additions to this list made in the future by the Committee on Statistics. The minimum requirements shall in any case include the following courses in mathematics now given in the College of Science, Literature, and the Arts, or their equivalent: Mathematics 107-108, Advanced Calculus; Mathematics 121-122-123, Mathematical Theory of Statistics.

**Minor**—The minor should normally be chosen from a subject-matter field in which the candidate expects to apply his statistical theory.

**Approval of Program**—The candidate's tentative program will be planned with the aid of that adviser selected from the committee named above who is most closely associated with the subject-matter field in which the minor work is taken. The committee will consider this program, will nominate a thesis committee for the candidate, and will refer these recommendations to the Graduate School.

**Language Requirement**—A reading knowledge of two foreign languages or a reading knowledge of one foreign language and a special research technique will satisfy this requirement.

## MINOR IN STATISTICS—DOCTOR OF PHILOSOPHY

The candidate for a minor in statistics must not assume that an arbitrary selection of courses from the following list will satisfy the minor requirements. The minor program should be planned in advance with an adviser from the committee listed above.

Mathematics		Credits
Math. 106	Differential Equations .....	3
Math. 107-108	Advanced Calculus .....	6
Math. 118	Vector Analysis .....	3
Math. 119-120	Matrices and Groups .....	6
Math. 121-122-123	Mathematical Theory of Statistics .....	9
Math. 131	Advanced Algebraic Theory .....	3
Math. 144-145-146	Fourier Series and Orthogonal Functions .....	9
Math. 203-204-205	Advanced Mathematical Statistics .....	9
Math. 206-207-208	Theory of Functions .....	9
Math. 258-259-260	Theory of Probability .....	9
M.&M. 132-133-134	Industrial Statistics .....	9
M.&M. 190-191-192	Problem Seminar .....	9
Statistics		
P.H. 110	Biometrics Principles .....	3
P.H. 111	Biostatistics Laboratory .....	2
P.H. 120	Advanced Biostatistics I .....	3
P.H. 121	Advanced Biostatistics Laboratory I .....	2
P.H. 130	Random Sampling Distributions .....	3
P.H. 131	Advanced Biostatistics Laboratory II .....	2
P.H. 140	Vital Statistics I .....	3
P.H. 150	Vital Statistics II .....	3
P.H. 200	Research in Biostatistics .....	Ar.
P.H. 210	Seminar in Biostatistics .....	Ar.
Bus.Adm. 112	Business Statistics .....	3
Bus.Adm. 119	Correlation .....	3
Bus.Adm. 120	Index Numbers .....	3
Bus.Adm. 180F-181F-182F	Senior Topics—Statistics .....	9
Agr.Econ. 191	Advanced Agricultural Statistics .....	3
Econ. 121-122-123	Theory of Statistics .....	9
Ed.Psy. 208	Methods in Educational Research .....	3
Ed.Psy. 216-217-218	Statistical Methods in Education .....	9
Ed.Psy. 218a-217a-218a	Statistical Methods in Education—Laboratory .....	6
Ed.Psy. 219	Design and Analysis of Statistical Investigations .....	3
Ed.Psy. 243	Problems in Statistics .....	Ar.
Fl.Gen. 248	Applied Statistics .....	3
Soc. 122	Statistical Methods .....	3

## FINANCIAL AIDS

A large proportion 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 *Graduate Medical Bulletin*.

## ASSISTANTSHIPS

Approximately 1,420 teaching and research assistantships are offered through the various colleges, divisions, and departments of the University. Holders pay tuition at the resident rate.

Stipends for these appointments vary from \$607.50 for 25 per cent of full-time service to \$1,215 for half-time service for the academic year, to \$1,620 for half-time service for the twelve-month period. The amount of graduate work that can be carried is proportionate to the service burden of the assistantship.

**Administrative and clinical fellowships** (not rigidly restricted as to major field of study) are available in the Graduate School office, the Social Science Research Center, Radio Station KUOM, the Office of Admissions and Records, the Student Unions, and the bureaus of the Office of the Dean of Students: the Counseling Bureau, the Bureau of Student Loans and Scholarships, the Student Activities Bureau, the Bureau of Veterans' Affairs, and the Foreign Student Adviser's Office. Holders of these fellowships will pay tuition at the resident rate.

Applications are due February 15 of each year unless specifically stated otherwise for appointments covering the ensuing academic year. Requests for further information and for application blanks may be addressed either to the dean of the Graduate School or to the head of the department in question, but all application blanks should be returned to the head of the department appointing the assistant.

In the University dormitories personnel assistantships, providing board and room are available to men and women interested in developing skills and understanding in counseling. Application blanks may be obtained from the directors of dormitories or from the Office of the Dean of Students, 200 Eddy Hall, University of Minnesota, Minneapolis 14, Minnesota. Applications must be filed on or before July 1 for all part-time counseling positions in the residence units.

## FELLOWSHIPS

Unless otherwise stipulated recipients pay fees at the resident rate.

*Open Only to Graduates of the University of Minnesota*

Applicants for these fellowships may apply concurrently for tuition scholarships.

**Albert Howard Fellowship**—A stipend of \$240 awarded in years when the funds suffice to graduates of the College of Science, Literature, and the Arts of the University of Minnesota. The holder is expected to do graduate work in liberal arts.

**Alexander P. Anderson and Lydia Anderson Summer Fellowships**—Two fellowships of \$350 each in botanical and zoological science.

**Minnesota State Pharmaceutical Association Fellowship**—A stipend of \$500 open to qualified graduates of the College of Pharmacy of the University of Minnesota. Applications should be made on or before March 1.

**Class of 1890 Fellowship**—A stipend of approximately \$250 open, whenever sufficient funds have accumulated, to a graduate of the College of Science, Literature, and the Arts, the College of Engineering, or the School of Architecture.

*Open to Qualified Graduates of Any College or University*

**Foreign Student Tuition Scholarships**—Forty scholarships open in any department or college to qualified foreign graduate and undergraduate students. Applications should be sent by March 15 to the Office of the Foreign Student Adviser, 302 Eddy Hall, University of Minnesota, Minneapolis 14, Minnesota.

**Grace Ellis Ford Fellowship of the Minneapolis Branch of the American Association of University Women**—A stipend of \$900 open in alternate years to a graduate woman student without restriction as to major field. Offered for 1952-53. The recipient may be granted a tuition scholarship upon demonstration of need.

**Minnesota State Division of the American Association of University Women Fellowship**—A stipend of \$1,200 open in alternate years to a graduate woman student without restriction as to major field. Offered for 1953-54. The recipient may be granted a tuition scholarship upon demonstration of need.

**Norwegian-American Graduate Fellowships**—A limited number of these fellowships are open to qualified graduate students from Norway. Stipend is \$750.

**Shevlin Fellowship**—A stipend of \$1,000 offered in rotation in the College of Agriculture, Forestry, Home Economics, and Veterinary Medicine, the College of Science, Literature and the Arts, the School of Chemistry, and the Medical School. Each of these colleges offers the fellowship once in four years. Offered in the College of Science, Literature, and the Arts for 1952-53. The applicant may apply concurrently for a tuition scholarship.

**Minneapolis Woman's Club Fellowship**—A stipend of \$750 available every second year to a woman student, without restriction as to field, stage of progress in graduate work, or geographical origin, and with emphasis upon high scholarship and qualities of outstanding leadership and initiative. Offered for 1952-53. The recipient may be granted a tuition scholarship upon demonstration of need.

**Greater University Graduate Fellowships**—Stipends of \$1,200 open to students in all areas of graduate study. Additional allowance for tuition.

**Caleb Dorr Research Fellowship**—A \$500 stipend available in the College of Agriculture, Forestry, Home Economics, and Veterinary Medicine, awarded on the basis of scholarship and the prospect of productive research. Caleb Dorr fellows will devote their entire time to the graduate work for which they are registered, and may not engage in private tutoring or be required to render any service to the University. The recipient may be granted a tuition scholarship upon demonstration of need.

**F. H. Peavey, Van Dusen-Harrington Scholarship**—Open to an outstanding student—American or foreign—this stipend of \$1,000 is available for graduate work in the College of Agriculture, Forestry, Home Economics, and Veterinary Medicine.

**Hill Foundation Research Assistantships**—Two stipends of \$1,620 for twelve months' research in speech pathology.

**Hormel Institute Fellowships**—Two fellowships at \$1,200 for a twelve-month period available to students interested in research that would have value for Hormel Institute projects.

**American Creosoting Company Fellowship**—A stipend of \$1,200 for work in the field of wood preservation in the School of Forestry.

**Kimberly-Clark Corporation Fellowship**—A stipend of \$1,500 for work in forest management in the School of Forestry.

**Mando Graduate Scholarship**—A stipend of \$900 for work in forest management in the School of Forestry.

**Chapman Chemical Company Fellowship**—A stipend of \$1,500 for work in wood preservation in the School of Forestry.

**American Potash Institute Scholarship**—A stipend of \$900 available for research in the field of soils.

**Middle West Soil Improvement Scholarship**—This sum of \$600 available for work in the field of soils.

**Spencer Chemical Company Fellowship**—A stipend of \$1,008 for research on fertilizer.

**Conway MacMillan Memorial Research Fellowship in Botany**—Established in 1946 by Charles J. Brand, former student of Professor MacMillan. This stipend of \$1,200 is awarded to doctoral students of promise and ability. The applicant may apply concurrently for a tuition scholarship.

**John C. Hutchinson Scholarship**—This stipend of \$300 is awarded every second year to a graduate student in classical languages. Offered 1953-54.

**California Company Fellowship**—A stipend of \$1,250, plus allowance for fees, for work in geology.

**Gulf Oil Corporation Fellowship**—A stipend of \$1,000 plus allowance for tuition and fees for research in geology. An additional \$100 per month is available if the recipient elects to study on a twelve-month basis.

**Magnolia Oil Company Scholarship**—A stipend of \$750 for work in geology.

**Shell Fellowship in Geology**—This stipend of \$1,500 also provides for payment of tuition and fees not to exceed \$300.

**Thomas F. Andrews Fellowship in Geology**—A stipend of \$400 available at intervals of two or three years to a graduate student majoring in geology. The applicant may apply concurrently for a tuition scholarship.

**Carl Schlenker Memorial Fellowship**—This stipend of \$300 is open to an unmarried American-born student majoring in German language and literature. Preference is given to graduate students.

**Clara H. Ueland Memorial Fellowship**—This stipend of \$450 is open to recent women graduates whose interests are in government and politics. The applicant may apply concurrently for a tuition scholarship.

**Allied Chemical and Dye Corporation Fellowship**—One fellowship of \$1,200 plus payment of tuition is available in chemistry. Holder must be a citizen of the United States, preferably male, in the last year of work for the doctorate.

**American Cyanamid Company Fellowship in Chemistry**—A stipend of \$1,200 plus allowance for tuition, excluding incidental fees, not to exceed \$300.

**Carbide and Carbon Chemicals Corporation Fellowship in Organic Chemistry**—This fellowship of \$1,400 (or \$2,100 if the student is married) also provides for payment of tuition and fees. Work is to be done under Professor C. F. Koelsch.

**Du Pont Fellowship in Chemistry**—This is a fellowship of \$1,400 (or \$2,100 if the student is married) plus payment of tuition and fees not otherwise paid by any governmental or private agency.

**Du Pont Postdoctoral Fellowship in Chemistry**—A fellowship of \$3,500.

**Minnesota Mining and Manufacturing Company Fellowship**—A fellowship of \$1,200 plus payment of tuition and fees not to exceed \$300 for research in chemistry.

**General Mills Predoctoral Fellowship in Organic Chemistry**—A stipend of \$1,400 plus allowance for fees.

**Monsanto Chemical Company Fellowship in Organic Chemistry**—A stipend of \$1,200 plus payment of fees not to exceed \$300 for study under Professor C. F. Koelsch.

**Shell Fellowship in Chemistry**—A fellowship of \$1,200 plus payment of tuition and fees not otherwise paid by any governmental or private agency.

**United States Rubber Company Fellowship in Chemistry**—A stipend of \$1,200 (or \$1,800 if the student is married) plus payment of tuition and fees not otherwise paid by any governmental or private agency.

**Visking Fellowship**—A stipend of \$1,500 plus allowance for fees, supplies, and equipment not to exceed \$750, rotates among Chemistry, Agricultural Biochemistry, and Chemical Engineering. Offered in Agricultural Biochemistry, 1952-53.

**Bristol-Myers Company Fellowship**—A stipend of \$2,400 for research on the complexes between metals and sulfhydryl-containing compounds under Dr. I. M. Kolthoff.

**Polymerization Research**—Seven fellowships at stipends varying with qualifications of the individual, under Dr. I. M. Kolthoff.

**United States Public Health Service Fellowships**—Several fellowships at varying amounts for polarographic studies of cancer under Dr. I. M. Kolthoff.

**Allied Chemical and Dye Corporation Fellowship in Chemical Engineering**—One fellowship of \$1,200 plus payment of tuition and fees not to exceed \$300 available to a citizen of the United States, preferably male, in the last year of work for the doctorate.

**Du Pont Fellowship in Chemical Engineering**—One fellowship of \$1,400 (or \$2,100 if the student is married) plus payment of tuition and fees not otherwise paid by any governmental or private agency.

**Minnesota Mining and Manufacturing Company**—One fellowship of \$1,200 plus payment of tuition and fees not to exceed \$600 for research in chemical engineering.

**Procter and Gamble Fellowship**—A stipend of \$1,200 (or \$1,800 if the student is married), plus additional allowance for tuition and fees not to exceed \$300, awarded for research in chemical engineering.

**Minneapolis-Honeywell Research Fellowships**—Three stipends at \$1,215 for research in electrical engineering.

**Minneapolis-Honeywell Research Fellowships**—Three stipends at \$1,215 for research in mechanical engineering.

**Westinghouse Fellowship**—This fellowship for graduate work in mechanical engineering carries a stipend of \$1,000.

**E. J. Longyear Company Graduate Fellowship**—A stipend of \$750 for research in metalliferous economic geology under Professor G. M. Schwartz.

**Armour and Company Fellowship**—A stipend of \$2,400 plus an allowance for tuition, supplies, and equipment for research in metallurgy.

**Superior Metal Products Company Fellowship**—A \$1,600 stipend plus an allowance for supplies for work in metallurgy under Professor R. L. Dowdell.

**Taconite Graduate Fellowships**—Four fellowships of \$1,000 for work in mining, metallurgy, geology, and other fields. The applicant may apply concurrently for a tuition scholarship.

**Samuel W. Melendy Memorial Fellowships**—Four \$1,000 fellowships. Major study must be pharmaceutical chemistry or pharmacognosy, and full time must be devoted to graduate study and research.

**Abbott Laboratories Fellowship in Physiological Chemistry**—A stipend of \$1,500. Work is to be done under Professor W. D. Armstrong.

**Social Work**—Several agency fellowships at \$75 or \$100 a month provided by social agencies in the Twin Cities.

Two United States Public Health stipends of \$2,400, available to students working toward the Ph.D. who have the Master's degree in social work and three years of successful subsequent social work experience.

Seven United States Public Health stipends of \$1,600 under the National Mental Health Act. Limited to psychiatric social work students in their second or third year of graduate social work training who will enter psychiatric social work practice on completion of their training.

A few work-study stipends of about \$170 per month in cooperation with the Veterans Administration. These are open to students who have one or more years' experience in a social agency and who are in their second year of graduate social work training as medical or psychiatric social work majors.

Several Public Welfare fellowships computed on estimated cost of living plus tuition for graduate students in social work who are committed to accept employment with the Minnesota Division of Social Welfare or one of the Minnesota County Departments of Public Welfare.

A few scholarships of the Board of Charities of the American Lutheran Church with a stipend up to \$800, conditioned by the student's need. Available to Lutheran students with acceptable scholarship who are committed to accept employment approved by the Lutheran Board of Charities.

A few scholarships of the Board of Charities of the Evangelical Lutheran Church at \$800 to casework or group work graduate students who are Lutherans.

A few scholarships of the Wheatridge Foundation at \$1,000 for the academic year. Available to Lutheran students who are studying to be medical social workers.

**Clinical Psychology**—Approximately 15 work-study stipends at from \$1,487 to \$2,240 for half-time psychological work under the joint training program of the University and the Veterans Administration are open to students who have completed at least one year of successful graduate work in clinical psychology.

Three United States Health Service stipends at from \$1,200 to \$2,400 involving only study for the Ph.D. in clinical psychology. The amount depends upon whether the student is in his first, second, third, or fourth year of graduate work when appointed.

#### MEDICAL FELLOWSHIPS

The University of Minnesota offers both on the Minneapolis Campus and through the Mayo Foundation at Rochester, Minnesota, a large number of graduate medical fellowships in the fundamental laboratory branches of medicine and in the clinical fields of medicine.

Further information may be found in the *Graduate School Announcement of Graduate Work in the Medical School and the Mayo Foundation*. Requests for application blanks should be addressed to the Dean of the Graduate School, University of Minnesota, Minneapolis 14, Minnesota, or for fellowships on the Mayo Foundation to the director of the Mayo Foundation, Rochester, Minnesota.

#### 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.

#### SERVICES OF THE BUREAU OF STUDENT LOANS AND SCHOLARSHIPS

The University has funds available for personal loans to graduate students who have satisfactorily completed two 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 \$300 during any one year or a maximum of \$600. All applications should be made to the Bureau of Student Loans and Scholarships, 201 Eddy Hall.

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

#### AIDS TO VETERANS

Graduate students eligible to receive benefits under the G.I. Bill of Rights (Public Law 346) or the act relating to vocational rehabilitation (Public Law 16) are advised to secure general instructions and information from the office of the University Bureau of Veterans' Affairs, 13 Shevlin Hall. Graduate students planning thesis research are encouraged to visit Room 12, Shevlin Hall, to obtain information on special procedures for securing required research supplies. They are also invited to communicate with or to call at the office of the Graduate School for helpful information and assistance.

#### 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 the above matters to the Foreign Student Adviser, Room 302, Eddy Hall, University of Minnesota, Minneapolis 14, Minnesota.

#### PLACEMENT OF GRADUATE STUDENTS

Aid and counsel to graduate students who wish college, university, or other positions may be had from advisers and departments, the dean of the Graduate School, and the deans of various colleges of the University and through the Bureau of Recommendations, which receives reports of vacancies for college teaching in all fields as well as in counseling, administration, and research. For further information, students may address the Director, Bureau of Recommendations, 102 Burton Hall, University of Minnesota, Minneapolis 14, Minnesota.

#### HOUSING FACILITIES

**Student Housing Bureau**—The University of Minnesota maintains a Student Housing Bureau with a full-time director and considers the housing of out-of-town students one of its major concerns. Students, whether graduates or undergraduates, while attending the University must have

their places of residence approved by the director of the Student Housing Bureau in Room 202, Eddy Hall. A list of approved and inspected places of residence may be obtained upon application to the director of student housing, Student Housing Bureau.

**Women's Residence Halls**—Comstock and Sanford, the women's residence halls, provide room, board, and social programs at a minimum cost. Graduate students are very welcome. Positions as counselors, open to qualified graduate students, offer full board and room for part-time duties. For additional information, please contact the director of women's residences, Comstock Hall.

**Men's Residence Halls**—Two large residence halls—Pioneer and Centennial—provide room, board, and social and athletic programs for men students at minimum cost. Pioneer Hall will be occupied largely by freshmen, Centennial Hall by upperclass and graduate students. Many residents earn part of their board and room by working in the halls. Positions as counselors, available to qualified graduate students, offer full board and room for part-time duties. The director of Centennial and Pioneer Halls will be happy to furnish additional information and suggests early reservations.

**Housing for Married Students**—*University Village*—Minnesota veterans with children still get top priority for the emergency housing in University Village. Probably some of this housing will be available for non-resident veterans, with or without children, and for nonveteran families with children. The village consists of expansible trailers and one-room prefab units, both of which are furnished, and also miniature unfurnished apartments with two bedrooms, in the quonset and metal barracks buildings. Rents are moderate in every case, and tenure is unlimited as long as the tenant carries a full graduate academic load. University Village projects are located between the Minneapolis and St. Paul campuses and adjacent to the St. Paul Campus. Both sections of the village are on the inter-campus carline.

*Thatcher Hall*—a modern, furnished apartment building on the St. Paul Campus, is again available to graduate students who are carrying a full academic load. Half of the apartments are of the in-a-door bed type, and the others have one bedroom. Priority is given to families with children, both for entrance into the building and for the larger units.

For additional information on University Village and Thatcher Hall, please write to University Village, Room 11, Administration Building, University of Minnesota, Minneapolis 14, Minnesota.

## ROTC PROGRAM

Students in the Graduate School may pursue the Air Force ROTC Program in the same manner as undergraduate students. To be eligible for the basic corps, applicants must have two years of academic work remaining. If the applicant has had two years of basic Air Force ROTC and has two 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.

## DESCRIPTION OF COURSES

### Abbreviations and Explanations

**An asterisk (\*)** indicates courses through which it is possible to prepare required Plan B papers. See page 12 for a description of the nature of these papers or reports.

**A dagger (†)** indicates that all quarters of a course preceding the dagger must be completed before credit is received for any quarter.

**Parallel** following a course number in prerequisites for a given course indicates that the student may be enrolled in the prerequisite course simultaneously.

**Permission** occurring in a course prerequisite indicates that permission of the *instructor* is necessary for registration. Where other permission is required this is indicated.

The abbreviation **Ar.** appearing in a course description following the number of credits to be earned in the course indicates that it was not possible to name the instructor at the time the bulletin went to print.

Courses numbered between 100 and 200 are open to both graduate and undergraduate students. Those numbered 200 or above are for graduate students.

**Course Fees**—Special fees are required for many courses. The amounts of these fees are announced in the *Class Schedule*, which is published each quarter and which the student receives when he registers.

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

### AERONAUTICAL ENGINEERING

Professors John D. Akerman, Rudolph Hermann, Ralph H. Upson, Joseph A. Wise; Associate Professor Eugene Stolarik; Assistant Professor Alfred E. Cronk; Lecturers Walter S. Bradfield, Jr., Frank D. Werner.

**Language Requirement**—For the Master's degree none. For the Doctor's degree either (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge.

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

**Doctor's Degree**—Work for the Ph.D. degree is offered in this department.

### Courses

**100f-101w-102s. Aerodynamics.** Atmospheric properties; fluid mechanics; stream functions and velocity potential; motion of body in liquids in three dimensions. Prandtl's wing theory. Dynamic loads, stability, maneuverability, controllability. Prereq.: 1 and M.&M. 25. 3 cred. per qtr. Stolarik, Cronk.

**103f-104w-105s. Advanced Aerodynamics.** Dynamic stability. Advanced theoretical aerodynamics, flutter analysis. 3 lect. hours per week. Prereq.: 102. 3 cred. per qtr. Stolarik, Cronk.

- 106f.w.s. Advanced Aerodynamics.** Compressible flow. Comparison of compressible and incompressible flow influences on aircraft. Airfoil analysis and design. Spanwise lift distribution. 3 lect. hours per week. Prereq.: 102. 3 cred. Upson, Stolarik.
- 107s. Aerodynamics of Viscous Fluids.** Viscosity effects in fluid flows. Navier-Stokes equation, laminar boundary layer theory. Application of boundary layer theory to aerodynamic design problems. 3 lect. hours per week. Prereq.: 102. 3 cred. Cronk.
- 110f.w.s. Vibration and Flutter.** Free harmonic and forced vibrations. Spring constants. Critical frequency. Vibrating systems with several degrees of freedom. Vibration of aircraft. Tail and wing flutter. 3 lect. hours per week. Prereq.: 115, M.&M. 80. 3 cred. Werner.
- 115f.w. or s. Airplane Stresses.** Deflection of structures. Theory of statically indeterminate structures. Analysis of fuselage trusses, landing gear, wing beams. Structural details and connections. Prereq.: 83. 3 cred. Cronk.
- 116f. Advanced Airplane Stresses.** Frames, space frameworks, secondary stresses, beams, columns, curved beams, rings, multispar and unit wing construction, mono-coque fuselages. 3 lect. hours per week. Prereq.: 115 or M.&M. 180. 3 cred. Wise.
- 117w. Advanced Airplane Stresses.** Analysis of thin-shelled plates and membranes used in aircraft wings and fuselages. Local stresses and effects of discontinuities. Initial and thermal stresses, combined stresses, and theories of failure as applied to aircraft structures. Prereq.: 115. 3 cred. Wise.
- 118s. Advanced Stresses on Aircraft Structures.** Theory of flexure of flat plates. Bucklings of plates. Combined bendings and axial stress in plates. Application and design of seaplane floats and hulls. 3 lect. hours per week. Prereq.: 115. 3 cred. Wise.
- 119s. Testing of Aircraft Structures and Models.** Theory of model studies. Similitude. Maxwell theorem of reciprocal deflections. Begg's deformeter. Strain gauges, mechanical, optical, magnetic and electrical resistance types. Interpretation of tests. Mohr's circles of stress and circles of strain. Measurement of deflection. 2 lect. and 3 lab. hours per week. Prereq.: 115. 3 cred. Wise.
- 120f-121w-122s.\* Airplane Design.** Design and stress analysis of aircraft structures involving beam—columns, thin web beams, multicell wings, closed frames. Sheet bucklings and tension characteristics of sheet-stringer combinations. Shear, bending, and torsion in shell structures. 2 lect. hours per week. Prereq.: 83, 102. 2 cred. per qtr. Upson.
- 123f.w.s-124f.w.s-125f.w.s.\* Advanced Airplane Design.** Problems in airplane design or development. Prereq.: 121, permission. 2 to 5 cred. per qtr. Akerman.
- 126f.\* Airscrew Propulsion.** Study of the theory common to the propulsive and lifting airscrews. Theory of the helicopter performance. 3 lect. hours per week. Prereq.: 120 or special permission. 3 cred. Stolarik.
- 127f.w.s\*-128f.w.s.\* Advanced Problems in Airscrew Design.** Prereq.: 126, permission. 2 to 5 cred. per qtr. Stolarik.
- 130f. Aerodynamic Design Laboratory.** Preliminary airplane design. To be taken concurrently with 120. 6 lab. hours per week. 2 cred. Stolarik.
- 131w-132s. Airplane Design Laboratory.** Air loadings analysis. Load factors. Structural design and analysis. Prereq.: for 131, 121 parallel; for 132, 122 parallel. 2 cred. per qtr. Stolarik.
- 141f.w.s. Aerodynamics Laboratory.** Measurement of air flow; calibration of Pitot tubes and anemometers; distribution of air pressure on surfaces; wind tunnel tests of wing, propeller, and airplane models. Prereq.: 101. 3 cred. Cronk, Upson.
- 164s. Problems Relating to the Stratosphere.** Prereq.: 102. 3 cred. Akerman.
- 165f.w.s.\*166f.w.s.\*167f.w.s.\* Advanced Aeronautical Laboratory.** Advanced research problems in aeronautical engineering requiring laboratory or field research facilities. Prereq.: 141, permission. 2 to 4 cred. per qtr. Staff.
- 173f. Introductory Meteorology.** Survey of meteorological phenomena and related physical principles: atmospheric statics; atmospheric thermodynamics; equations for simple atmospheric motions. Laboratory work consists of problems illustrating the physical principles involved. 2 lect., 3 lab. hours per week. 3 cred. Mantis.

- 174w. Applied Meteorology.** Meteorological observations; collection and dissemination of meteorological data. Elementary weather analysis and interpretation of weather charts. 1 lect., 6 lab. hours per week. Prereq.: 173. 4 cred. Mantis.
- 175a. Advanced Meteorology.** Physical meteorology: atmospheric stability; heat balance; equations of hydrodynamics as applied to the atmosphere; structure and mechanism of cyclones and anticyclones. 3 lect., 3 lab. hours per week. Prereq.: 173. 4 cred. Mantis.
- 180f.w. or s. Instrumentation and Techniques for Supersonic Flow.** Principles, uses, and limitations of measuring devices used in supersonic flow. Static and dynamic pressure orifices; Mach cones and wedges; shadowgraph and Schlieren apparatus; interferometer; hot wire anemometer; temperature measuring devices and methods; specific conditions and problems. 1 lect., 2 lab. hours per week. Prereq.: 106 or M.E. 134. 2 cred. Bradfield.
- 190f-191w-192s.\* Seminar.** Readings, reports, conferences, and discussions. Prereq.: 102. 1 cred. per qtr. Akerman.
- 193f.w.s-194f.w.s-195f.w.s.\* Advanced Problems in Aeronautical Engineering.** Prereq.: permission. 2 to 5 cred. per qtr. Staff.
- 201f-202w-203s. Aerodynamics of Compressible Fluid.** Equations of motion in a compressible fluid. Thermodynamic considerations. Isentropic channel flow. Method of characteristics. Application of aerodynamic design. The small perturbation method. The Busemann first and higher order approximations to pressure coefficient on aerodynamic surfaces. Aerodynamic characteristics of two-dimensional supersonic profiles. Extension of foregoing techniques to three dimensions. Finite wing theory. Conical flow. Applications to supersonic aircraft design. 3 lect. hours per week. Prereq.: 106 or permission. 3 cred. per qtr. Hermann, Bradfield.
- 204s. Supersonic Aerodynamics Laboratory.** A laboratory course in supersonic wind tunnel operations, technique, and instrumentation. Flow study and model testing supersonic wind tunnels at Rosemount Research Laboratory. 2 lect. and 3 lab. hours per week. Prereq.: 201 parallel or M.E. 134. 3 cred. Akerman, Bradfield.
- 208s. Aerodynamics of Viscous Fluids.** Turbulent boundary layers, free turbulence and laminar stability in incompressible flow. Laminar and turbulent boundary layers in compressible flow with applications. 3 lect. hours per week. Prereq.: 107. 3 cred. Leadon.
- 220w. High Speed Performance and Design.** General principles of designing for performance. Compressibility corrections at subsonic speeds. Transonic effect. Supersonic possibilities and requirements. 3 lect. per week. Prereq.: 202 or special permission. 3 cred. Upson.
- 230f. Aerodynamics of Supersonic Inlet Diffusers.** Diffuser types and pressure recovery. The one-dimensional normal shock diffuser. Various definitions of diffuser efficiency. Compression by one, two, or more oblique shocks. Two-dimensional diffuser for ramjets. Spike diffusers and pulsations. 3 lect. per week. Prereq.: 201 or M.E. 134. 3 cred. Hermann.
- 231w. Aerodynamics and Flight Performance of Supersonic Missiles.** 3 lect. hours per week. Prereq.: 230. 3 cred. Hermann.
- 232s. Aerodynamics and Flight Performance of Supersonic Missiles.** Prereq.: 231 or permission. 3 to 5 cred. Hermann.
- 238f.w. or s. Joint Seminar with Mathematics and Mechanics Department.** Topics vary from year to year and are announced each time the course is given. Prereq.: permission. 3 cred. Aeronautical Engineering and Mathematics and Mechanics staffs.
- 240f.w. or s. Dynamics of Aircraft Structures.** Fundamental principles of vibrations of spring-supported masses, beams, trusses, and other structural forms; response of structures to suddenly applied forces and impulses; strength of structures under impactive and repeated forces; application to vibration and flutter of aircraft structures and components, and their response to blast or explosion, jet reaction, gust loads, landing loads, and similar dynamic forces. 3 to 5 cred. Wise.
- 241f.w. or s. Dynamics of Aircraft Structures.** Prereq.: 240. 3 cred. Wise.
- 272f-273w-274s.\* Research in Aeronautical Engineering.** 2 to 5 cred. per qtr. Staff.

**275f.w.s-276f.w.s-277f.w.s.\* Advanced Aircraft Engines.** Advanced study of aircraft engines and auxiliary equipment; analysis of current developments in aircraft engines, new engine accessories, and installations; theoretical analysis of their effect upon the performance of modern aircraft. 2 to 5 cred. per qtr. Staff.

## AGRICULTURAL BIOCHEMISTRY¶

Professors William F. Geddes, Clyde H. Bailey, David R. Briggs, Walter O. Lundberg, Max O. Schultze, Fred Smith; Associate Professors Paul D. Boyer, Robert Jenness; Assistant Professors Louis S. Cuendet, Irvin E. Liener.

**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 division staff that he has an adequate background.

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

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

**Minors**—Courses 119 to 124, 129 to 133, and 202 provide a basic training in biochemistry and are particularly recommended to students registered for the Ph.D. degree. The minor requirement may be met by completing 23 to 25 credits from these courses.

**Language Requirement**—For the Ph.D. degree, a reading knowledge of two foreign languages is required, one of which must be German. For the M.S. degree, one foreign language, French or German, is required. 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.

### Courses

- 103s.‡ Dairy Chemistry.** Lectures and laboratory work on the physical, colloidal, and chemical properties of milk and dairy products. Prereq.: 2, 6 or equiv. Lect., 3 cred.; lect. and lab., 6 cred. Jenness.
- 105s.\* Plant Biochemistry.** An introduction to the chemistry, metabolism, and nutrition of plants. Prereq.: org. chem., 3 or equiv. 3 cred. Cuendet.
- 106s.\* Animal Biochemistry.** An introduction to the chemistry, metabolism, and nutrition of animals. Prereq.: org. chem., 3 or equiv. 3 cred. Schultze.

‡ Lectures only may be taken upon permission of instructor.

† Thesis work fee. The fee for thesis research privileges is \$20 for the M.S. degree and \$50 for the Ph.D. degree. These fees are payable at the rate of \$10 per quarter through the purchase of Agricultural Biochemistry deposit cards.

- 108s. Chemistry of Wheat and Wheat Products.** A lecture course, with collateral library reading on the chemistry and technology of wheat. Prereq.: 5. 3 cred. Geddes.
- 110s. Flour Laboratory Methods.** Analysis of wheat and its products. Prereq.: 2 or equiv., 108 parallel. 3, 4, or 5 cred. Cuendet.
- 116w. Advanced Animal Nutrition.** Biochemistry of animal nutrition. Prereq.: 6 or equiv., 120 advised. 3 cred. Schultze.
- 117s. Laboratory Problems in Animal Nutrition.** A laboratory course on methods used in nutrition studies. Prereq.: 116, permission. 3 cred. Liener.
- 118f.w.s. Laboratory Problems in Biochemistry.** Laboratory work in the preparation and isolation of pure compounds and in methods of identification or determination of biochemical products. Prereq.: permission. 3 to 5 cred. per qtr. Staff.
- 119f. Colloids.** Lectures and assigned reading on the preparation and properties of colloidal systems, and their relation to biochemical processes. Prereq.: Phys. 9 advised, Course 3, or 8 cred. in org. chem. 3 cred. Briggs.
- 120w,121w,122s. Proteins, Carbohydrates, Lipides.** Lectures and assigned reading on composition, structure, chemical and physical properties, and the functions of proteins, carbohydrates, and lipides. Prereq.: 119 or permission. 3 cred. per qtr. 120: Proteins. Briggs, Boyer, and Schultze; 121: Carbohydrates. Smith; 122: Lipides. Lundberg.
- 123s. Enzymes.** Lectures and assigned reading on the nature and function of enzymes. Prereq.: 6 cred. of advanced biochem. or permission. 3 cred. Boyer.
- 124f. Vitamins.** Lectures and reading on the biochemistry of vitamins and their physiological action. Prereq.: 6, 119; 123 advised, or equiv. 3 cred. Schultze.
- 129f. Colloids Laboratory.** Preparation, purification, and physical chemical properties of inorganic and biocolloid systems. Prereq.: 2 or equiv., 119 parallel. 2 cred. Briggs.
- 130w,131w,132s,133s. Proteins, Carbohydrates, Lipides and Enzymes Laboratory.** Laboratory courses in the preparation, identification, and analysis of proteins, carbohydrates, and lipides, and on the preparation and properties of enzymes paralleling Courses 120, 121, 122, 123. 130: Proteins. Jenness; 131: Carbohydrates. Smith; 132: Lipides. Lundberg; 133: Enzymes. Boyer. Prereq.: 2 or equiv. 2 cred. per qtr.
- 202f. Biochemical Micromethods.** Laboratory work on selected biochemical techniques including chromatography, colorimetry, spectrophotometry, fluorometry, manometric and microbiological assay methods. Prereq.: 6 cred. from 129 to 133 inclusive, or permission. 3 cred. Boyer.
- 203f.w.s.su.\* Research Problems.** Work on research problems in various fields of biochemistry. Prereq.: permission. 2 to 5 cred. per qtr. Staff.
- 205f.w.s.su.\* Special Topics in Biochemical Literature.** Library work and preparation of reports on special biochemical problems. Prereq.: permission. 1 to 3 cred. per qtr. Staff.
- 208f.w.s. Cereal Chemistry Seminar.** Prereq.: 108 or permission. 1 cred. per qtr. Geddes, Cuendet.
- 213f.w.s.\* Seminar in Dairy Chemistry.** Prereq.: 103, permission. 1 cred. Jenness.
- 216f.w.s.\* Nutrition and Enzymes Seminar.** Prereq.: 116, 123, permission. 1 cred. Schultze, Boyer.
- 219f.w.s.\* Colloid Chemistry Seminar.** Prereq.: 119, permission. 1 cred. Briggs.
- 220f.w.s.\* Protein Chemistry Seminar.** Prereq.: 120, permission. 1 cred. Briggs, Jenness.
- 221f.w.s.\* Carbohydrate Chemistry Seminar.** Prereq.: 121, permission. 1 cred. Smith.
- 222f.w.s.\* Chemistry of Lipides Seminar.** Prereq.: 122, permission. 1 cred. Lundberg.
- 224f.w.s.\* General Seminar.** Reports on recent developments in biochemistry and on research work carried out in the division. 1 cred. Staff.

## AGRICULTURAL ECONOMICS

Professors Oscar B. Jesness, Willard W. Cochrane, Austin A. Dowell, E. Fred Koller, George A. Pond; Associate Professors Rex W. Cox, Selmer A. Engene.

**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.

**Majors and Minors**—The thesis may be in any field of agricultural economics (marketing, farm management, economics of agricultural production, agricultural prices, agricultural policy, farm finance, land economics.) Candidates will be expected to take work in different fields, the program depending upon the field 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.

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

**Doctor's Degree**—This division offers work leading to the Ph.D. degree.

**Note**—For courses in general economics and business administration, see Economics.

### Courses

- 102w. Farm Management: Organization.** The business side of farming with emphasis on farm selection and organization. Prereq.: 2. 3 cred. Pond.
- 103s. Farm Management: Operation.** A continuation of 102 with special attention to efficiency in farm operation. Prereq.: 102. 3 cred. Pond.
- 104s. Types of Farming.** A study of types of farming and of prevailing farm practices in the principal agricultural production areas. Prereq.: 2. 3 cred. Pond.
- 107s. Farm Work Simplification.** A study of principles and methods of accomplishing work in less time and with less effort. Practice in planning improved working methods. Prereq.: 2. 3 cred. Engene.
- 110f. Economics of Agricultural Production.** Principles of production economics elaborated in terms of the production of the major farm products and producing areas. Prereq.: 2. 3 cred. Dowell.
- 126f. Economics of Consumption.** Formulation of the economic principles relating to choice between different uses of income, time, and energy by individuals and family organizations. Prereq.: 2 or 3. 3 cred. Cochrane.
- 131w. Market Prices.** Analysis of the price-making process as it works out in the market places where the major farm products are sold. Market quotations and price quoting. Prereq.: 30, 40. 3 cred. Cochrane.
- 140f. Marketing Organization: Staples.** Principles of production economics applied to the organization of markets and marketing organization for the grains, tobacco, cotton, and wool. Prereq.: 40. 3 cred. Cox.
- 141w. Marketing Organization: Dairy and Poultry Products.** Prereq.: 40. 3 cred. Jesness.
- 142s. Marketing Organization: Fruits and Vegetables.** Prereq.: 40. 2 cred. Cox.
- 143w. Marketing Organization: Livestock and Meats.** Prereq.: 40. 3 cred. Dowell.
- 144f. Cooperative Organization.** Prereq.: 40. 3 cred. Jesness.
- 150s. Advanced Farm Finance.** Prereq.: 50 or equiv. 3 cred. Koller.
- 170w. Land Economics.** Prereq.: 110. 3 cred. Dowell.

- 172s. 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. Prereq.: 110 or permission. 3 cred. Dowell.
- 190f. Agricultural Statistics.** Intended for beginning graduate students who have had no course in the elements of statistical method. 3 cred. Cox.
- 191w. Advanced Agricultural Statistics.** Prereq.: 190. 3 cred. Cochrane.
- 200f-201w-202s.\* General Seminar in Agricultural Economics.**§ Cred. ar. Jesness and staff.
- 206w. Seminar in Agricultural Policy.** A study of economic problems of agriculture and policies adopted by governmental, agricultural, and other agencies toward such problems. 3 cred. Jesness.
- 221f.\* Farm Organization Studies.** A seminar study of the principles involved in the analysis of farm organization data and the computation of farm costs. 3 cred. Pond.
- 226s.\* Advanced Farm Organization.** Analysis of farm organization and the application of the budgeting method in improving the farm business. 3 cred. Pond.
- 230.\* Research Problems in Farm Organization and Operation.** Individual study of methods of conducting research work and analyzing problems in farm organization and operation. Reports required for credit. Cred. ar. Pond, Engene. (Offered when demand warrants.)
- 235s. Methods of Price Analysis.** Application of economic theory and statistical techniques to agricultural price and market research. Prereq.: 191. 3 cred. Cochrane.
- 241f.\* Seminar in the Marketing of Livestock and Livestock Products.** 3 cred. Dowell. (Offered when demand warrants.)
- 244w.\* Seminar in Cooperative Marketing.** 3 cred. Koller, Jesness. (Offered when demand warrants.)
- 246f.\* Seminar in Economics of Consumption.** 3 cred. Cochrane. (Offered when demand warrants.)
- 270s. Seminar in Land Tenure.** 3 cred. Dowell. (Offered when demand warrants.)

## AGRICULTURAL ENGINEERING

Professors Arthur J. Schwantes, Andrew Hustrulid, Philip W. Manson, Charles K. Otis; Associate Professors Evan R. Allred, Clarence H. Christopherson, John Strait; Assistant Professor Arnold M. Flikke.

**Prerequisites**—For a major in agricultural engineering the general prerequisite comprises all *specified* 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 division staff as to his preparation.

A graduate of an approved undergraduate curriculum in another line of engineering might select a major in some phase of agricultural engineering for which his undergraduate work has furnished the foundation. Additional supporting work may be required.

**Master's Degree**—Offered under Plan A. In special cases Plan B is accepted when approved by the division graduate faculty. Candidates for graduate degrees in agricultural engineering may include, with the approval of their adviser, in their major or minor or both, courses in fundamental engineering and in agricultural or allied pure sciences.

§ Under this head special seminars or individual work may be arranged on subjects suited to the needs of particular groups of graduate students.

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

### Courses

- 104f.s. The Soil Moisture Relation in Agriculture.** The scientific basis of soil moisture regulation and conservation in such phases as irrigation, drainage, and soil erosion. Lect. and problems. Not open to engineers. Prereq.: Soils 4. 4 cred. Manson.
- 106w. Agricultural Hydrology.** Study of the hydrologic cycle and its component parts—precipitation, transpiration, evaporation, infiltration, and runoff. Measurement and estimation of runoff by various methods. Ground water hydrology. Prereq.: 61 or parallel or special permission. 3 cred. Manson.
- 107s. Drainage, Irrigation, and Soil Erosion Control Design.** Design and field layout of drainage, erosion control, and irrigation systems for the control and conservation of soil and water in agriculture. Prereq.: 61, 106 or special arrangement. 2 lect., 6 lab. hours per week. 4 cred. Manson, Allred.
- 111f-112w-113s.\* Problems in Agricultural Engineering.** S, Soil and Water; B, Buildings; P, Power and Machinery; R, Rural Electrification. Prereq.: permission. 2 to 6 cred. per qtr. Staff.
- 114w. Buildings, Equipment, Materials, and Methods of Construction.** The relation of structures and building equipment to agriculture. Lect. and special problems. Not open to engineers. Prereq.: 3, 6, 7 or equiv. 3 cred. Christopherson, Otis.
- 124s. Agricultural Machinery and Mechanical Power Management.** Machinery and power management, use, and costs. Not open to engineers. Prereq.: 9 cred. in agr. eng. including phys. and 12. 3 cred. Schwantes, Strait.
- 125s. Topics in Agricultural Physics.** Advanced studies of the essential physical principles involved in the utilization of electricity in agriculture. Prereq.: 172, or calculus and 24, 25 or equiv. 3 cred. Hustrulid.
- 126w. Management of Agricultural Machinery.** Principles of power and machinery management. Term problem and assigned topics. Prereq.: 171, Agr.Econ. 102. 3 cred. Schwantes.
- 167w. Advanced Farm Structures.** Design of structural members and assemblies for farm structures. Insulation and ventilation of animal shelters. Building equipment. Prereq.: 53, 63, M.E. 160, C.E. 146. 3 cred. Otis.
- 171f. Design of Agricultural Machinery.** Operating principles and problems. Prereq.: 52, M.E. 121. 3 cred. Strait.
- 172s. Applied Electricity.** Topics including farmstead wiring, instruments, lighting, motors and controls, control circuits, and storage batteries. Prereq.: E.E. 38 or parallel. 3 cred. Hustrulid.
- 211f-212w-213s.\* Advanced Problems and Research.** Prereq.: 111, 112, or 113 and permission. 2 to 6 cred. per qtr. Staff.

### AGRONOMY AND PLANT GENETICS

Professors Will M. Myers, Elmer R. Ausemus, Charles R. Burnham, Joseph O. Culbertson, Raymond S. Dunham, Ernest H. Rinke; Associate Professors Jean W. Lambert, Alois R. Schmid, Horace L. Thomas; Assistant Professors Emmett L. Pinnell, Robert G. Robinson.

**Prerequisites**—In agronomy or plant genetics, 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 Work**—With the approval of the adviser, courses in agricultural biochemistry, botany, horticulture, plant pathology, plant physiology, and other biological sciences may be accepted as major work in both agronomy and plant genetics. Students majoring in plant genetics are required to continue study during at least one summer.

**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. This is particularly true of those who are unable to spend more than one or two quarters at a time in residence at the University of Minnesota while doing graduate work.

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

**Doctor's Degree**—The division offers work leading to the Ph.D. degree.

## Courses

### AGRONOMY

- 121w. Grain Crops.** Production, improvement, and uses of corn, small grains, and flax. Lect. and lab. Prereq.: 1. 4 cred. Dunham.
- 122s. Grain and Hay Grading.** Development of grades, study of grading methods, and actual practice in grading grain and hay samples according to federal standards. Lect. and lab. Prereq.: 1. 3 cred. Lambert.
- 123f. Forage Crops.** Distribution, characteristics, production, preservation, and uses of forage crops. Lect. and lab. Prereq.: 1. 4 cred. Schmid.
- 126f. Crop Judging.** Laboratory practice in identification of crops, weeds, and diseases in relation to judging and grading farm crops. Prereq.: 122. 4 cred. Schmid.
- 133s. Pasture Crops and Management.** Characteristics, distribution, establishment, renovation, and management of crops for temporary and permanent pastures. Lect., lab., and field work. Prereq.: 123. 4 cred. Schmid.
- 134s. Seminar in Agronomy.** Critical studies of problems in agronomy. Prereq.: 9 cred. in agron. 2 cred. Staff.
- 135f. Weed Control.** Cultural and chemical methods of weed control; weed and seed laws pertaining to dissemination and control. Lect., lab., and field work. Prereq.: 1, Pl.Path. 3. 3 cred. Dunham, Heggeness.
- 201f.w.su.\* Research in Farm Crops.** Problems in physiology, production and classification of crop plants. Prereq.: 121, 123. Cred. ar. Dunham, Schmid.
- 202f.w.\* Farm Crops Seminar.** Reviews and discussions of important agronomic literature. Prereq.: 9 cred. in farm crops. 1½ cred. per qtr. Dunham, Thomas, Schmid.
- 203w. Advanced Studies in Agronomy.** Origin, classification, ecology, and physiology of major crop plants; techniques in agronomic research; agricultural biology and other new concepts of crop production. Prereq.: 21, 23. 3 cred. Dunham, Schmid, Thomas.

### PLANT GENETICS

- 131f.w. Principles of Genetics.** Fundamental principles of breeding, heredity, variation, biometry, and evolution. Lect. and lab. 4 cred. Lambert.
- 132w. Farm Crops Plant Breeding.** Applied genetics. Methods of breeding each of the important agricultural crops. Lect. and lab. Prereq.: 31 or 131. 4 cred. Rinke.
- 136s. Introduction to Applied Statistics.** Material covered will be probability, mean, normal distribution, variance, standard error, t test,  $X^2$  test, correlation, and analysis of variance. Emphasis will be placed on how to do the required computing and interpretation of the results in terms of biology rather than of the mathematical background. Lect. and lab. 3 cred. Thomas.
- 241f.w.su.\* Research in Plant Genetics.** May be taken as major or minor work. Cred. ar. Myers, Burnham, Rinke, Thomas, Lambert.
- 242f.s.\* Plant Breeding Seminar.** 1 cred. per qtr. Agronomy and Horticulture staffs.

- 243f. Methods in Plant Breeding.** Methods applicable to improving self- and cross-pollinated crop plants, the effects of inbreeding, selection, hybridization, and heterosis. 3 cred. Myers.
- 244f.su. Laboratory Methods in Plant Breeding.** Practice in plant breeding technique, methods of controlling pollination, and handling of plant cultures. Cred. ar. Staff.
- 245f. Advanced Genetics.** A survey of genetic knowledge. Lect. and lab. Prereq.: elementary genetics. 3 cred. Burnham.
- 246w.\* Genetics Seminar.** Contributions to genetic theory and practice. 2 cred. Agronomy, Horticulture, and Animal Husbandry staffs.
- 247w. Cytogenetics.** A survey of knowledge of chromosome behavior, polyploidy, and chromosomal aberrations with supplemental laboratory work in cytology. Lect. and lab. Prereq.: Bot. 119. 3 cred. Burnham.
- 248w. Applied Statistics.** The application of statistical methods to the analysis of biological data, particularly with small samples. Prereq.: P.H. 110 or 136. 3 cred. Thomas.
- 249f. Advanced Genetics, Specialized.** Prereq.: 245. 2 cred. Burnham.
- 250w. Cytogenetics, Specialized.** Advanced material. Prereq.: 247. 2 cred. Burnham.

### AMERICAN STUDIES

Professor Tremaine McDowell, Chairman, Associate Professor Bernard Bowron, Secretary; Professors H. Harvard Arnason, Ralph D. Casey, Philip D. Jordan, Lowry Nelson, Henry Nash Smith; Associate Professors Mulford Q. Sibley, Alice F. Tyler.

**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.

**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**—Under Plan B, 45 hours of American courses are required, distributed in four fields: (1) history, (2) literature, (3) philosophy and fine arts, (4) social sciences. All candidates must include American Studies 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 American courses distributed in the four fields named above and in the fifth field of foreign civilization. All candidates must include American Studies 200 and 210-211-212 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*.

### Courses

**200f-201w-202s. 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. Limited to candidates for the M.A. degree. 3 cred. per qtr. McDowell and staff.

**210f-211w-212s. Seminar in American Studies.** An overview of American civilization in the terms of the various departments which cooperate in the Program in American Studies. Limited to candidates for the Ph.D. degree. 3 cred. per qtr. Hornberger and staff.

**250f-251w-252s. Readings in American Civilization.** Independent study of interdisciplinary aspects of American civilization under guidance of members of various departments. Prereq.: permission of department chairman. Cred. ar. Ar.

**Note:**—For approved American courses in history, literature, philosophy, and other departments concerned, see the *Bulletin of the Program in American Studies*.

## ANATOMY

Professors Edward A. Boyden, Ph.D., Head, Olof Larsell, Ph.D., Lemen J. Wells, Ph.D.; Associate Professors Berry Campbell, Ph.D., J. Francis Hartmann, Ph.D., W. Lane Williams, Ph.D.; Assistant Professor R. Dorothy Sundberg, Ph.D.

**Prerequisites**—Prerequisite work for all majors or minors in the Department of Anatomy includes general zoology, 9 credits, and elementary courses in anatomy (embryology, gross anatomy, histology, and neurology), 9 credits.

**Major and Minor Work**—Each major in anatomy must have had the elementary courses in that branch of anatomy in which he desires to specialize—embryology, gross anatomy, hematology, histology, or neurology. 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 Courses 100-101, 103, 104, 107, and 111).

**Language Requirement**—For the Master's degree a reading knowledge of 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.

**Master's Degree**—Offered only under Plan A.

**Doctor's Degree**—The department provides excellent facilities for students who wish to take work or to pursue investigations in anatomy leading to the Ph.D. degree.

## Courses

**100f-101w. Gross Human Anatomy.** Dissection of the human body. 8 cred. per qtr. Enrolment limited. Boyden.

**102s. Anatomy of the Head and Neck.** Prereq.: 59. 6 cred. Hartmann.

**103w-104s. Human Histology.** Microscopic study of the various tissues and organs. Prereq.: 100-101 or equiv. 8 cred. Williams.

**105f. Microscopic Anatomy.** Prereq.: 102. 9 cred. Campbell.

**107f. Human Embryology.** Development of the human body. Prereq.: 100-101 or equiv. 5 cred. Wells.

**111s. Human Neurology.** A study of the gross and microscopic structure of the central nervous system and sense organs of man. Prereq.: 103, 104, and 107, or Zool. 149-150. 6 cred. Larsell.

**131f. Biological Electron Microscopy.** Hours and cred. ar. Hartmann.

**132w. Experimental Study of the Fetus.** Hours and cred. ar. Wells.

**134w. Anatomy of the Newborn.** Detailed laboratory study of the anatomy of the newborn. Prereq.: 107 or equiv. 3 cred. Wells.

- 149f.w.s. Experimental Neurology.** Morphology of the central nervous system as determined by experimental methods. Prereq.: 111. Hours and cred. ar. Campbell.
- 150s. Special Topics in Neurology.** Study of the literature in selected phases of human neurology. Prereq.: 111. Hours and cred. ar. Larsell.
- 153f.154w.155s.156su. Advanced Anatomy.** Advanced work in embryology, gross anatomy, hematology, histology, or neurology. Hours and cred. ar. Boyden, Larsell, Wells, Campbell, Hartmann, Williams, Sundberg.
- 158s. Special Histology and Neurology of the Head Region.** Prereq.: 103, 104, 111. 3 cred. Larsell.
- 160w.s. Seminar in Problems of Reproduction.** Prereq.: 107. 1 cred. per qtr. Wells.
- 164w. Segmental and Topographic Anatomy of the Lungs.** Prereq.: 101. 2 cred. Boyden.
- 165f-166w. Hematology.** Normal and pathologic morphology of the blood and blood-forming organs, with emphasis on study of the blood from the standpoint of diagnosis and prognosis. Prereq.: 103 or equiv. 4 cred. per qtr. Sundberg.
- 167s. Seminar in Hematology.** Prereq.: 165, 166. 1 cred. Sundberg.
- 201f.202w.203s.204su. Research in Anatomy.** Gross anatomy, embryology, histology, hematology, and neurology. Special facilities are offered to graduate students in the clinical departments for work upon problems in applied anatomy. Hours and cred. ar. Boyden, Larsell, Wells, Campbell, Hartmann, Williams, Sundberg.
- 205f-206w-207s. Anatomical Seminar.** Reviews of the current literature and discussion of research work being carried on in the department. 1 cred. per qtr. Boyden and staff.

### ANIMAL HUSBANDRY

Professors Evan F. Ferrin, Lester E. Hanson, Alfred L. Harvey, Laurence M. Winters; Associate Professors Philip A. Anderson, John N. Cummings; Assistant Professors Raymond M. Anderson, Woodrow J. Aunan.

**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 animal husbandry or animal breeding but must select a minor in some other field. With the approval of the adviser, graduate courses in agricultural biochemistry, genetics, zoology, veterinary medicine, economics, dairy husbandry, and statistics may be accepted as major work.

**Language Requirement**—Candidates for the Master's degree may, with Graduate School approval, be exempted from the language requirement. For the Ph.D. degree this 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.

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

**Doctor's Degree**—The division offers work leading to the Ph.D. degree with major specialization in the field of animal production or animal breeding.

### Courses

- 101f. Livestock Selection.** Competitive selection of several types and breeds of livestock. Evaluation of ancestry, performance records, and other factors as aids to observation in selecting breeding animals. Visits to stock farms. Prereq.: 9. 3 cred. R. M. Anderson.

- 107s.\* Meat Problems.** Wholesale cuts and grades of meat; the processing industry and the utilization of by-products. Special problems and visits to processing and merchandising establishments. Prereq.: 53. 3 cred. P. A. Anderson.
- 112w. Animal Breeding.** Application of the physiology of reproduction and genetics to the breeding of farm animals. Prereq.: Agron. 31. 3 cred. Winters.
- 113s. Livestock Management.** Management principles and problems of care and of health in the production of beef cattle, sheep, and swine. Prereq.: 56, 57, 112. 3 cred. P. A. Anderson, Ferrin, Harvey.
- 114s. Artificial Insemination.** Lectures and laboratory on the fundamentals and techniques involved in artificial insemination. Problems and procedures in managing artificial breeding associations. Prereq.: 112, permission. 4 cred. Cummings.
- 116f. Prenatal Development of Farm Animals.** Textbook, lectures, and demonstrations dealing with prenatal development of farm animals. Prereq.: 112 or equiv., permission. 4 cred. Cummings.
- 201f.\* Advanced Animal Breeding I.** Assigned readings and lectures devoted to the more recently proposed techniques in breeding, and their likely application to farm animals. Prereq.: 112, P.H. 110. 3 cred. Winters.
- 203w.\* Advanced Animal Breeding II.** Assigned readings and discussions of recent literature concerning physiology of reproduction with special reference to farm animals. Prereq.: 112, 116. 3 cred. Cummings.
- 204s.\* Advanced Animal Breeding III.** Assigned readings and discussions on outlining and initiating a research project and methods of calculating and interpreting the data after they are gathered. Prereq.: 201, 203, P.H. 130. 3 cred. Winters.
- 205s.\* Seminar in Animal Breeding.** Review of current literature and discussion of topics having special emphasis on constructive livestock breeding. Prereq.: 201, 203. 2 cred. Winters.
- 206w.\* Advanced Livestock Feeding I.** Nutrition of farm animals with particular reference to cattle, sheep, and swine. Lect. and special assignments. Prereq.: 56, 57, Agr.Biochem. 6, or equiv. 3 cred. Hanson.
- 207s. Advanced Livestock Feeding II.** Prereq.: 206. 3 cred. Hanson.
- 208f,209w,210s.\* Animal Husbandry Seminar.** Special assignments and review of literature pertaining to the livestock industry. 1 cred. per qtr. Ferrin.
- 211f.\* Experimental Methods.** Theory, plan, and conduct of experimental work in animal husbandry. Factors affecting results, sources of error, interpretation of data. 3 cred. Ferrin.
- 212w.s.\* Research in Meats.** Problems assigned to fit the needs of the student. 3 to 9 cred. per qtr. P. A. Anderson, Aunan.
- 213f.w.s.\* Research in Animal Husbandry.** Problems assigned to fit the needs of the student. 3 to 9 cred. per qtr. Ferrin, Hanson, Harvey, Winters.

## ANTHROPOLOGY

Professor Wilson D. Wallis; Associate Professor Lloyd A. Wilford; Assistant Professor Robert F. Spencer.

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

**Master's Degree**—Offered only under Plan A.

**Doctor's Degree**—The department offers work leading to the Ph.D. degree.

### Courses

- 105. Elements of Language.** A survey of speech sounds followed by practice in phonetic recording. Analysis of phonetic patterns in language. Practical work in dictation of Chippewa, Dakota, Finnish, and other languages. 3 cred. Spencer.

- 106s. **European Prehistory.** Types of prehistoric men and cultures. 3 cred. Ar.
- 109f. **General Linguistics.** 4 cred. Spencer.
- 110f. **Physical Anthropology.** Physical types of man, prehistoric and contemporary. 3 cred. Wilford.
- 111w. **Advanced Physical Anthropology.** Prereq.: 110, or Zool. 22 or 133, or a course in human anatomy, or permission. 3 cred. Wallis.
- 113f. **Character of Culture.** 3 cred. Wallis.
- 116s. **Indians of the Southwest.** Pueblo and other tribes. 3 cred. Ar.
- 117s. **Anthropology and Contemporary Problems.** 3 cred. Ar.
- 118w. **Indian Civilizations of Mexico and Central America.** 3 cred. Ar.
- 119s. **Contact of Cultures.** The impact of western civilization on native societies. The tenacity of culture patterns and the disintegration of aboriginal culture. Case examples from North America, Africa, and Asia. 3 cred. Wallis.
- 120f. **Indians of the Plains.** The tribes which lived between the Upper Mississippi and the Rockies, from the forests of western Canada to Texas. 3 cred. Spencer.
- 122f-123w-124s. **Problems in Anthropology.** Advanced work with individual guidance on special problems. Prereq.: permission. Cred. ar. Wallis, Wilford, Spencer.
- 125f. **Peoples of Southeast Asia and Indonesia.** 3 cred. Spencer.
- 126f. **Ethnology of India.** 3 cred. Spencer.
- 127w. **Races and Cultures of China.** 3 cred. Spencer.
- 128s. **Races and Cultures of Japan.** 3 cred. Spencer.
- 129s. **Economic Activities in Primitive Culture.** 3 cred. Ar.
- 131w. **Islamic Culture Sphere.** 3 cred. Spencer.
- 140su.‡ **Field Trip in Archeology.** Prereq.: limited to male students, permission. 1 to 12 cred. Wilford.
- 161s. **Primitive Religion.** Concepts of the sacred and the supernatural. Religious and ceremonial practices. 3 cred. Wallis.
162. **Peoples of Negro Africa.** Physical types; social, political, and economic phases of the cultures of Negro Africa. 3 cred. Ar.
- 165f. **Psychological Phases of Culture.** The role of the individual in primitive culture. Psychological factors in diffusion of culture traits. 3 cred. Spencer.
- 166f. **History of Anthropological Theory and Method.** An examination and critique of theory and method in historical perspective. 3 cred. Wallis.
- 169w. **Peoples of the South Seas.** Survey of the native cultures of the Pacific Islands. 3 cred. Spencer.
- 171s. **Peoples of Northeastern Asia and Northwestern North America.** 3 cred. Spencer.
- 172f. **Indians of South America.** 3 cred. Ar.
- 204f-205w-206s. **Seminar in Anthropology.** Individually directed research. 3 cred. per qtr. Wallis, Wilford, Spencer.
- 251f-252w-253s. **Seminar in Culture and Personality.** Prereq.: M.D. degree. Cred. ar. Spencer.

## ARCHITECTURE

Professors Roy Jones, Robert Jones; Associate Professors Robert G. Cerny, Harlan E. McClure, Howard F. Koeper.

**Prerequisites**—The graduate major in architecture in every case is architectural design. The prerequisite for this field is graduation from a professional curriculum in architecture equal in extent and quality to that of the University of Minnesota.

**Master's Degree**—Work for the Master's degree is offered only under Plan A.

‡ This course may be taken for credit only once.

### Courses

- 104f. City Planning.** (Same as Pol. Sci. 123, Soc. 106.) Social, economic, political, and technical phases of modern city planning. For mature students in the College of Science, Literature, and the Arts and the Institute of Technology. 3 cred. Robert Jones, Anderson, Caplow, Filipetti, Valle.
- 105w. Professional Relations.** Relations of the architect to clients, contractors, and fellow practitioners. Procedures of architectural practice. 3 cred. Cavin.
- 106s. City Planning.** Technical phases of modern city planning, with special reference to the architects' functions therein. Prereq.: 104. 3 cred. Robert Jones.
- 201f.w.s. Special Researches in Architectural History.** Prereq.: 51-52-53. Cred. ar. Koeper.
- 250f.w.s. (AD-V). Architectural Design, Grade V.** Problems involving individual research in either composition or construction. Prereq.: AD-IV or equiv. Cred. ar. Roy Jones, Robert Jones, Cerny, McClure, Koeper.

### ART

Professors H. Harvard Arnason, Dimitri T. Tselos; Associate Professor John Rood; Assistant Professors Bernard P. Arnest, Lorenz E. A. Eitner, Philip G. Morton, Malcolm H. Myers, Hylton A. Thomas, Donald R. Torbert; Lecturer Cameron Booth.

**Prerequisites**—*For the Master of Arts degree*, a minimum undergraduate preparation of 27 Senior College credits in the history of art or its equivalent.

*For the Master of Fine Arts degree*, admission to candidacy is limited to students who provide evidence of exceptional promise as creative artists in one or more of the following fields: painting, printmaking, sculpture, design.

**Language Requirement**—For any of the three 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**—Offered only under Plan A. The thesis subject and major work will be in the historical field. A total program of 45 quarter credits is required.

**Master of Fine Arts Degree**—The candidate for the master of fine arts degree must complete a program of approximately 90 quarter credits, and submit a thesis in the form of creative work. Eighteen quarter credits, not including the thesis seminar, will be earned in courses in the history and criticism of art. The remainder of the credits will be in studio courses in art and in such areas of study outside the Art Department as are approved for the individual student by the M.F.A. Committee. The candidate must be in continuous residence at the University through the three quarters immediately prior to his graduation.

**Master of Arts Degree in Art History**—This two-year degree places special emphasis on preparation for art museum work. The candidate must have an undergraduate major in art history of approximately 27 credits of Senior College courses or the equivalent with permission of his adviser. Some experience in studio work, preferably design, is recommended. To earn the degree he must offer 45 credits of course work in-

cluding a minimum of 27 credits in art history and criticism, the other 18 credits being divided between studio courses in design and courses outside the Department of Art. The required thesis will be in history or criticism of art.

The candidate will devote about half of his time over a two-year period to intern work in museums of the Twin Cities.

**Doctor's Degree**—The Department of Art offers work leading to the Ph.D. degree in the history and criticism of art.

## Courses

### HISTORY OF ARTS

- 106f. Art in Egypt, Mesopotamia, and Greece.** Architecture, sculpture, and painting of the pre-Hellenic civilizations in Egypt, Mesopotamia, and the Aegean. Development of Greek art from its beginnings to the Periclean age. 3 cred. Eitner.
- 107w. Hellenistic Art to Christian Art.** Art of the Hellenistic kingdoms. Hellenic and Etruscan art in Italy. Art of the Roman Empire. The transformation of classical styles under the influence of oriental traditions and of Christian religion. Development of Christian art. Art of the Byzantine Empire. Survivals of classical forms in early medieval art. 3 cred. Eitner.
- 108s. Romanesque and Gothic Art.** Development of architecture, sculpture, and painting in western Europe and Italy from the tenth to the fifteenth century. Art of the cathedrals. Romanesque and Gothic monumental and manuscript painting. Development of Gothic art as manifestation of currents in medieval culture. 3 cred. Eitner.
- 116f. The Origins of Renaissance Art in Italy.** Development of Italian painting and sculpture from Byzantine and Gothic traditions. The Pisani, Giotto and his followers, Duccio, Simone Martini and the Lorenzetti. Continuation of Gothic traditions. The International Style. 3 cred. Thomas.
- 117w. Early Renaissance Art and Architecture in Italy.** The monumental realists in Florence: Masaccio, Donatello, Ghiberti. Origins of Renaissance architecture: Brunelleschi, Alberti. The Umbrian painters; Piero della Francesca. Development of North Italian painting; Mantegna, Antonello da Messina, the Bellini, Florentine fifteenth-century sculpture and architecture. Siennese sculpture and painting; Jacopo della Quercia. 3 cred. Thomas.
- 118s. High Renaissance Art and Architecture in Italy.** Works of Leonardo da Vinci, Raphael, and Michelangelo. Venetian painters of the High-Renaissance; Titian, Tintoretto, Veronese. The mannerists. Proto-Baroque currents. 3 cred. Thomas.
- 116Af. Northern Renaissance Art.** Late Gothic manuscript illumination in the fourteenth and fifteenth centuries; the International Style in the North. The beginnings of Renaissance painting in the North: Jan van Eyck, Robert Campin, Rogier van der Weyden, Konrad Witz, and their contemporaries. Late Gothic and early Renaissance sculpture and minor arts. 3 cred. Ar. (Offered 1952-53.)
- 117Aw. Northern Renaissance Art.** Development of Flemish and Dutch painting in the late fifteenth and early sixteenth centuries: Memling, David, Van der Goes, Bosch. The German Renaissance: Dürer, Grunewald, Altdorfer, Cranach. 3 cred. Ar. (Offered 1952-53.)
- 118As. Northern Renaissance Art.** The late sixteenth century in Flanders and Germany: the mannerists and Breughel, Holbein. Renaissance art in France, Spain, and England. Sixteenth-century Renaissance sculpture and architecture in the North. 3 cred. Ar. (Offered 1952-53.)
- 126f. Baroque Art of Italy and Spain.** The Academy and the reform of mannerism. Caravaggio and the early realists. Seventeenth-century painting, architecture, and sculpture in Italy and Spain. 3 cred. Ar. (Offered 1953-54.)

§ Unless otherwise noted the prerequisite for History of Art courses is 9 credits in history of art, or literature, or history with permission.

- 127w. Baroque Art of Northern Europe.** Emphasis on the work of Rubens and Rembrandt. The classic tradition of the seventeenth century in the painting, architecture, and sculpture of France and England. 3 cred. Ar. (Offered 1953-54.)
- 128s. The Art of Eighteenth-Century Europe.** The transformation into the Neoclassicist reaction in the arts of Italy, France, England, and Germany. 3 cred. Ar. (Offered 1953-54.)
- 136f. Art in the United States.** The Origins. Painting, sculpture, and architecture from the beginnings through the Colonial and Revolutionary periods. Relations with England and the European continent. Copley, Stuart, West, and their followers. Influence of Jefferson. 3 cred. Torbert.
- 137w. Art in the United States.** The Nineteenth Century. The 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 cred. Torbert.
- 138s. Art in the United States.** The Contemporary Movements. The Armory Show and development of modern realism, expressionism, and abstraction. Frank Lloyd Wright and modern American architecture. 3 cred. Torbert.
- 146f. European and American Architecture: 1775-1850.** Revivalist and progressive movements; Neoclassic and Neo-Gothic styles; the genesis of modern style under rationalism and industrial revolution. Emphasis on the contributions of the most important architects of France, England, and the United States. Prereq.: 1, 9 cred. in hist. of art, lit., hist. or permission. 3 cred. Tselos. (Offered 1953-54.)
- 147w. European and American Architecture: 1850-1900.** Victorian Gothic, eclecticism, and the rise of modern pragmatism in architecture within historical and antihistorical currents; the influence of Victorian Gothic and French academism on American architecture and the divergent reactions to it in Art Nouveau and the Chicago School. Prereq.: 1, 9 cred. in hist. of art, lit., hist. or permission. 3 cred. Tselos. (Offered 1953-54.)
- 148s. Modern Architecture: 1900-1950.** Rise of proto-modern architecture in European and American centers; development of the new international style and its various phases; its relation to modern sculpture and painting and its meaning in the new esthetic directions. Prereq.: 1, 9 cred. in hist. of art, lit., hist. or permission. 3 cred. Tselos. (Offered 1953-54.)
- 156f. European and American Painting: 1775-1830.** The beginnings of classicism and romanticism in the late baroque. The art of the French Revolution and of the Napoleonic era. The classical and Gothic revivals. Goya, David, Delacroix, Ingres and their contemporaries. Prereq.: 1, 9 cred. in hist. of art, lit., hist., or permission. 3 cred. Eitner. (Offered 1952-53.)
- 157w. European and American Painting: 1830-1875.** The last phases of romanticism and classicism. The realist movement and the further development of realism in impressionism. The later work of Delacroix and Ingres; Courbet, Millet, Manet, Monet, Renoir, Degas, and their contemporaries. Prereq.: 1, 9 cred. in hist. of art, lit., hist., or permission. 3 cred. Eitner. (Offered 1952-53.)
- 158s. European and American Painting: 1875-1900.** The reaction against impressionism; neoromanticism, symbolism, postimpressionism. The pre-Raphaelites. The work of Gauguin, Van Gogh, Toulouse Lautrec, Cezanne. The neoimpressionists. Prereq.: 1, 9 cred. in hist. of art, lit., hist., or permission. 3 cred. Eitner. (Offered 1952-53.)
- 156Af-157Aw-158As. Twentieth-Century European and American Painting.** Growth of modern painting and of the postimpressionist inheritance; French Fauves and German Expressionists; the impact of primitive art and its assimilation in cubism; the puristic defections and rise of Dada and surrealism; the new objectivity, the new romanticism and the new eclecticism; attention to peculiarly American assimilation of the European phases of painting. 3 cred. per qtr. Arnason. (Offered 1953-54.)
- 166f. European and American Sculpture from Houdon to Rodin: 1770-1900.** Transition from the rococo to neoclassicism; the academic, romantic, and realistic currents culminating in impressionistic realism in Rodin. Parallel

- developments in Germany, England, and the United States are considered in terms of their outstanding representative sculptors. Prereq.: 1, 9 cred. in hist. of art, lit., hist. or permission. 3 cred. Arnason.
- 167w. Modern Sculpture in Europe and the United States: 1900-1950.** Influence of Rodin and the reactions against his impressionist romanticism; the direction toward the archaic, medieval, and primitive sculpture; the impact of abstract painting and the expansion of the limits of sculpture into symbolic primitivism, constructivism, and kinetic sculpture. Prereq.: 1, 9 cred. in hist. of art, lit., hist. or permission. 3 cred. Arnason.
- 168s. The History of the Graphic Arts.** Origins of the woodcut and of engraving. Renaissance and baroque master etchers and engravers. Mantegna; Raimondi, Schongauer; Dürer; Holbein; Lucas van Leyden; Callot, Rembrandt. The reproductive and portrait engraving of the seventeenth and eighteenth centuries. Lithography. Gericault; Delacroix; Daumier. Twentieth-century printmaking. Prereq.: 1, 9 cred. in hist. of art, lit., hist. or permission. 3 cred. Thomas.
- 176f-177w-178s. Scandinavian Art.** Painting, sculpture, architecture in Denmark, Norway, Sweden, Finland, and Iceland from the beginnings to the present. After a general survey in the fall quarter, the winter and spring quarters will be devoted largely to modern Scandinavian art with emphasis on recent development in industrial and applied arts. 3 cred. per qtr. Visiting professor.
- 196f-197w-198s. Readings in Art History and Criticism.** Prereq.: permission. 3 cred. per qtr. Staff.
- 206f-207w-208s. Seminar in European and American Architecture.** Prereq.: permission. 3 cred. per qtr. Tselos.
- 216f-217w-218s. Seminar in European and American Painting.** Prereq.: 27 cred. in Senior College courses in art hist., permission. 3 cred. per qtr. Arnason, Tselos.
- 236f-237w-238s. Seminar Problems in Art History and Criticism.** Prereq.: permission. 3 cred. per qtr. Staff.
- 250f-251w-252s. Thesis Seminar.** Independent creative and critical research. Required of M.F.A. students. Also open to second year M.A. and Ph.D. students. Prereq.: permission of graduate adviser. No cred. Arnest, Booth, and staff.

## STUDIO COURSES

- 101w-102s. Ceramic Sculpture.** A course designed to provide a disciplined and permanent medium for advanced sculpture integrated with the courses offered in wood, stone, and metal; to increase the tactile experience of the student through study of a variety of ceramic materials; to study relationships of abstract form compatible with the requirements of the ceramic medium. Prereq.: 25, 42, 93. 3 cred. per qtr. Frazier.
- 103f. Design in Industry.** Historical development of industrial design. An evaluation, by means of research problems, of the relationship between design, function, and manufacturing processes. Prereq.: Design II. 3 cred. Staff.
- 104w. Design in Industry.** Continued research and field trips investigating design in industry and the effects of mass production of the product. Practical laboratory problems in design for industry. Prereq.: 103. 3 cred. Staff.
- 105s. Design in Industry.** Continuation of 104 leading to a final experimental problem. Prereq.: 104. 3 cred. Staff.
- 123f-124w-125s. Advanced Photography.** An intensive course in photographic technique and use of photography as an art medium. Prereq.: 53, 54, 55, Design II, or equiv. 3 cred. Downs.
- 140f.w.s. Metal Sculpture and Jewelry.** Introduction to metal design in jewelry. Study of the basic processes of soldering, forming, forging, engraving, chasing, and repousse. Prereq.: permission. 3 cred. Morton.
- 141f.w.s. Metal Sculpture and Jewelry.** Special problems in the areas of metal sculpture, relief sculpture in repousse, jewelry, and enameling. Prereq.: permission. 3 cred. Morton.

- 142f,w.s. Metal Sculpture and Jewelry.** Advanced problems in metal sculpture, relief sculpture, jewelry, or enameling. Prereq.: permission. 3 cred. Morton.
- 150f,w.s.,151f,w.s.,152f,w.s. Problems in Painting.** Prereq.: permission. Cred. ar. Staff.
- 180f,w.s.,181f,w.s.,182f,w.s. Problems in Sculpture.** Prereq.: permission. Cred. ar. Staff.
- 190f,w.s.,191f,w.s.,192f,w.s. Advanced Printmaking.** Prereq.: permission. Cred. ar. Myers.
- 193f,w.s.,194f,w.s.,195f,w.s. Advanced Problems in Design.** Offers advanced students opportunity to carry out a creative problem in design with guidance in practice and research methods. Discussion of the common denominators of art as they occur in commercial art, illustration, display and museum techniques, and industrial design. Prereq.: permission. 3 cred. per qtr. Staff.
- 200f-201w-202s. Advanced Problems in Studio Work.** Prereq.: permission. Cred. ar. Staff.

## ASTRONOMY

Professor Willem J. Luyten.

The Astronomical Observatory possesses a ten and one-half inch refracting telescope; a five-inch star camera; a photographic measuring machine by the Société Gènevoise.

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

**Language Requirement**—Exemption from the language requirement for the Master's degree may be made in individual cases by petition.

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

### Courses

- 101f. Celestial Mechanics.** A course dealing with Newton's Laws of Motion and their application to gravitational astronomy. Prereq.: Math. 51. 3 cred. Luyten.
- 121f-122w-123s.\* Astrophysics and Stellar Statistics.** An introductory course on the motions of the stars. 3 cred. per qtr. Luyten.
- 140f. Method of Least Squares.** Applied especially to engineering, physics, and astronomy. Prereq.: Math. 51. 3 cred. Luyten.
- 211f-212w-213s.\* Seminar.** For students who are prepared for advanced work along specific lines. 1, 2, or 3 cred. per qtr. Luyten.

## BACTERIOLOGY AND IMMUNOLOGY

Professors Jerome T. Syverton, M.D., Head, Harold Macy, Ph.D.; Associate Professors Herman C. Lichstein, D.Sc., Joseph C. Olson, Jr., Ph.D., Dennis W. Watson, Ph.D., Newell R. Ziegler, M.D., Ph.D.; Assistant Professors Wendell Hall, M.D., Ph.D., James J. Jezeski, Ph.D., Karl R. Johansson, Ph.D., Edwin L. Schmidt, 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.

**Master's Degree**—Offered under Plan A.

**Doctor's Degree**—Work toward the Ph.D. degree is offered in this department.

**Note**—For information on work in Cancer Biology, see page 62.

## Courses

- 100s.† Bacteriology for Dental Students.** Morphology; methods of staining, culture media; methods of identification; principles of sterilization and disinfection; antibiotics; bacteria and disease; fundamentals of immunology; the oral flora; bacteriology of oral infections, dental caries, alveolar abscess, and periodontal infection; the relationship of oral infections to other focal and general infections. 6 cred. Staff.
- 102w.† Medical Bacteriology.** The pathogenic bacteria, especially in their relationship to disease; principles of infection and immunity; microbiological techniques for laboratory diagnosis and antibiotic determinations. For students other than medical students. Prereq.: 53. 5 cred. Staff.
- 103s. Soil Microbiology.** Methods for enumeration and study of microflora and microfauna. Biochemical activities of soil population. Prereq.: 53, 8 cred. in org. chem., permission. 4 cred. Schmidt.
- 104f. Sanitary Bacteriology.** Standard and other methods for the bacteriological analysis of water, sewage, food, and dairy products. Preparation of standard culture media, technique, and evaluation of results. Primarily for majors in bacteriology. Prereq.: 53, 15 cred. in chem. 4 cred. Johansson.
- 105f-106w.† Principles of Infectious Disease.** The instruction, which includes medical bacteriology, immunology, mycology, and virology, is designed to familiarize medical students with the factors that operate to result in an infectious process. Emphasis is given to the principles and techniques that make possible the diagnosis, treatment, and prevention of specific infectious disease. Prereq.: Anat. 103. Physiol.Chem. 100 or 101, or Biochem. 120. 5 cred. per qtr. Syverton and staff.
- 112f. General Mycology.** A survey of the perfect fungi with emphasis on life cycles, morphology, physiology, ecology, and economic significance. (Formerly Bact. 113). Prereq.: 53, 15 cred. in bact. or 3 cred. in pl. path. 3 cred. Staff.
- 113w. Actinomycetes and Yeasts.** A study of the taxonomy, morphology, genetics, and ecology of the actinomycetes and yeasts; detailed consideration is given to the physiology and economic importance of these microorganisms. (Formerly Bact. 114). Prereq.: 112. 3 cred. Roth.
- 114s. Medical Mycology.** The pathogenic fungi and the mycotic infections in man and animals; emphasis on diagnostic procedures. Prereq.: 102. 3 cred. Staff. (Offered 1952-53 and alternate years.)
- 115s. The Fungi Imperfecti.** The ecology, biochemistry, nutrition, metabolism, genetics, and economic role of the more important genera of the asexual fungi. Prereq.: 112. 3 cred. Roth. (Offered 1953-54 and alternate years.)
- 116s.\* Immunology.** Mechanism of the interactions between host and parasite. Techniques and theories of serologic procedures; laws of hemolysis, quantitative relationship between antigen and antibody; opsonins, serums, vaccines, toxin, antitoxin, complement fixation, neutralization, precipitative and agglutinative reactions, blood grouping, atopy, anaphylaxis. Prereq.: 102 or 105. 3 cred. Watson.
- 121f. Physiology of Bacteria.** A detailed study covering: chemical and physical structure; staining; growth; influence of environment on growth; nutrition; enzymes; metabolism. Required of all bacteriology majors. Prereq.: 53, 8 cred. in org. chem. or biochem. 3 cred. Lichstein.
- 122w. Physiology of Bacteria Laboratory.** Techniques employed in study of bacterial physiology and metabolism. Required of all graduate students in bacteriology; open to others by permission. Prereq.: 121. 3 cred. Lichstein.
- 123s. Bacterial Metabolism.** Advanced treatment of several broad aspects of metabolism including enzymes; biological energy; fermentation; respiration; nitrogen metabolism; photosynthesis. Required of all graduate students in bacteriology; open to others by permission. Prereq.: 121-122 or equiv., introductory biochem. 3 cred. Lichstein. (Offered 1953-54 and alternate years.)

† Microscope required. Students may obtain use of microscope by purchasing \$3 microscope cards from the bursar.

- 124f. Viruses and Rickettsia.** Character, nature, and transmission of viruses and rickettsia; important viral and rickettsial diseases; method for identification and laboratory diagnosis. Prereq.: 102 or 105, 116. 4 cred. Syverton.
- 201f.w.s. Research in Bacteriology and Immunology.** Graduate students with the requisite preliminary training may elect research, either as majors or minors in bacteriology or immunology. Hours and cred. ar. Syverton and staff.
- 203f.w.s. Seminar.** 1 cred. Staff.
- 204w-205s. Advanced Bacteriology.** Techniques in bacteriology; microscopy and photomicrography; methods for studying variation; quantitative methods; cultivation and identification of anaerobes; methods of studying bacterial reactions catalyzed by enzymes. Prereq.: 121-122, which may be parallel, permission. 3 cred. per qtr. Ar.
- D.H.115s. Advanced Dairy Bacteriology.** Investigations of specific problems in the microbiology of milk and dairy products. Prereq.: D.H. 150 or equiv., D.H. 111 or 112. 3 cred. Jezeski.
- D.H.150w. Dairy Bacteriology.** Microbiology in relation to milk production and the processing of milk and dairy products. Lect. and lab. Prereq.: Bact. 53. 3 cred. Olson.
- D.H.212f,\*213w,\*214s,\*215su,216su. Research in Dairy Bacteriology.** Opportunities and facilities are offered for investigation and advanced study of problems involving the bacteriology and mycology of milk and dairy products. Open in the Summer Session only to those who have preliminary graduate work. Cred. ar. Macy, Olson, Jezeski.
- Pl.Path.117f. Virus Diseases of Plants.** The nature of plant viruses and types of diseases they cause; particular emphasis on methods for studying virus diseases. Prereq.: Pl.Path. 1 or 10. 3 cred. King. (Offered 1953-54 and alternate years.)

## BIOPHYSICS

Professors Otto H. Schmitt (adviser for Biophysics); K. Wilhelm Stenstrom (adviser for Medical Physics and Radiology); Edward J. Baldes (adviser for Biophysics and Medical Physics, Mayo Clinic). Staff for the program in Biophysics is drawn from the departments of Physics, Zoology, and Botany and from the Medical School and the Mayo Clinic.

**Prerequisites**—Basic preparation in biology, physics, chemistry, and mathematics with an undergraduate major in one of these subjects or in biophysics is required. Each program for graduate work in biophysics must be approved by the appropriate adviser.

**Language Requirement**—Either (a) two foreign languages or (b) one foreign language and the option of a collateral field of knowledge.

**Master's Degree**—Offered in general under Plan A. By petition Plan B may be followed.

**Doctor's Degree**—This department offers work leading to the Ph.D. degree.

### Courses

- Biophys.105.** A review of elementary physics for medical students. (Part of Rad. 121.) By arrangement with instructor. 1 cred. Stenstrom.
- Biophys.138f.w.s. Seminar in General Physiology and Biophysics.** Cred. ar. Staff.
- Zool.155,\*156,\*157.\* Biophysics.** Theoretical and experimental aspects of biology that can be studied by quantitative physical means. Course 155: Tissue ultrastructure (biostatics) as revealed by hypermicroscopy, birefringence, X ray, electron and radioactive means, and by colloidal and micellar phenomena. Course 156: Dynamics of biophysical systems: excitatory state, contraction, secretion, synthesis. Course 157: Integrative biophysical systems:

stability of systems, transmission of information, sensory mechanisms. The schedule and credit for these courses may be irregular; students wishing to register should consult the department. Any section may be taken separately. Prereq.: 28 cred. distributed between phys. and biol., permission; phys. chem. and general physiol. recommended. 3 cred. per qtr. Schmitt.

**Biophys.170f.w.s.su. Problems in Biophysics.** Investigations of the effects of Roentgen, radium, visible, and ultraviolet radiation may be undertaken. Instruments are available for spectrophotometric work in the visible and ultraviolet regions, for temperature measurements by means of thermocouples, and to a certain extent for electrical measurements. Hours and cred. ar. Stenstrom.

**Biophys.204f.w.s.su.\* Research in Biophysics and Physiology of Radiation.** Cred. ar. Stenstrom.

**Biophys.221f.w.s-222f.w.s\*-223f.w.s.\* Research in Biophysics.** Cred. ar. Schmitt.  
**Zool.296f\*-297w\*-298s.\* Seminar in Biophysics.** Cred. ar. Schmitt.

Credit in biophysics is regularly granted for the following courses drawn from other departments. For descriptions of courses listed only by title, see detailed listings under the respective departmental headings.

**Bot.118w. Extranuclear Cytology.** 3 cred. Dahl.

**Bot.119f. Nuclear Cytology.** 3 cred. Dahl.

**Phys.Chem.101f-102w-103s. Physical Chemistry.** 3 cred. per qtr. Crawford, Lipscomb, Wertz.

**Phys.101f-103w-105s. Theoretical Physics.** 5 cred. per qtr. Nier.

**Phys.107f\*-109w\*-111s.\* Modern Physics.** 3 cred. per qtr. Collins.

**Phys.110w.s\*-112w.s.\* Modern Experimental Physics.** 3 cred. per qtr. Ar.

**Phys.120f.\* Atomic Physics.** 3 cred. Blair.

**Phys.121w.\* Experimental Nuclear Physics I.** 3 cred. Blair.

**Phys.134f.w.\* Experimental Optics.** 3 cred. Valasek.

**Phys.144f. Electrical Measurements.** 3 cred. Blair.

**Phys.146w.\* Electronics.** 3 cred. Blair.

**Phys.148s. Applications of Electronic Circuits.** 3 cred. Ar.

**Phys.181f\*-183w\*-185s.\* Atomistics and Elementary Quantum Mechanics.** 3 cred. per qtr. Williams.

**Phys.191f\*-192w\*-193s.\* Introduction to Mathematical Physics.** 3 cred. per qtr. Hill.

**Physiol.106s-107su.† Human Physiology.** 15 cred. Visscher, Gellhorn, and others.

**Zool.100f.101w.102s. Zoological Techniques.** The content of this course is subject to the direction of the major adviser. Cred. ar., not to exceed 3 cred. per qtr. Ar.

**Zool.109w. Sense Organs.** 3 cred. Minnich.

**Zool.110s. Animal Reactions.** 3 cred. Minnich.

**Zool.112f\*-113w.\* Advanced General Physiology.** 3 cred. per qtr. Steinbach.

**Zool.128f-129w. Insect Physiology.** 4 cred. per qtr. Richards.

**Zool.140s. Biological Microscopy.** 4 cred. Richards.

**Zool.160f-161w-162s. Cytology.** 3 cred. per qtr. Ar.

**Zool.182s. Experimental Embryology.** 5 cred. Spratt.

**Zool.291f-292w-293s. General Seminar.** Ar.

## BIOSTATISTICS

Professor Alan E. Treloar, Ph.D.; Lecturer Lillian R. Elveback, M.A.

**Prerequisites**—Satisfactory evidence of high aptitude for quantitative reasoning, supplemented by scientific training of a broad character. Preparation in college mathematics through differential calculus is highly desirable, but not essential if there is a compensating breadth in scientific background.

**Language Requirement**—For the M.S. degree none. For the Ph.D. either (a) two foreign languages or (b) one foreign language and the

option of either a special research technique or a collateral field of knowledge.

**Major**—Courses in mathematics, applied statistics, philosophy, and the sciences may be required at the discretion of the adviser as part of the major program.

**Minor**—Courses in statistics or closely related fields may be accepted as part of a minor program. Approval must be secured from the minor adviser.

**Master's Degree**—Offered under both Plan A and Plan B. (See the *Bulletin of the School of Public Health* for the master of public health degree.)

**Doctor's Degree**—Work for the Ph.D. degree is offered both in this department and under the Statistics curriculum (see page 27) in accordance with the general requirements of the Graduate School.

### Courses

- P.H.110f.s. Biometric Principles.** An introduction to statistical analysis with special reference to large samples and the basic principles of reasoning. Description of univariate distributions, normal correlations, and simple tests of significance. Prereq.: College algebra, 111 parallel. 3 cred. Treloar, Johnson, Erickson.
- P.H.111f.s. Biostatistics Laboratory.** Practical training in techniques discussed in Course 110, which must be parallel. 2 cred. Johnson, Erickson.
- P.H.120w.\* Advanced Biostatistics I.** Exact sampling distributions ( $t$ ,  $\chi^2$ ,  $F$ ); small sample tests and their power; analysis of variance. Prereq.: 110 with grade not lower than C; 121 parallel. 3 cred. Elveback.
- P.H.121w. Advanced Biostatistics Laboratory I.** Practical exercises in theory discussed in 120, which must be parallel. 2 cred. Elveback.
- P.H.130s.\* Advanced Biostatistics II.** Continuation of 120, including correlation and regression with two or more variables; further discussion of  $\chi^2$  and analysis of variance. Prereq.: 120 with grade not lower than C, 131 parallel. 3 cred. Elveback.
- P.H.131s. Advanced Biostatistics Laboratory II.** Practical exercises associated with 130, which must be parallel. 2 cred. Elveback.
- P.H.140w. Vital Statistics I.** Study of official sources; population changes; rates; trends; tests of significance. Prereq.: permission. 3 cred. Treloar and staff.
- P.H.150s.\* Vital Statistics II.** Sources of error in vitality records; adjustment procedures; morbidity and survival rates; the life table and its application in medical problems. Prereq.: permission. 3 cred. Treloar. (Offered when demand warrants.)
- P.H.200f.w.s.\* Research in Biometry.** By special arrangement only. Staff.
- P.H.201f.w.s.\* Topics in Biometry.** Individual studies by special arrangement. Staff.
- P.H.211f.w.s. Seminar in Biometry.** By special arrangement only. Staff.

### BOTANY§

Professors A. Orville Dahl, Chairman, Ernst C. Abbe, Donald B. Lawrence; Associate Professors Allan H. Brown, Albert W. Frenkel, Gerald B. Ownbey; Assistant Professor John W. Hall; Instructor Thomas Morley.

**Prerequisites**—For major work, General Botany (Course 1-2-3 or 4-5 or equivalent) and at least 17 additional credits in botany approved by the department; with permission of the major adviser, credits in related

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

subjects may be substituted. For minor work, General Botany (Course 1-2-3 or 4-5 or equivalent).

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

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

**Doctor's Degree**—The department offers work leading to the Ph.D. degree.

### Courses

- 106w. **A Survey of Angiosperm Families I—Lower Angiosperms.** Prereq.: 52 or permission. 3 cred. Morley. (Not offered 1952-53.)
- 107s. **A Survey of Angiosperm Families II—Higher Angiosperms.** Prereq.: 106. 3 cred. Morley. (Not offered 1952-53.)
- 108w. **Pteridophytes.** The classification of living ferns and fern allies. Prereq.: 52 or permission. 3 cred. Ownbey. (Not offered 1952-53.)
- 110f. **Gymnosperms.** Classification of gymnosperms. Prereq.: 52 or permission. 3 cred. Ownbey. (Not offered in 1953-54.)
- 112w. **Aquatic Flowering Plants.** Prereq.: 10 cred. in bot. or zool. or permission. 3 cred. Ownbey.
- 113f. **Fall Flora of Minnesota.** A survey of the flowering plants of the state with particular reference to the fall flora of the local area. Prereq.: 52 or equiv. or permission. 3 cred. Ownbey, Morley.
- 114w. **Phyletic Taxonomy of Angiosperms.** A study of evolutionary relationships within the angiosperms. Prereq.: 52 or permission. 3 cred. Morley. (Not offered 1953-54.)
- 115s. **Spring Flora of Minnesota.** A survey of the flowering plants of the state, especially the spring flora of the local area. Prereq.: 52 or equiv. or permission. 3 cred. Ownbey, Morley.
- 116su. **Summer Flora of Minnesota.** Offered only at Itasca Biological Station. Prereq.: 10 cred. in bot. or zool. or permission. 4 cred. Ar.
- 117s. **Floristic Plant Geography.** Prereq.: 52 or permission. Cred. ar. (Not offered 1952-53.)
- 118w. **Extranuclear Cytology.** Studies of the structure of protoplasm, cytoplasmic constituents, and the cell wall. Lect., lab., reading. Prereq.: 10 cred. in bot. or zool. or permission. 3 cred. Dahl.
- 119f. **Nuclear Cytology.** Studies of chromosomes and other nuclear structures. Nuclear phenomena, life cycles, and taxonomy. Lect., lab., reading. Prereq.: 10 cred. in bot. or zool. and an elementary course in genetics, or permission. 3 cred. Dahl.
- 120s. **Research Methods in Cytology.** Principles and practice of preparing materials for cytological investigation. Lect., lab., reading. Prereq.: 1-2-3 or 4-5, 118 or 119, and permission. 3 to 5 cred. Dahl, Hansen. (Not offered 1953-54.)
- 121f. **Developmental Anatomy.** Origin and structure of the organs of higher vascular plants. Prereq.: 10 cred. in bot. 3 cred. Abbe.
- 123w. **Research Methods in Histology.** Principles and practice of preparing materials for histological investigation; photomicrography; preparation of manuscript. Prereq.: 1-2-3 or 4-5, 121 or 125, permission. 3 to 5 cred. Abbe, Hansen. (Not offered 1952-53.)
125. **Morphogenesis.** Response of the vegetative body of the plant to environmental and genetical change. Prereq.: 10 cred. in bot. 3 to 5 cred. Abbe. (Not offered 1953-54.)
- 127w. **Morphology of Vascular Plants.** A detailed consideration of the evolutionary interrelationships of the vascular plants. Prereq.: 10 cred. in bot. 5 cred. Abbe. (Not offered 1952-53.)
- 128s. **Introduction to Paleobotany.** Identification and structure of fossil plants; relationship of fossil plants to modern groups. Prereq.: 54 or permission. 3 cred. Hall.

- 130f.\* **General Plant Ecology.** Interrelations of plants and environment. Term paper required. Prereq.: 10 cred. in bot. 3 cred. Lawrence, Hulbert.
- 131f. **Field Ecology.** Vegetation of the Twin Cities region. Written reports. Prereq.: 50 or 130 or Forestry 3, 4. 5 cred. Lawrence, Hulbert.
- 132w. **Morphological Ecology.** Evolution of life forms. Term paper required. Prereq.: 50 or 130 or Forestry 3, 4. 5 cred. Lawrence, Hulbert. (Not offered 1952-53.)
- 133s. **Ecological Plant Geography.** Vegetation of North America. Term paper required. Prereq.: 50 or 130 or Forestry 3, 4. 5 cred. Lawrence, Hulbert.
- 134f. **Research Methods in Ecology.** Vegetation sampling, measurement of environment, scientific writing. Term paper required. Prereq.: 18 cred. in plant science including 50 or 130. 5 cred. Lawrence, Hulbert.
- 137s. **Experimental Ecology.** Ecological life histories, field manipulation of plants and communities, measurement and presentation of results. Term paper required. Prereq.: 18 cred. in plant science including 50 or 130, 51. 5 cred. Lawrence, Hulbert.
- 140f. **Advanced Survey of Plant Physiology.** Designed for graduate students or advanced undergraduates having a rudimentary knowledge of plant or animal physiology and desiring a comprehensive survey course at a somewhat more advanced level than is provided by 51. Students who have had 51 should not enroll in 140. Prereq.: an elementary course in bot. or zool., a course in pl. physiol., or permission, a course in org. chem. or biochem. 3 cred. Frenkel.
- 154f. **Spectroscopy and Photochemistry Applied to Biology.** Prereq.: 20 cred. in chem. or biochem. or permission. 3 to 5 cred. (Not offered 1952-53.)
- 165s. **Introduction to Pollen Analysis.** Basic pollen morphology in relation to pollen analysis in allergy, ecology, and phylogeny. Lect., lab., reading. Prereq.: permission. 3 cred. Dahl. (Not offered 1952-53.)
- 170f. **Water Relations of Plants.** Prereq.: 51 or 140, 20 cred. in chem. or biochem., Phys.Chem. 101-102-103 or 107, or permission. 3 cred. Brown, Frenkel. (Not offered 1953-54.)
- 171w. **Mineral Nutrition of Plants.** Prereq.: 51 or 140, 20 cred. in chem. or biochem., Phys.Chem. 101-102-103 or 107, or permission. 3 cred. Brown, Frenkel. (Not offered 1953-54.)
- 172s. **Plant Growth.** Prereq.: 51 or 140, 20 cred. in chem. or biochem., Phys. Chem. 101-102-103 or 107, or permission. 3 cred. Brown, Frenkel. (Not offered 1953-54.)
- 173f, 174w, 175s. **Advanced Physiology Laboratory.** To be taken with or after 170, 171, 172, respectively. 2 cred. per qtr. Brown, Frenkel. (Not offered 1953-54.)
- 176f. **Plant Respiration.** Prereq.: 51 or 140, 20 cred. in chem. or biochem., Phys. Chem. 101-102-103 or 107, or permission. 3 cred. Brown, Frenkel. (Not offered 1952-53.)
- 177w. **Photosynthesis.** Prereq.: 51 or 140, 20 cred. in chem. or biochem., Phys. Chem. 101-102-103 or 107, or permission. 3 cred. Brown, Frenkel. (Not offered 1952-53.)
- 178s. **Nitrogen Metabolism of Plants.** Prereq.: 51 or 140, 20 cred. in chem. or biochem., Phys.Chem. 101-102-103 or 107, or permission. 3 cred. Brown, Frenkel. (Not offered 1952-53.)
- 179f, 180w, 181s. **Advanced Physiology Laboratory.** To be taken with or after 176, 177, 178, respectively. 2 cred. per qtr. Brown, Frenkel. (Not offered 1952-53.)
- 194su,\*195su,\*196su,\*197f,\*198w,\*199s.\* **Problems.** Advanced work in a specialized field. Prereq.: 20 cred. in natural science and permission. 1 to 5 cred. per qtr. Ar.
- 201f,\*202w,\*203s,\*204su.\* **Research Problems in the Morphology of Vascular Plants.** Cred. ar. Abbe.
- 205f,\*206w,\*207s,\*208su.\* **Research Problems in Taxonomy.** Cred. ar. Ownbey, Morley.
- 209f\*-210w\*-211s.\* **Research Problems in Paleobotany.** Cred. ar. Hall.

- 221f.\*222w.\*223s.\*224su.\* **Research Problems in Ecology.** Cred. ar. Lawrence, Hulbert.
- 225f.\*226w.\*227s.\*228su.\* **Research Problems in Plant Physiology.** Cred ar. Brown, Frenkel.
- 229f.\*230w.\*231s.\*232su.\* **Research Problems in Cytology.** Cred. ar. Dahl.
- 240f-241w-242s. **Seminar in Morphology.** 1 cred. per qtr. Abbe.
- 243f-244w-245s. **Seminar in Taxonomy.** 1 cred. per qtr. Ownbey, Morley.
- 246f-247w-248s. **Seminar in Paleobotany.** 1 cred. per qtr. Hall.
- 249f-250w-251s. **Seminar in Ecology.** 1 cred. per qtr. Lawrence, Hulbert.
- 252f-253w-254s. **Seminar in Plant Physiology.** 1 cred. per qtr. Brown, Frenkel.
- 255f-256w-257s. **Seminar in Cytology.** 1 cred. per qtr. Dahl.

### CANCER BIOLOGY

Professors John J. Bittner, Ph.D., Head, Maurice B. Visscher, M.D., Ph.D.

**Prerequisites**—Graduate study in the field of cancer biology, leading to the Ph.D. degree, with a major in cancer biology, is offered to qualified students who have a broad background in basic sciences.

**Language Requirement**—Either (a) two foreign languages or (b) one foreign language and the option of a collateral field of knowledge.

**Major**—Candidates for the Ph.D. degree with a major in cancer biology may offer toward the major graduate work in any one of the following fields: cytology and organology, bacteriology, pathology, physiology, and genetics. Attendance at the seminar in cancer biology is required of all students in cancer biology. The thesis must deal with the field of the major.

**Minor**—It is suggested that students majoring in cancer biology present a minor in any one of the following fields: pathology, genetics, virology, bacteriology, physiology, biochemistry, cytology, histology.

#### Courses

- 140f.w.s. **Seminar in Cancer Biology.** 1 cred. Bittner.
- 141f.w.s. **Problems in Cancer Biology.** Cred. and hours ar. Bittner.
- 207f.w.s. **Research in Cancer Biology.** Cred. and hours ar. Bittner.

### CHEMISTRY

Professor Lloyd H. Reyerson, Head and Assistant Dean.

Work in the School of Chemistry is organized in two departments, Chemistry and Chemical Engineering. The Department of Chemistry is composed of four divisions—Analytical, Inorganic, Organic, and Physical Chemistry.

The candidate for a higher degree is expected to show, in addition to the completion of the prescribed work, a maturity acquired by intensive personal study of the literature and of the methods of chemistry.

**Prerequisites**—For a major in chemistry, all candidates must offer the substantial equivalent of the courses in inorganic chemistry, analytical chemistry, organic chemistry, and physical chemistry required of undergraduate students in the first three years of the chemistry curriculum, at least one year of college physics, and one year of college mathematics.

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

**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**—In the School of Chemistry, candidates for the Master's degree must have a reading knowledge of German or French; German is preferred. For the Doctor's degree two foreign languages are required, one of which must be German.

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

**Master's Degree**—Work for the Master's degree is offered under Plan A. Plan B is occasionally permitted with approval of graduate group committee.

**Doctor's Degree**—Candidates for the doctorate must satisfactorily complete the following courses before the fifth quarter in residence: Inorganic Chemistry 260, Organic Chemistry 261, Analytical Chemistry 262, Physical Chemistry 263, and (for minors in Chemical Engineering only) Chemical Engineering 264.

## CHEMISTRY, ANALYTICAL

Professors Izaak M. Kolthoff, Ernest B. Sandell; Associate Professor Edward J. Meehan.

### Courses

- 101w-102s. Quantitative Analysis.** General principles, methods, and procedures of gravimetric and volumetric analysis. Typical problems are assigned and attention is given to proper laboratory practice. Prereq.: Inorg.Chem. 13. 5 cred. per qtr. Meehan.
- 103s. Quantitative Inorganic Microanalysis.** Representative methods of micro- and semi-microanalysis, gravimetric, volumetric, and colorimetric. Prereq.: 1-2. 3 cred. Limited to 16 students. Sandell.
- 104f. Qualitative Inorganic Microanalysis.** Use of microscope; technique of handling small amounts of materials. Inorganic qualitative analysis by crystal reactions and spot tests. Prereq.: 1-2. 3 cred. Sandell.
- 105w. Polarizing Microscope.** Its use and application to chemistry. Identification of substances. Prereq.: Phys.Chem. 101. 3 cred. Limited to 20 students. Sandell.
- 106f-107w-108s. General Technical Analysis.** Analysis of commercially important materials such as iron, steel, non-ferrous alloys, ores, and glass. Use of microscope in technical problems. Prereq.: 1-2. 2 or 3 cred. per qtr. Sandell.
- 109f.w.s.¶ Rock Analysis.** Laboratory course covering the technique of rock analysis. Prereq.: 1-2. 3 cred. Ar.
- 122s. Advanced Analytical Chemistry.** Condensed review of modern fundamentals of gravimetric and volumetric analysis. Prereq.: quantitative chemistry. 2 cred. Meehan.
- 123f.\* Advanced Analytical Chemistry.** Analysis of complex materials by modern methods. Prereq.: 1-2 or permission. 3 cred. Meehan.
- 127f.\* Optical Methods in Analytical Chemistry.** Prereq.: Phys.Chem. 103. 2 cred. Meehan.

¶ Registration is limited. Permission of instructor must be obtained.

- 131f. **Application of Indicators in Neutralization Reactions and pH Determinations.** Prereq.: 1-2, Phys.Chem. 103. 3 cred. Kolthoff.
- 132w. **Electrometric Measurements and Titrations.** Applications of potentiometric and conductometric methods in analytical work. Prereq.: 1-2, Phys.Chem. 103. 3 cred. Kolthoff.
- 133s.\* **Voltammetry and Amperometric Titrations.** The dropping mercury electrode (polarograph) and the platinum microelectrode. Prereq.: Phys. Chem. 103. 2 cred. Kolthoff.
- 134f.w.s.su.\* **Voltammetry and Amperometric Titrations.** Laboratory for 133. 2 cred. Kolthoff.
- 135f-136w-137s.\* **Seminar: Modern Problems in Analytical Chemistry.** Prereq.: 1-2, Phys.Chem. 103. 1 cred. per qtr. Kolthoff.
- 138s. **Advanced Volumetric Analysis.** Prereq.: 131. 3 cred. Kolthoff.
- 140w. **Water Analysis.** Analysis of potable water with interpretation of results. Prereq.: 1-2. 2 cred. Sandell.
- 201f-202w-203s.\* **Selected Topics in Analytical Chemistry.** Cred. ar. Kolthoff, Sandell.
- 262f. **General Survey of Analytical Chemistry.** A course of independent reading under the guidance of the staff. This course is a prerequisite to candidacy for the Ph.D. degree in any field of chemistry and must be completed by the end of the fall quarter of the second year of residence. Prereq.: permission. 1 cred. Kolthoff.
- 301f-302w-303s.\* **Research in Quantitative Analysis.** Cred. ar. Kolthoff, Sandell, Meehan.

### CHEMISTRY, INORGANIC

Professors M. Cannon Sneed, Hervey H. Barber, Lloyd H. Reyerson; Associate Professors Gladstone B. Heisig, Otto H. Johnson, J. Lewis Maynard, Thomas D. O'Brien, Paul R. O'Connor, Norville C. Pervier; Assistant Professors Robert C. Brasted, Alfred R. Pray.

**Prerequisites**—For major or minor work: A Bachelor's degree with a major in chemistry including one year each of organic and physical chemistry, together with calculus, physics, and German. An average of B or better is required.

**Language Requirement**—German is required for the Master's and Doctor's degrees. French is required for the Ph.D. degree, but another language may be substituted by petition.

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

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

### Courses

- 102s. **Semimicro Qualitative Analysis.** Acquaints the student with underlying principles in identification of cations and anions by "spot tests" with inorganic and organic reagents, and with the "pressure bulb method" for filtration. Research problems in analysis are considered. Prereq.: Anal. Chem. 1-2. Cred. ar. Barber.
- 103f\*-104w\*-105s.\* **Advanced Inorganic Chemistry.** Selected topics in theoretical inorganic chemistry. 103: Atomic Structure and the Properties of the Elements Based Thereon; 104: The Chemistry of the More Familiar Elements Based upon Structural and Periodic Relationships; 105: Coordination Compounds. Prereq.: Anal.Chem. 1-2, Org.Chem. 156 and 159. 103, 3 cred.; 104, 4 cred.; 105, 3 cred. O'Brien, Brasted, Maynard.
- 106w\*-107s.\* **Chemistry of Less Familiar Elements.** Prereq.: Anal.Chem. 1-2, Org.Chem. 62. 3 cred. per qtr. O'Brien. (Offered 1952-53 and alternate years.)
- 108s. **Nonaqueous Systems.** Reactions in the principal nonaqueous systems—both protonic and aprotic. Prereq.: Phys.Chem. 101-102-103. 3 cred. Pray.

- 109w-110s.\* Synthetic Inorganic Chemistry.** Methods of preparation and purification of inorganic compounds of special interest. Current literature. Prereq.: Org.Chem. 62 or permission. 3 to 5 cred. per qtr. Heisig.
- 111su. Silicon and Related Elements.** Review of current studies on boron, silicon, germanium, tin, and lead with emphasis on recent silicon chemistry. Prereq.: Anal.Chem. 1-2, Org.Chem. 62. 3 cred. Johnson.
- 134f-135w-136s. Seminar.** Modern problems in inorganic chemistry. Prereq.: Anal.Chem. 1-2, Phys.Chem. 103. 1 cred. per qtr. Sneed and others.
- 260f. Survey of Inorganic Chemistry.** A course of independent reading required of all candidates for the Ph.D. degree in chemistry. Examination by the end of the fall quarter of second year in residence. Prereq.: permission. 1 cred. Staff.
- 301f.su-302w-303s. Research in Inorganic Chemistry.** Cred. ar. Sneed, Reyerson, Barber, Heisig, Johnson, Maynard, O'Brien, O'Connor, Brasted, Pray.

### CHEMISTRY, ORGANIC

Professors Lee I. Smith, Richard T. Arnold, C. Frederick Koelsch, Walter M. Lauer; Associate Professor William E. Parham; Assistant Professor Stuart W. Fenton.

**Prerequisites**—For major work: Bachelor's degree, with minimum average of B, from an approved curriculum involving four years of chemistry and including one year each of organic and physical chemistry together with the necessary supporting subjects (integral calculus, physics, and German). For minor work: One 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 are required, but another language may, by petition and with the approval of the division, be substituted for French. Native languages, except German or French, 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 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 division.

### Courses

- 101w. Intermediate Organic Chemistry.** A survey course which considers important modern topics: unusual types of aliphatic, aromatic and heterocyclic compounds, natural products, and industrial processes. Prereq.: 63, 64, or equiv. 3 cred. Lauer.
- 102f. Organic Qualitative Analysis, Elementary Course.** Reactions of typical functional groups and an introduction to the methods of organic qualitative analysis. Prereq.: 63, 64, or equiv. 4 cred. Fenton.
- 105f-106w-107s.\* Advanced Organic Chemistry.** An advanced descriptive course containing an introduction to the literature of organic chemistry. Prereq.: 63, 64 or equiv. 3 cred. per qtr. Smith.
- 110f. Organic Qualitative Analysis, Advanced Course.** Identification of pure organic compounds, separation and identification of constituents of mixtures. Prereq.: 102 or equiv. Registration limited to 20. 4 cred. Koelsch.
- 116w.\* Heterocyclic Compounds.** A discussion of typical classes of heterocyclic compounds, ring-closures, and the like. Prereq.: 63, 64. 3 cred. Parham. (Offered 1953-54 and alternate years.)

- 130s. Organic Quantitative Analysis.** Methods of proximate and ultimate analysis of organic compounds, with special attention to semimicro methods. Prereq.: 63, 64, Anal.Chem. 1-2. Registration limited to 15. 3 cred. Lauer.
- 139f.w.s. Advanced Organic Chemistry Laboratory Work.** Advanced laboratory problems including some original work. Students are urged to take this course during the winter quarter; permission of the instructor is required to take it at any other time. Prereq.: 63, 64, 156. Registration limited to 20. 2 to 5 cred. Arnold.
- 140f.w.\* Aromatic Compounds.** Discussion of the chemistry of typical aromatic compounds, including derivatives of benzene, naphthalene, anthracene, phenanthrene, and other polynuclear hydrocarbons, together with a consideration of certain heterocyclic compounds which show aromatic character. The properties of these compounds will be illustrated by examples chosen from the sterols and the alkaloids. Prereq.: 63, 64. 3 cred. Koelsch. (Offered alternately in fall and winter quarters; winter, 1952-53, Parham; fall, 1953-54, Koelsch.)
- 141f.\* Reagents in Organic Chemistry.** Discussion of typical reagents used in organic reactions; their limits of applicability, methods of use, and types of substances with which they react. Prereq.: 63, 64. 3 cred. Koelsch. (Offered 1952-53 and alternate years.)
- 142s.\* Chemistry of Natural Products.** Discussion of the organic chemistry of important classes of natural products. Prereq.: 63, 64. 3 cred. Fenton. (Offered 1951-52 and alternate years.)
- 201f-202w-203s.\* Organic Chemistry Seminar.** One hour per week. One cred. per qtr. Required of all students taking major work in organic chemistry. Smith, Arnold, Koelsch, Lauer, Parham, Fenton.
- 205f-206w.\* Theoretical Organic Chemistry.** Structure, reaction mechanisms, relation of physical properties to constitution, and other topics of a theoretical nature. Prereq.: 107. 3 cred. per qtr. Lauer.
- 212s.\* Physico-organic Chemistry.** Contributions made to organic chemistry by kinetic and equilibrium studies of organic reactions, including mechanisms and catalytic and ionotropic reactions; and an introduction to the current electronic formations of organic reactions. Prereq.: 107, Phys.Chem. 103, and calculus, or permission. 4 cred. Arnold or Fenton.
- 261f. General Survey of Organic Chemistry.** A course of independent reading under the guidance of the staff. This course is a prerequisite to candidacy for the Ph.D. degree in any field of chemistry and must be completed by the end of the fall quarter of the second year in residence. Prereq.: permission. 1 cred. Smith.
- 301f-302w-303s. Research in Organic Chemistry.** Prereq.: 110, permission of the division. Cred. ar. Smith, Arnold, Koelsch, Lauer, Parham, Fenton.

## CHEMISTRY, PHYSICAL

Associate Professor William N. Lipscomb; Professors Bryce L. Crawford, Jr., Isaac M. Kolthoff, Robert S. Livingston, Lloyd H. Reyerson; Assistant Professors Paul R. O'Connor, John E. Wertz.

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

### Courses

- 101f-102w-103s.\* Physical Chemistry.** A general survey of the subject. Prereq.: Anal.Chem. 1-2, Phys. 7-8-9, differential and integral calculus. 3 cred. per qtr. Lipscomb, Wertz.
- 104f.su-105w.su-106s.su.\* Physical Chemistry Laboratory.** To accompany or follow 101-102-103. 1 or 2 cred. per qtr. Wertz.

- 107f.su-108w.su. Elementary Physical Chemistry.** Prereq.: 2 years of college chemistry and 1 year of college physics, Math. 15-16 or 6-7. 3 cred. per qtr. Livingston.
- 110f.\* Experimental Research Techniques I.** Physical manipulations, including use of tools and machines as well as a course in glass blowing with demonstrations and practice by the student. Prereq.: 103, permission. 2 cred. Wertz. (Offered 1953-54.)
- 111w. Experimental Research Techniques II.** Materials of research, high vacuum technique, characteristics of thermoionic tubes, rectifiers, amplifiers, oscillators, photocells. Prereq.: 110. 2 cred. Wertz. (Offered 1953-54.)
- 112s. Advanced Physicochemical Experiments.** Precise measurements in various fields: thermochemistry, electromotive force, conductance, analysis of Raman spectrum, surface tension, magnetic susceptibility, dielectric constant, characteristics of the photographic plate, and ionization potentials of a gas. Prereq.: 111. 2 cred. Wertz. (Offered 1953-54.)
- 113w.\* Fundamentals of Reaction Kinetics.** Empirical analysis of rate measurements; collision theory, transition state theory; chain reactions. Prereq.: 103. 3 cred. Livingston.
- 114s.\* Kinetics of Reactions in Liquid and Heterogeneous Systems.** Effect of solvents and electrolytes on reaction velocity, diffusion processes, induced reactions, homogeneous and heterogeneous catalysis. Prereq.: 113. 3 cred. Livingston. (Offered 1953-54 and alternate years.)
- 118s.\* Advanced Physical Chemistry.** Methods of determining molecular structure with simple applications. Chemical and physical properties in terms of the nature of chemical bonds. Prereq.: 103. 3 cred. Lipscomb.
- 120w-121s. Introduction to Molecular Structure.** Elementary quantum mechanics and statistical mechanics discussed and applied to the problem of the chemical bond. Prereq.: 103. 3 cred. per qtr. Crawford. (Offered 1953-54 and alternate years.)
- 123f-124w.\* Crystal Analysis.** Theory and practice of X-ray crystallography. Methods and examples of structure determination. Prereq.: 103. 3 cred. per qtr. Lipscomb. (Offered 1953-54 and alternate years.)
- 128f.\* Colloid Chemistry.** Fundamental principles of colloid chemistry, surface chemistry, electrokinetic phenomena, lyophobic and lyophilic colloids. Prereq.: 103. 3 cred. Reyerson.
- 129w.\* Adsorption and Catalysis.** Fundamental principles of adsorption at the different interfaces and the application of these principles to heterogeneous catalysis. Prereq.: 128. 3 cred. Reyerson.
- 130s.\* Colloids in Industry.** The important applications of colloid chemistry to many of the fields of chemical industry. Prereq.: 128. 3 cred. Reyerson.
- 131s.\* Colloidal Processes.** A survey of the important colloidal processes: coagulation, sol-gel transformation, thixotropy, and dilatancy. Prereq.: 128. 3 cred. Reyerson. (Offered 1953-54.)
- 132f-133w-134s. Colloid Chemistry Laboratory.** Prereq.: 128. 1 or 2 cred. per qtr. Reyerson.
- 161f. Nuclear Chemistry and Radioactivity.** The properties of nuclei, disintegration, properties of radiation; natural and artificial radioactivity; modern views of nuclear structure. Prereq.: 103. 3 cred. per qtr. O'Connor. (After 1954 this course will be listed under Inorganic Chemistry.)
- 175s.\* Photochemistry.** A general survey, including a discussion of spectroscopy, with particular reference to the visible and ultraviolet absorption spectra of molecular gases. Prereq.: 103, Phys. 9. 3 cred. Livingston. (Offered 1952-53 and alternate years.)
- 201f-202w-203s. Thermodynamics and Chemistry.** Detailed study of the principles of thermodynamics and their application to physical and chemical phenomena. Prereq.: 103, calculus. 4 cred. per qtr. Ar.
- 204f-205w-206s. Kinetic Theory and Atomistics.** Kinetic theory of gases and liquids, atomic structure, quantum theory. Prereq.: 103, calculus. 4 cred. per qtr. Crawford.
- 209s. Advanced Crystal Chemistry.** Zone theory of solids. Conduction and bonding in metals. Electrical, magnetic, optical, and mechanical properties of solids in relation to their structure. Prereq.: 103. 3 cred. Lipscomb. (Offered 1953-54 and alternate years.)

- 221f-222w-223s. Colloid Seminar.** 1 cred. per qtr. Reyerson.
- 231f.w.s.† Radioactivity Laboratory.** Use and standardization of electroscopes and Geiger-Müller tubes; radioactive measurements; chemistry of trace quantities. Prereq.: 161 or parallel. 1 or 2 cred. O'Connor. (After 1954 this course will be listed under Inorganic Chemistry.)
- 250f-251w-252s. Physical Chemistry Seminar.** Required of all students majoring in physical chemistry. 1 cred. per qtr. Livingston.
- 254w. Molecular Vibrations.** The dynamics of molecular vibrations will be discussed with the aid of group theory and the result applied to the interpretation of vibrational spectra. 3 cred. Crawford.
- 255s. Quantitative Theory of Valence.** The basic method of both the atomic orbital and molecular orbital techniques will be discussed with quantitative applications. 3 cred. Crawford. (Offered 1953-54 and alternate years.)
- 257f.w.s. Research Seminar in Crystal Structure.** Study of advanced techniques in the determination of crystal structures, and evaluation of the results of crystal structure investigations. 1 cred. per qtr. Lipscomb.
- 262. Radioactive Seminar.** 3 cred. O'Connor. (After 1954 this course will be listed under Inorganic Chemistry.)
- 263f. General Survey of Physical Chemistry.** A course of independent reading under the guidance of the staff. This course is a prerequisite to candidacy for the Ph.D. degree in any field of chemistry and must be completed by the end of the fall quarter of the second year in residence. Prereq.: permission. 1 cred. Ar.
- 301f-302w-303s. Research in Physical Chemistry.** Thermodynamics, electrochemistry, photo- and radiochemistry, reaction kinetics, molecular structure, colloids, adsorption, crystal structure. Cred. ar. Lipscomb, Crawford, Kolthoff, Livingston, Reyerson, O'Connor, Wertz.

## CHEMICAL ENGINEERING

Professors Neal R. Amundson, Norman H. Ceaglske, Edgar L. Piret; Associate Professor Arthur E. Stoppel; Assistant Professors Herbert S. Isbin, Arthur J. Madden, George W. Preckshot.

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

For minor work, mathematics including integral calculus, physics, organic and physical chemistry.

**Major and Minor Work**—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 Phys.Chem. 101-102-103 with laboratory.

**Language Requirement**—For the Master's degree a reading knowledge of German. In special cases approved by the department, French or another language may be submitted. For the Doctor's degree two foreign languages, one of which must be German. The second language must have the approval of the department.

**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 two weeks of fall and spring quarters.

† Registration is limited. Permission of the instructor must be obtained.

**Master's Degree**—Offered under Plan A. Plan B is occasionally permitted with approval of graduate group committee.

**Doctor's Degree**—The Department of Chemical Engineering offers work leading to the Ph.D. degree.

(Professional degrees in engineering—These degrees are all administered by the Institute of Technology.)

### Courses

- 100s. **Chemical Engineering Stoichiometry.** Prereq.: quant. chem. 3 cred. Ceaglske.
- 101f.\*‡ **Unit Operations.** Principles and methods of operation, and uses of the unit operation equipment. Fluid flow and filtration. Lect. and problems. Prereq.: Completion of two years' work in the Institute of Technology or equiv. 3 cred. Stoppel, Isbin, Preckshot.
- 102w.\*‡ **Unit Operations.** Continuation of 101. Discussions and problems on heat transfer, evaporation, humidification, and air conditioning. Lect. and rec. Prereq.: 101. 5 cred. Stoppel, Isbin, Preckshot.
- 103s.\*‡ **Unit Operations.** Continuation of 101 and 102. Drying, distillation, absorption, extraction, crystallization, etc. Prereq.: 102. 5 cred. Stoppel, Isbin, Preckshot.
- 105f.\*‡ **Fuels and Combustion.** Technology of solid, liquid, and gaseous fuels; analysis, combustion characteristics, calculation of heat and material balances, specific uses, and furnaces. Prereq.: Anal.Chem. 1-2. 2 cred. Stoppel.
- 111f. **Unit Operations Laboratory.** Prereq.: 101. 1 cred.
- 112w. **Unit Operations Laboratory.** Prereq.: 102. 1 cred.
- 113s. **Unit Operations Laboratory.** Prereq.: 103. 1 cred.
- 117w.118s.‡ **Chemical Engineering Equipment Design.** Fundamental principles in the design of chemical engineering equipment. Prereq.: 103. 3 cred. per qtr. Piret.
- 119f-120w. **Chemical Engineering Thermodynamics.** Principles of the fundamental laws of energy as applied to chemical engineering problems. 2 lect., 2 rec. hours per week. Prereq.: 103. 3 cred. Isbin, Preckshot.
- 121f.‡ **Chemical Engineering Economics.** Economics and business considerations controlling chemical engineering industries: statistical analysis of these industries, raw and finished products, principles of plant location, layout and design, unit operation costs, principles of management, operation, and control. Prereq.: 131, 132. 3 cred. Ar.
- 131f.\*‡ **Inorganic Technology.** Applications of unit operations common to chemical industries, chemistry involved, equipment used, marketing of products, utilization of by-products, use of trade journals. Lect. and rec. Prereq.: for chem. engrs., 103. 3 cred. Madden.
- 132w.\*‡ **Organic Technology.** Similar to 131 but covering organic field. Lect. and rec. Prereq.: for chem. engrs., 103, 131. 3 cred. Madden.
- 151f.su.\* **Chemical Manufacture (Inorganic).** Manufacture of technical products on a scale large enough to afford data for the determination of operating conditions and cost of manufacture. Use of semiworks equipment. Technical trade journals used. Lab. Prereq.: 103, 132. 3 or more cred. Staff.
- 152w.su.\* **Chemical Manufacture (Organic).** Similar to 151 but covering the organic unit processes. Lab. Prereq.: 103, 131. 3 or more cred. Staff.
- 153f-154w-155s-156su.\* **Special Problems.** Investigations of problems of chemical engineering interest. 3 or more cred. per qtr. Staff.
- 171f. **Instrumentation and Control.** Theory and application of instrumentation and control with particular emphasis on application to the chemical industry, including some theory of servomechanisms. Prereq.: permission. 3 cred. Ceaglske.
- 172w. **Instrumentation and Control.** Follows 171. 2 lect. and 3 lab. hours. Prereq.: 171. 3 cred. Ceaglske.

‡ Full graduate credit as major work will not be allowed for these required undergraduate courses.

- 176f.\* Applied Electrochemistry.** Laws and phenomena of electrochemistry, including electroplating, batteries, electric furnaces, and electrochemical products. Class and lab. work. Prereq.: Phys.Chem. 103, permission. 4 cred. Madden.
- 187w. Chemical Engineering Inspection Trip.** Visits to representative chemical engineering industries between winter and spring quarters. 2 cred. Staff.
- 201f-202w-203s.\* Seminar.** Presentation and discussion of papers concerning the newer developments in chemical engineering. 1 cred. per qtr. Piret, Amundson.
- 205f-206w-207s. Advanced Unit Operations.** Fundamentals and new developments in unit operations. Theory and applications to equipment and process design including economic balance problems. Prereq.: 103. 3 cred. per qtr. Piret. (Alternates with 208-209-210. Offered 1952-53.)
- 208f-209w-210s. Advanced Unit Operations.** The principles of chemical engineering and their application to industrial problems. Survey of the literature. Prereq.: 103. 3 cred. per qtr. Piret, Madden. (Alternates with 205-206-207. Offered 1953-54.)
- 211f-212w-213s. Process and Plant Design.** Several phases of chemical engineering training including unit operations, reaction kinetics, economic balance and market survey are combined to develop, from laboratory and literature data, an economic and technically sound industrial process for a projected chemical product. Equipment and plant layout prepared. Cost analyses. Prereq.: 103. 3 cred. per qtr. Isbin. (Alternates with 231-232-233. Offered in 1953-54.)
- 214f-215w-216s. Advanced Mathematics for Chemical Engineers and Chemists.** Numerical analysis; ordinary and partial differential equations; Fourier series and special functions; finite difference equations; partial differentiation. Theory of heat conduction and diffusional operations. Prereq.: differential equations. 3 cred. per qtr. Amundson.
- 220s. Advanced Chemical Engineering Thermodynamics.** An advanced course covering chemical engineering applications. Prereq.: 119-120, permission. 3 cred. Preckshot.
- 221w-222s. Reaction Kinetics in Chemical Engineering.** Applications of the principles of reaction kinetics to chemical engineering process development. Prereq.: permission. 3 cred. per qtr. Piret.
- 225f-226w-227s. Fluid Flow and Related Topics.** A fundamental course covering advanced topics in viscous and turbulent fluid flow, eddy diffusion, and heat transfer. Prereq.: permission. 3 cred. Amundson.
- 231f-232w-233s. Introduction to Nuclear Reactor Design and Applications.** Fundamental theory for reactor design with practical applications. 3 cred. per qtr. Isbin. (Alternates with 211-212-213. Offered 1952-53.)
- 301f-302w-303s.\* Research in Chemical Engineering.** Unit operations, reaction kinetics, electrochemistry, unit processes, and others. Cred. ar. Ceaglske, Piret, Amundson, Stoppel, Isbin, Madden, Preckshot.

### CHILD WELFARE

Professors John E. Anderson, Merrill F. Roff, Dale B. Harris; Associate Professors Elizabeth M. Fuller, Mildred C. Templin; Assistant Professor Donald M. Brieland.

**Prerequisites**—For graduate work, an undergraduate major in either psychology, sociology, education, home economics or the equivalent, and at least 12 hours in psychology, 8 hours in sociology, and 3 hours in statistics. Where the background lies in other fields, such as nursing or medicine, special adjustments may be made.

**Language Requirement**—For the Master's degree, one foreign language. For the Ph.D. degree, two foreign languages or, with the adviser's approv-

al, one foreign language and either (a) a special research technique of 15 credits in mathematics at the Senior College or graduate level, or (b) a collateral field of 15 graduate credits in education, home economics, social work, sociology, speech, speech correction, or in educational psychology or psychology (if the minor is in another area), or in any of the basic science fields in medicine, or (c) a collateral field of 15 credits in graduate journalism or English courses that give specific practice in writing for publication.

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

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

### Courses

- 130f. Motor, Linguistic, and Intellectual Development of the Child.** The scientific literature. Prereq.: 12 cred. in psychology or equiv. 3 cred. Anderson and staff.
- 131w. Personality, Emotional, and Social Development of the Child.** The scientific literature. Prereq.: 12 cred. in psychology or equiv. 3 cred. Anderson and staff.
- 132s. Later Childhood and Adolescence.** Growth: mental, social, and emotional development. Prereq.: 12 cred. in psychology or equiv. 3 cred. Harris.
- 140f.w. Behavior Problems in Younger Children.** Types, origin, development, and treatment. Prereq.: 12 cred. in psychology, educational psychology, or sociology. 2 cred. Blodgett.
- 141w.s. Behavior Problems in Older Children and Adolescents.** Types, origin, development, and treatment. Prereq.: 12 cred. in psychology, educational psychology, or sociology. 2 cred. Blodgett.
- 142s. Psychology of Atypical Children.** Physical and mental deviations and handicaps. Personal, social, and vocational adjustment. Prereq.: 12 cred. in psychology. 3 cred. Blodgett.
- 143f. Problems of Mental Deficiency.** Diagnosis, care, training; social and vocational problems; legal aspects. Prereq.: 12 cred. in psychology or equiv. 3 cred. Blodgett.
- 150f-151w-152s. Childhood Education.** 150f: History and philosophy; 151w: Organization and administration; 152s: Methods and materials. Prereq.: 12 cred. in education or equiv. 2 cred. per qtr. Fuller.
- 160w. Physical Growth and Motor Development.** From early fetal life to maturity. Prereq.: 12 cred. in psychology or equiv. 3 cred. Roff.
- 166f. Maturity and Aging.** Developmental changes in the aging and the aged; adjustment and care. Prereq.: 12 cred. in psychology, education, or sociology. 2 cred. Anderson.
- 170w. Parent Education.** Programs, materials, methods, and organization. Demonstration of group procedures. Prereq.: 15 cred. in child welfare or home economics or psychology or education or public health or sociology. 3 cred. Cummings.
- 185s. Children in a Changing World.** Effects of social change, depressions, war, and catastrophes upon children. Prereq.: 12 cred. in psychology, education, or sociology. 3 cred. Templin.
- 190s. Use and Interpretation of Tests for Children.** Survey of mental testing for the social worker, teacher, etc. Prereq.: 12 cred. in psychology, educational psychology, or sociology. 2 cred. Roff.
- 200f.w. Observation and Study of Children.** Introduction to research and practical work. Supervised observations of children in various agencies, and discussion of projects. Required of all entering graduate students. Prereq.: 12 cred. in psychology, 3 cred. in statistics. 1 cred. Harris.
- 210s. Advanced Developmental Psychology.** Principles governing the development, organization, and integration of behavior. Prereq.: 130-131 or equiv., permission. 3 cred. Anderson.

- 220f-221w-222s. Seminar in Current Research.** Report on research in progress or completed. 1 cred. per qtr. Roff.
- 223f-224w-225s. Seminar in Developmental Theory.** Efficacy of theories in interpreting developmental material. Prereq.: permission. 1 cred. per qtr. Anderson.
- 226s. Seminar in Projective Methods with Children and Adolescents.** Demonstrations, critical analysis, and discussions of use in research and clinic. Prereq.: permission. 2 cred. Harris.
- 227s. Multiple Factor Analysis.** Mathematical rationale and concrete applications. Prereq.: 3 qtrs. of statistics and mental measurement. 2 cred. Roff.
- 230f-231w-232s. Seminar in Recent Literature.** Reviews of current scientific articles. Attendance of candidates for graduate degrees required. 1 cred. per qtr. Anderson.
- 233w-234s. Research Methods.** Experimental, observational, and statistical procedures in the study of children. Prereq.: 12 cred. in psychology or educational psychology, including statistics. 2 cred. per qtr. Roff.
- 240f-241w-242s. Practicum in Behavior Problems.** Supervised experience in the application of diagnostic and remedial procedures to children's behavior problems. Prereq.: 140-141, permission. Cred. ar. Harris, Blodgett.
- 250f.w.s. Internship in Professional Work with Children.** Practical experience under qualified supervision in clinics, institutions, and agencies. Prereq.: permission of department. Cred. ar. Anderson and staff.
- 260f-261w-262s. Seminar in Developmental Research and Practice.** Discussion of various topics and procedures. Open to majors who have completed one year of graduate study; required of Ph.D. candidates; others by permission. 2 cred. per qtr. Staff.
- 270f-271w-272s.\* Readings and Research in Child Development.** Reports based on independent readings or projects in child development or childhood education that are approved by the listed instructors. Required of M.A. Plan B students, but open to other graduate students with permission. Cred. ar. Anderson, Harris, Roff, Fuller, Templin, Brieland.
- 274w-275s. Technique and Field Work in Parent Education.** Methods of teaching parent groups. Organization of groups. Lesson plans, observations, and field work. Prereq.: 170, permission. Cred. ar. Cummings, Brieland.
- 290w-291s. Mental Examination of Preschool Children.** Training and practice in administering and interpreting individual tests. Registration limited. 290: Minnesota, Merrill-Palmer, Arthur; 291: Stanford-Binet Tests. Prereq.: 12 cred. in mental measurement, permission. 4 cred. per qtr. Blodgett.

### CIVIL ENGINEERING

Professors Lorenz G. Straub, Paul Anderson, George J. Schroeffer, Joseph A. Wise; Associate Professors Miles S. Kersten, John F. Ripken, Edward Silberman, Theodor W. Thomas; Assistant Professors Alvin G. Anderson, Walter T. Graves.

**Language Requirement**—For the Ph.D. degree two foreign languages, one of which must be German.

**Master's Degree**—Offered under Plan A; in special cases, Plan B may be accepted when approved by the Civil Engineering graduate faculty. Plan B petitions should preferably be submitted the first quarter of the student's residence, but not later than the end of the quarter in which he will have 15 credits in the Graduate School.

Under special conditions petitions will also be approved granting the degree of master of science in civil engineering, with a designated major in one of the following four divisions of the department: Hydraulic Engineering, Sanitary Engineering, Soil Mechanics, or Structural Engineering.

**Doctor's Degree**—The department offers work leading to the Ph.D. degree.

(Professional degrees in engineering—These degrees are administered by the Institute of Technology.)

### Courses

#### SURVEYING

- 109. Cadastral Surveying.** Study of the newer methods of accurate surveys of property with geodetic control and coordinates of property monuments. Prereq.: 16. 2 cred. Ar.
- 112. Aerial Surveying and Photogrammetry.** Study of methods of preparation of planimetric and contour maps by aerial and terrestrial photogrammetry, types of photographs, ground control and optical and mathematical analysis required for a complete survey. Prereq.: 23. 3 cred. Ar.

#### RAILWAY ENGINEERING

- 121. Railway Engineering.** Train resistance, ruling and momentum grades, curvature, distance, rise and fall as factors in location and operation of railroads. Train loadings, acceleration, retardation; locomotives and equipment. Prereq.: 22. 3 cred. Ar.
- 122.\* Railway Engineering.** Lectures, office work, and field inspection. Design and operation of various types of yards and terminals and terminal facilities. Prereq.: 22. 3 cred. Ar.
- 123. Railway Engineering.** Design and construction of railroad buildings and structures: culverts, trestles, switches, crossovers, crossing frogs, etc. Prereq.: 22. 3 cred. Ar.
- 124. Transportation.** Development of railway, inland waterway, highway, and airline transport; federal regulation and control. Financial and rate grouping of railways; method of accounting, valuation, and cost and value of service. Prereq.: 22. 3 cred. Ar.

#### STRUCTURAL ENGINEERING

- 130. Statically Indeterminate Structures.** Method of moment area. Williot Diagram. Slope-deflection method. Prereq.: 33, M.&M. 128. 3 cred. Andersen.
- 131. Structural Analysis.** Moment distribution method. Prereq.: 130. 2 cred. Andersen.
- 132. Structural Design.** Continuous structures of steel and concrete. Prereq.: 131. 2 cred. Andersen.
- 137. Structural Laboratory.** Theoretical and experimental analysis of structural members and models. Prereq.: 130, 141. 2 cred. Graves.
- 140. Advanced Structural Laboratory.** A continuation of Course 137. Calculated and experimental influence lines for frame structures including gabled bents. Secondary stresses for trusses. Prereq.: 137. 3 cred. Wise.
- 141. Reinforced Concrete.** Principles of reinforced concrete. Theory of beams, slabs, and columns and the application to simple structures. Prereq.: 33. 3 cred. Wise.
- 142. Reinforced Concrete Design.** Continuation of 141 with special emphasis on the practical features of the design of buildings, bridges, retaining walls, etc. Prereq.: 130, 141. 3 cred. Wise.
- 143. Arch Analysis and Design.** Analysis and design of reinforced concrete arches. Prereq.: 131, 142. 3 cred. Andersen.
- 147. Foundations.** Design and construction of footings, cofferdams, and caissons for bridges and buildings. Piers and abutments. Underpinning of buildings. Exploration and testing of foundation sites. Excavation and removal of materials from foundation sites. Prereq.: 32. 3 cred. Andersen.
- 232. Advanced Structural Problems in Sanitary Engineering.** Theory of domes, tanks, dams, culverts, and elliptical sewer sections. Prereq.: 132. 3 cred. Andersen.

- 233.\* Advanced Problems in Foundations.** Lateral earth pressure theories. Design of sheet piling. Bearing piles and cofferdams. Prereq.: 132, 147. 3 cred. Andersen.
- 234\*-235.\* Advanced Theory of Structures.** Applications of the theory of indeterminate stresses to the more complex problems of structural analysis. Continuous and swing bridges, simple and multiple arch and suspension systems, wind stresses in tall building frames, secondary stresses. Prereq.: 132, 142. 3 to 5 cred. per qtr. Andersen, Wise.
- 236.\* Advanced Structural Design.** Effects of shrinkage and plastic flow. Eccentrically loaded concrete sections. Nonsymmetrical bending. Torsion. Prereq.: 132 or 235. 3 to 5 cred. Andersen.
- 237-238-239. Structural Model Analysis.** Development and use of structural models for the solution of specific problems. Prereq.: 137. 3 cred. per qtr. Wise.
- 240-241-242. 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. Prereq.: 140. 3 to 5 cred. per qtr. Wise.
- 243.\* Dynamics of Structures.** Vibrations of beams, trusses, and frameworks. Impact, and effect of suddenly applied forces. Forces on structures due to earthquakes, shocks, and explosions. Fatigue of materials. Prereq.: 132. 3 cred. Wise.
- 244.\* Dynamics of Structures Laboratory.** Laboratory work in vibrations of beams and trusses. Prereq.: 243. 3 cred. Wise.
- 245. Advanced Problems in Bridge Design.** Selection of type and span. Secondary stresses and problems associated with rigidity of joints. Prereq.: 132. 3 cred. Graves.
- 247\*-248-249. Seminar in Structures.** Special topics in the higher theory of structures. Prereq.: 132, 142. 3 to 6 cred. per qtr. Ar.

#### HIGHWAY ENGINEERING AND SOILS MECHANICS

- 146. Concrete and Concrete Materials.** Theory of design and control of concrete mixtures. Practice in control tests of concrete and concrete materials. Lect., lab. Prereq.: M.&M. 141. 3 cred. Thomas.
- 148-149-150. Advanced Concrete.** Short research problems in concrete. Prereq.: 146. 2 cred. per qtr. Thomas.
- 151.\* Advanced Highway Laboratory.** Special experimental studies of highway materials. Prereq.: 52. 3 to 5 cred. Thomas.
- 152.\* Highway Design.** Study of the basis for design, design of intersections, street grades, pavement design, plans and specifications. Prereq.: 52. 3 cred. Thomas.
- 153. Soils in Highway Engineering.** Classification, soil maps, surveys, physical tests, compaction, design of graded mixes, and soil stabilization. Prereq.: 53. 3 cred. Kersten.
- 155. Field Soil Studies.** Soil classification and mapping, analysis of soil conditions where road failures have occurred. Prereq.: 53. 2 cred. Kersten.
- 156. Highway Traffic Engineering.** Traffic surveys, traffic control, highway safety, highway commercial transportation as related to other forms of transportation. Prereq.: 52. 3 cred. Thomas.
- 157. Highway Economics.** Annual highway costs; effect of highway location and design on motor vehicle operating costs. Allocation of highway costs to motor vehicle owners and general public. Economics of highway administration, finance, and taxation. 2 cred. (Not offered 1952-54.)
- 158. Airport Design.** Field layout, drainage, and studies of sub-bases, bases, and surfaces for aprons, runways, and taxiways. Prereq.: 52. 3 cred. Kersten.
- 159. Soil Mechanics.** Seepage, consolidation, strength theory. Settlement analysis; stability of slopes; bearing capacity. 3 lect. per week. Prereq.: 53. 3 cred. Kersten.

- 251-252.\* **Advanced Soil Mechanics Laboratory.** Consolidation; permeability; direct shear; triaxial compression; California bearing ratio; and other special laboratory problems in soil mechanics. Prereq.: 159 or parallel. 3 cred. per qtr. Kersten.

## HYDRAULIC ENGINEERING

160. **Applied Hydraulics.** Pipe flow, compound pipe systems, network analysis. Centrifugal pumps, analysis and problems. Characteristic curves, pump constants, selection and economic factors. Open channel flow design, hydraulic elements, nonuniform flow computations, losses, irrigation, and drainage problems. 2 lect., 4 lab. hours per week. Prereq.: 102, 104. 3 cred. Ar.
161. **Hydrology.** A study of the fundamental aspects of hydrology as the basis for hydraulic engineering work. Sources of basic data, common curves. Precipitation, types, variations, rainfall depth computations, storm rainfall, intensity-duration-frequency. Losses. Groundwater and infiltration. Run-off, characteristics, components, variations, estimating supply, storage. Flood flows, Unit Graph analysis, flood control. Erosion, transportation, silting. Water use and rights. 2 lect., 4 lab. hours per week. Prereq.: 102. 3 cred. Ar.
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. Prereq.: 161 or equiv. 3 cred. Ar. (Not offered every year.)
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. Prereq.: 161. 3 cred. Ar.
263. **Advanced Hydraulic Engineering Problems.** Special hydraulic problems in laboratory, drafting room, and field. Prereq.: 183, 190, 192, or equiv., permission. 3 to 5 cred. Straub.

## MUNICIPAL ENGINEERING

167. **City Planning.** Physical elements of the city: topography, drainage, geology. Public works and structures. Internal and external transportation. Zoning. Subsurface structures. Esthetic features of the city. 3 to 5 cred. (Not offered every year.)
169. **Public Works Engineering.** An introduction to the engineering phases and relationships of public works. Historical survey. Federal, state, and local administration problems. Present trends and practices. The need for adequate public planning design and construction. Responsibilities of the engineer. Typical problems. 3 cred. Ar. (Not offered every year.)

## SANITARY ENGINEERING

170. **Water Supply.** Sources of water supply, characteristics of water; quantities and rates; quality of water, collection, distribution, and water purification; test methods. Selection of equipment. Laboratory problems in analysis and design. Inspection trips. Prereq.: 161, M.&M. 129. 3 cred. Schroepfer, Johnson, Ziemke.
171. **Sewerage and Sewage Treatment.** Sources and quantities of sewage; sanitary, storm, and combined sewer systems; materials and methods of construction; sewer appurtenances; pumping equipment; physical, chemical, and biological characteristics of sewage. Disposal by dilution. Domestic sewage and industrial waste treatment. Laboratory problems in analysis and design. Inspection trips. Prereq.: 161, 170. 3 cred. Schroepfer, Johnson, Ziemke.
172. **Sanitary Laboratory.** The biological, bacteriological, physical, and chemical analyses of water, sewage, air, coagulant chemicals, disinfectants, sewage sludge, etc. 3 cred. Schroepfer, Ziemke.
- 173.\* **Sanitary Engineering Problems (Water).** Investigations of problems in water supply to supplement 170. Collection, distribution, and purification. Economic studies. Prereq.: 170. 3 cred. Schroepfer.

- 174.\* Sanitary Engineering Problems (Sewage and Industrial Wastes).** Investigations of problems in sewage treatment and industrial wastes disposal to supplement 171. Stream pollution, stream standards, economic studies of various types and degrees of treatment. Prereq.: 171. 3 cred. Schroepfer.
- 175.\* Industrial Waste Disposal.** Investigation of various types of industrial wastes and methods of disposal. Economic studies. Prereq.: 174. 3 cred. Schroepfer.
- 176-177-178. Sanitary Engineering Seminar.** Required of senior and graduate students. Reports and discussion on assigned topics in the field of sanitary engineering with occasional talks by practicing sanitary engineers on subjects of interest. 1 cred. per qtr. Schroepfer.
- 179. Public Health Engineering.** Sanitary problems associated with the location, construction, and operation of water supplies, purification works, and distribution systems, with the treatment and disposal of sewage, excreta, and waste, and with the production, pasteurization, and distribution of milk. Public health engineering methods as applied to sanitary problems in urban and rural communities including schools, institutions, camps, bathing places, dwellings, etc. Lect., field, and lab. demonstrations. 3 cred. Ar.
- 261\*-262.\* Water and Sewage Plant Design.** Design of water purification and sewage treatment works. Prereq.: 171. 3 to 5 cred. per qtr. Schroepfer.
- 264. Sanitary Engineering Unit Operations.** Lectures, laboratory studies, and plant-scale studies on screening, sedimentation, chemical coagulation, aeration, filtration, disinfection of water with chlorine, disinfection of air, heat transfer, handling of material, drying, incineration, and digestion. 3 cred. Schroepfer.
- 276.\* 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. Hours ar. Prereq.: 173. 3 to 5 cred. Schroepfer.
- 277.\* Advanced Sanitary Engineering (Sewage and Industrial Wastes).** Principles of sewage collection and treatment, and of industrial waste disposal. Inspection and investigation of sewage works systems. Advanced study of certain phases of sewage treatment. Hours ar. Prereq.: 174. 3 to 5 cred. Schroepfer.

## GENERAL

- 280\*-281\*-282.\* Civil Engineering Research.** Original work in concrete, structural steel, soils, hydraulics, municipal, sanitary, or transportation problems. Investigations, reports, tests, designs. Prereq.: permission. 5 cred. per qtr. Ar.

## CLASSICS

Professor Norman J. DeWitt; Associate Professor William A. McDonald; Assistant Professor Donald C. 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**—Offered under both Plan A and Plan B, in either Greek or Latin (see also pages 7-13).

**Major in Greek or Latin**—The Master's degree requires a 9-credit sequence in the 200 series, plus (for Plan A) 9 credits in the 100 series and (for Plan B) 12 credits minimum in the 100 series.

**Minor in Greek or Latin**—The Master's degree requires a 9-credit sequence in the 200 series or 9 credits minimum in the 100 series.

**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 re-

spectively. Some other subject may be offered as a minor, but in any case the candidate will be expected to complete at least the prerequisites for graduate study (see below) in both Greek and Latin. A set of written examinations, to be taken before admission to the preliminary oral examination, will include (a) translation at sight of representative passages from Greek and Latin literature, (b) translation and interpretation of passages selected from the works of a particular author, Greek or Roman, to be chosen by the candidate in consultation with his adviser, and (c) Greek and Roman history, philosophy, art, archaeology, and the history of Greek and Latin literature.

**Note**—For information on work in Comparative Literature, see page 21.

#### GREEK

**Prerequisites**—Any three of the courses numbered 51, 52, 53, 73, or the equivalent.

#### Courses

**121f-122w-123s.† Advanced Prose Composition.** Prereq.: 24 cred. in Greek. 3 cred. per qtr. McDonald.

**171f.\$172w.\$173s.\*§ Advanced Reading Course.** Prereq.: permission of the department. 3 cred. per qtr. Ar.

One of the following courses will be offered each year, according to the needs of the students.

**201f-202w-203s.\* Seminar: Greek Literary Bibliography and Criticism.** 3 cred. per qtr. Swanson.

**211f-212w-213s.\* Seminar: Greek Epic.** 3 cred. per qtr. McDonald. (Offered 1952-53.)

**221f-222w-223s.\* Seminar: Greek Drama.** 3 cred. per qtr. McDonald. (Offered 1953-54.)

#### LATIN

**Prerequisites**—Course 81-82-83, or the equivalent.

#### Courses

**111f-112w-113s.† Advanced Prose Composition.** Prereq.: 73. 2 cred. per qtr. DeWitt.

**133s. Vulgar Latin.** Development of Latin into Romance. Prereq.: permission for advanced students of either Latin or Romance. 3 cred. Swanson.

**171f.\$172w.\$173s.\*§ Advanced Reading Course.** Prereq.: permission of department. 3 cred. per qtr. Ar.

One of the following courses will be offered each year according to the needs of the students:

**201f.202w.203s.\* Seminar: Cicero.** 3 cred. per qtr. DeWitt. (Offered 1952-53.)

**211f.212w.213s.\* Seminar: Latin Epic.** 3 cred. per qtr. McDonald.

**241f.242w.243s.\* Seminar: Introduction to Classical Philology.** 3 cred. per qtr. Swanson.

**251f.252w.253s.\* Seminar: Roman Drama.** 3 cred. per qtr. DeWitt. (Offered 1953-54.)

#### CLASSICS COURSES (FOR WHICH NO LATIN OR GREEK IS REQUIRED)

**106f-107w. Introduction to the Study of Language.** Prereq.: any 2 courses numbered above 50 in a foreign language. 3 cred. per qtr. Swanson.

**108s. Cultural Aspects of Language.** Prereq.: any 2 courses numbered above 50 in a foreign language. 3 cred. Swanson. (Offered 1952-53.)

§ Since the authors to be read vary from term to term and from year to year, this course may be repeated for credit.

**122w. Introduction to Greek Archaeology.** 3 cred. McDonald.

**123s. Introduction to Roman Archaeology.** 3 cred. McDonald.

**191f, 192w, 193s. Classical Literary Traditions.** Prereq.: 9 cred. in lit., English or foreign. 3 cred. per qtr. De Witt.

### DAIRY HUSBANDRY

Professors James B. Fitch, Willes B. Combs, Samuel T. Coulter, Thor W. Gullickson, Harold Macy, William E. Petersen; Associate Professors Marshall C. Hervey, James J. Jezeski, Joseph C. Olson, Jr.

**Prerequisites**—For a major in dairy production a sufficient preparation in chemistry, genetics, and animal physiology; for a major in dairy products, bacteriology, chemistry, physics, and economics; for a major in dairy bacteriology, chemistry, physics, bacteriology, and dairy products. When the preparation appears inadequate additional courses may be required.

For a minor in dairy husbandry, the chief of the division must be satisfied as to the student's preparation.

**Major**—With the approval of the adviser, certain courses in agricultural biochemistry, bacteriology, genetics, agricultural economics, and animal husbandry may be accepted as part of the major.

**Language Requirement**—Candidates for a Master's degree may petition for exemption from the language requirement, except majors in dairy bacteriology. 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**—Offered under both Plan A and Plan B.

**Doctor's Degree**—Work for the Ph.D. degree is offered in connection with other supporting divisions.

### Courses

**101f. Milk Production.** Problems of the dairy farmer. Prereq.: 1. 3 cred. Fitch.

**103w. Dairy Stock Feeding.** Application of principles of nutrition to feeding dairy animals. Prereq.: 101, An.Husb. 56. 3 cred. Gullickson.

**104f. Dairy Stock Selection.** Problems in selection of dairy cattle. Prereq.: 9, 101 or parallel. 3 cred. Hervey.

**105f-106w.\* Seminar.** Bibliographical methods and study of dairy literature. Reports on assigned subjects and reviews of recent scientific investigations. Prereq.: 3 courses in dairy husb. 1 cred. per qtr. Petersen.

**110w. Dairy Products: Ice Cream and Frozen Dairy Foods.** Manufacture of ice cream with special reference to the chemical and physical processes involved. Lect., lab. Prereq.: 1, 3. 3 cred. Combs, Thomas.

**111f. Dairy Products: Butter.** Manufacture of butter with special reference to the chemical and bacteriological processes involved. Lect. and lab. Prereq.: 1, 2, 3. 3 cred. Coulter, Thomas.

**112s. Dairy Products: Cheese.** Manufacture of cheese, with special reference to the chemical, bacteriological, and physical processes involved. Lect., lab. Prereq.: 1, 2, 3. 3 cred. Combs, Thomas.

**113s. Technical Control.** Lectures and laboratory. Chemical and bacteriological laboratory methods used in technical control of milk and its products. Prereq.: 50, 111, or 112. 3 cred. Coulter, Jezeski.

**114w. Milk By-Products.** Manufacture of condensed milk, dry milk, casein, and other milk by-products with special reference to the physical processes involved. Lect., lab. Prereq.: 1, 3. 3 cred. Coulter.

- 115s. Advanced Dairy Bacteriology.** Investigation of specific problems in the microbiology of milk and dairy products. Prereq.: 150 or equiv., 111 or 112. 3 cred. Jezeski.
- 116s. Milk Secretion.** Anatomy and physiology of milk secretion and factors influencing the quality and quantity of milk. Prereq.: physiol., 9 cred., and Agr.Biochem. 103. 3 cred. Petersen.
- 117s. Dairy Cattle Breeding.** Application of the principles of genetics to the improvement of dairy cattle. Prereq.: 101, 104, Agron. 31. 3 cred. Hervey.
- 118s. Milk Production and Secretion.** Management and nutritional problems of interest to veterinary students; physiology and biochemistry of lactation. 3 cred. Petersen.
- 150w. Dairy Bacteriology.** Microbiology in relation to milk production and the processing of milk and dairy products. Lect., lab. Prereq.: Bact. 53. 3 cred. Olson.
- 202f.\*203w.\*204s.\*208su.210su. Research in Dairy Production.** Facilities for study and investigation of subjects pertaining to dairy cattle. Open in Summer Session only to those who have had preliminary graduate work. Cred. ar. Fitch, Petersen, Hervey, Gullickson.
- 205f.\*206w.\*207s.\*209su.211su. Research in Dairy Manufacturing.** Opportunity and facilities for study and investigation of problems concerning dairy products. Open in Summer Session only to those who have had preliminary graduate work. Cred. ar. Combs, Coulter.
- 212f.\*213w.\*214s.\*215su.216su. Research in Dairy Bacteriology.** Opportunity and facilities for investigation and advanced study of problems involving the microbiology of milk and dairy products. Open in Summer Session only to those who have had preliminary graduate work. Cred. ar. Macy, Jezeski, Olson.

## DENTISTRY

For staff and courses of study offered, see *Graduate Medical Bulletin*.

## ECONOMICS AND BUSINESS ADMINISTRATION

Professors Richard L. Kozelka, Francis M. Boddy, Oswald H. Brownlee, Helen G. Canoyer, George Filipetti, Richard K. Gaumnitz, Ernest A. Heilman, Walter W. Heller, Leonid Hurwicz, Carl L. Nelson, Andreas G. Papatreou, John J. Reighard, J. Warren Stehman, Arthur R. Upgren, Roland S. Vaile, Dale Yoder; Associate Professors Arthur M. Borak, Herbert G. Heneman, Jr., Edwin H. Lewis, Edmund A. Nightingale, Harry J. Ostlund, John G. Turnbull, John T. Wheeler; Assistant Professors Robert J. Holloway, Joseph P. McKenna, Harlan M. Smith, Spencer M. Smith, John A. Stovel, Ben B. Sutton, Lloyd Ulman.

**Prerequisites**—A minimum of 9 quarter credits in economics, including the principles of economics, is required before any course work may be counted toward either a graduate major or minor in economics. All candidates must have maintained an average of B or better in their undergraduate work in economics.

In their preliminary preparation candidates for the M.A. in economics will be expected to meet the following requirements:

either

a. Twelve credits in economics or business administration courses at the Senior College level,

or

b. Preparations at the elementary level in accounting, money and banking, principles of economics, and statistics.

Candidates for the Ph.D. in economics or business administration will be expected to meet both requirements (a) and (b) above.

#### MASTER OF ARTS

For a major in economics or business administration the candidate must include Econ. 103-104 unless this course or its equivalent has been completed in the undergraduate program.

##### Plan A

1. For the purposes of this plan the courses in economics and business administration are to be considered as one department.

2. A foreign language is required only if the thesis is written in economic history, economic theory, money and banking, public finance, or statistics.

3. Both a written and an oral examination are required.

##### Plan B

1. For the purposes of this plan the courses in economics and business administration may be considered as four separate fields, namely: accounting, economics, general business administration, and statistics. Normally it will be expected that all candidates under this plan will take at least 9 credits of work outside of these fields.

2. The 9 credits earned in courses requiring independent work and the preparation of written reports shall be made a part of an approved program only on recommendation by the candidate's adviser and the instructor for the course.

3. Reading knowledge of a foreign language is not required.

4. Only an oral final examination is required.

#### MASTER OF BUSINESS ADMINISTRATION

This degree is offered for students who desire graduate training in business administration. Those who have received the Bachelor's degree from a recognized school of business may expect to complete the work in one year; those who are graduates of other professional schools or of liberal arts colleges may expect that it will take two years.

**Prerequisites**—1. Candidates must meet the prebusiness requirements of the School of Business Administration in accounting, money and banking, principles of economics, and statistics. Psy. 1-2 (General Psychology) is a prerequisite for specialization in advertising, foreign trade, merchandising, and personnel administration; and Math. 20 (Mathematics of Investment) is a prerequisite for specialization in accounting and finance. Preparation in these prebusiness subjects, if not completed as part of the candidate's undergraduate program, may be completed after entrance upon the work for this degree by taking the appropriate courses without graduate credit.

2. Candidates who have not taken the core group courses required for the degree of bachelor of business administration in this University must do so as part of the work for the Master's degree though some of these courses will not carry graduate credit and will therefore not count toward the formal credit requirements for the degree. These courses are business law, monetary and banking policy, advanced general accounting or cost accounting, corporation finance, survey of marketing, business

statistics, production management, intermediate economic analysis, labor problems, elements of public finance, government regulation of business, and personnel administration.

3. In addition, B.A. 184 (Scientific Management in Industry) is a requirement for the degree.

### Plan A and Plan B

The degree is offered under both Plan A and Plan B, subject to the usual regulations governing those plans, with the following exceptions:

1. The same departmentalization of the courses in economics and business administration is recognized as under the master of arts degree, Plan B.

2. A foreign language is not required.

3. The examination requirements for Plan A and Plan B are the same as those for the master of arts degree.

### DOCTOR OF PHILOSOPHY

1. Those who wish to become candidates for this degree should first obtain the Master's degree under Plan A.

#### 2A. Major in economics:

a. Candidates are required to pass written and oral examinations in economic theory and European economic history as part of their work in the major. In general these requirements may be met with a minimum of five courses in economic theory numbered over 200 and three courses in European economic history.

b. In addition, candidates are required to pass written and oral examinations in any four of the following seven areas or fields, such fields to be designated at the time the doctoral program is submitted.

Economic theory	Monetary theory
International economics	Public finance
Labor economics	Statistics
Marketing	

c. Minor: If the candidate's minor is in history, the requirement in economic history (a) above may constitute part of the minor.

#### 2B. Major in business administration:

a. Candidates are required to pass both written and oral examinations in economic theory, a field of concentration chosen from Group A below, and four additional fields of which at least two must be in Group A and at least one in Group B.

Group A	Group B
Accounting	Economic theory
Business finance	Monetary theory
Industrial management	Public finance
Labor and industrial relations	Statistics
Marketing	
Transportation	

At least 21 credits must be in the 200 group.

3. All doctoral programs for either major must be approved by the candidate's adviser and the chairman of the graduate committee of the department before they are submitted to the Social Science Group Committee.

4. For either major reading knowledge of two foreign languages is required or one foreign language and an acceptable research technique.

At present, calculus to the equivalent of Math. 50-51 is accepted as representing proficiency in a research technique.

5. The written preliminary examination will be given at only three periods during each year. Normally these will be at the Christmas vacation, during the spring vacation, and during the first term of the Summer Session.

### Courses¶

#### ECONOMICS

**Note**—The following courses in other departments carry credit also in Economics: History 180-181-182, Selected Readings in Economic History; History 221-222-223, Graduate Seminar in Economic History.

- 100. Foundations of Mathematics for Social Scientists.** Sets. Relations. Partially ordered systems. Functional relations. Elements of logical calculus. Groups. Matrices. Applications mostly in economics, some in statistics. Prereq.: Math. 7, 30 or permission. 3 cred. Hurwicz.
- 101. Econometrics I.** Elements of probability. General theory of statistical decisions. Specification. Models underlying statistical analysis in economics and certain other fields (simultaneous equation models, factor analysis models). Maximum likelihood method. Elementary regression theory. Least squares method. Identification. Structural estimation in economic and other models. Examples: production functions, demand functions; analysis of abilities. Prereq.: elementary statistics, Math. 51 or permission. 3 cred. Hurwicz.
- 102. Econometrics II.** Properties of multivariate distributions. Regression. Specification error. Identification. Techniques of estimation in simultaneous equation systems. Time series problems. Aggregation. Prereq.: Math. 51 or a course in mathematical statistics or permission. 3 cred. Hurwicz.
- 103-104.†§ Advanced Economic Theory.** An advanced course in general economic theory with special emphasis on the systematic development of the tools of modern economic analysis. Prereq.: 20 cred. in soc. sci., including 7 or equiv. 3 cred. per qtr. Boddy.
- 105. The Development of Economic Thought: Classical Theory.** This course, the first of a series of three, will study the writings of the precursors and the later developers of classical economic theory, roughly from Adam Smith to John Stuart Mill. Prereq.: 81 or equiv. 3 cred. Boddy.
- 106. The Development of Economic Thought: Socialistic Critics and Neo-classical Theory.** Begins with Karl Marx and includes the Austrians, Marshall, Edgeworth, and Pigou. Prereq.: 81 or equiv. 3 cred. Papandreou.
- 107. Development of Economic Thought: Theories of Effective Demand.** Underconsumptionists and twentieth-century business cycle theories, beginning with Malthus and Say and continuing through Hobson, Mitchell, Hawtrey, and Keynes. Prereq.: 81 or equiv. 3 cred. Ar.
- 108. City Planning.** (Same as Arch. 104.)
- 110. Industrial Price Control.** Methods by which the prices of industrial products are determined under actual competitive conditions. Price policies, combinations, international cartels, administered prices, price leadership, price associations, and government intervention will be considered. Prereq.: 7 or equiv., 15 additional cred. in econ. and/or bus. admin.; 75 or 155 is desirable. 3 cred. S. Smith.
- 121-122†-123. Theory of Statistics.** Advanced course in statistical analysis. The first quarter acquaints the student with modern statistical tools and their uses in analysis and interpretation of data and does not stress mathematical developments. Later quarters consider origins and derivations and require more mathematical preparation. Prereq.: 5 or equiv. 3 cred. per qtr. Ar.

§ Credit may not be received for both Courses 80-81 and 103-104.

† No courses are starred for work under Plan B. Students working toward the Master's degree under Plan B may, by arrangement with the instructor, have any course so planned as to include the necessary Plan B paper.

- 126. Economic Problems of Latin America.** Development of economic resources; influence of foreign economies; organization for production; state of the industrial arts; domestic markets and transportation; government finance; present tendencies in respect to economic progress, economic security, and social control. Prereq.: 7 or equiv. 3 cred. Ar.
- 140. Cooperative Movement.** History and philosophy of various cooperative developments. Similarities and contrasts between agricultural marketing cooperatives, consumer cooperatives, trade unions, and others. Consumer cooperation as a medium for economic control. Prereq.: 7 or equiv. 3 cred. Canoyer.
- 142. Monetary and Banking Policy.** Advanced course in money and banking policy viewed from the social standpoint with primary reference to the Federal Reserve system. Selected problems in monetary policy; monetary reconstruction and monetary reform. Prereq.: 3, 80. 3 cred. Uppgren and others.
- 149. Business Cycles.** Analysis of factors involved in business fluctuations. Comparison of theories of their causes. Examination of proposals for the stabilization of employment, production, and capital formation. Introduction to the statistical data and methods of business forecasting. Prereq.: 64 or 142 or permission. 3 cred. Uppgren.
- 155. The Modern Corporation.** Various types of corporate securities and their uses. Financial plans for industrial, utility, and other types of corporations. Financial affairs of an established business. General financial problems of the holding company, consolidations, mergers, and reorganizations. Prereq.: 3, 7 or equiv. 3 cred. Stehman and others.
- 161. General Manpower Economics and Labor Problems.** (1) Marketing of manpower resources; (2) institutional structure of labor markets; (3) economic and social problems arising out of labor marketing processes; (4) methods, procedures, and proposals for solving these problems. Includes the basic materials of 73 plus advanced discussion and special assignments. Prereq.: 7. 3 cred. Yoder and others.
- 162. Labor Movements.** Analysis of the development of labor movements in Europe and the United States. Examination of the origins of labor movements, their growth, their problems under various forms of government, and analysis of the economic and social consequences of these developments. Prereq.: 73 or 161. 3 cred. Ulman.
- 163. Union Organization and Administration.** Analysis of: (1) the structural nature and (2) the operation of contemporary American unions. Nature of internal administration and government of unions, and the economic and social issues arising out of relationships with managements in matters of hours, wages, and other conditions of employment. Prereq.: 73 or 161. 3 cred. Ulman.
- 164. Labor Legislation: Collective Bargaining.** Analysis of (1) inter-relationships between the development of labor organizations and the techniques they use to further their interests, and the actions and decisions of the executive, legislative, and judicial branches of the government, and (2) economic and social implications of issues arising in this area. Prereq.: 73 or 161. 3 cred. Turnbull.
- 166. Settlement of Industrial Disputes.** Major consideration of the economic impact and implications of principal methods of settling labor disputes, including mediation, conciliation, fact-finding, and voluntary and compulsory arbitration. Prereq.: 81 or 104. 3 cred. Turnbull.
- 169. Labor Legislation: Economic Security.** Analysis of: (1) origins and development of economic and social problems of the worker; (2) executive, legislative, and judicial attempts to deal with these problems; and (3) economic and social consequences of the developments. Treatment of "protective labor legislation," involving child labor, hours and wages, industrial accidents and illness, old age, and unemployment. Prereq.: 73 or 161. 3 cred. Turnbull.
- 172. Economics of Transportation.** Analysis of the economics of the agencies of modern transportation, including rail, water, highway, air, and pipe line. Relative advantage of each agency, national transportation policy, regulation, rate making, taxation, coordination of services. Prereq.: 7 or equiv. 3 cred. Nightingale.

- 176. Introduction to International Economics.** Techniques of international economic analysis. The approach, while primarily theoretical, will indicate the relevance of the theory to current problems. The balance of payments; foreign exchanges; free trade versus protection; techniques of trade control; international commercial policies; contemporary international economic problems and institutions. Prereq.: 7. 3 cred. Uppgren.
- 178. Economics of Consumption.** Descriptive and analytical treatment of: the nature of human wants; origins and personal distribution of money income and purchasing power; demand and price; standards and levels of living; relationship of consumption to the population problem and possibilities for improvement of consumption. Prereq.: 7. 3 cred. Canoyer.
- 179. Economic Problems of the Far East.** Survey of recent economic developments in the Far East as these developments illustrate and are governed by economic principles. Economic regionalism, problems of population and migration, control of raw materials, industrial efficiency, internal economic institutions, and international commercial policies. Prereq.: 7 or equiv. 3 cred. Vaile.
- 185.§ Economics of Marketing.** (1) Role of market distribution in our total economy; (2) costs of market distribution; (3) regional specialization and market distribution; (4) public, quasi-public, and corporate control of markets; (5) role of the consumer in market distribution. Prereq.: 7 or equiv. 3 cred. Vaile.
- 186. International Economic Relations.** Foreign economic interests of the United States, policies to promote world recovery. Processes of dynamic development and adaptation of a nation's foreign trade to changing world markets. Requirements for freedom of selection of international economic policies and for their successful operation. Short laboratory problems required. Prereq.: 176. 3 cred. Uppgren.
- 189.†§§ Principles of Public Finance.** Public expenditures, revenues, debts, fiscal policy, and financial administration. Emphasis on tax principles, practices, and burdens. Prereq.: 7 or equiv. 3 cred. Borak.
- 190. National Income.** The conceptual framework for the study of income flows, the use of statistical materials within this framework, and the use of the results for measurement and welfare. Prereq.: 80 or equiv. 3 cred. Ar.
- 191-192.†§§ Public Finance.** Public expenditures, revenues, debts, fiscal policy, and financial administration. Emphasis on tax principles, practices, and burdens. Prereq.: 7 or equiv. 3 cred. per qtr. Heller.
- 193. State and Local Taxation.** Main problems of state and local finance and proposed solutions, including coordination of national, state, and local fiscal policy and administration. Prereq.: 189, 191-192 or B.A. 58. 3 cred. Borak.
- 195. Fiscal Policy.** Analysis of fiscal policy theory as developed by Keynes and his followers; use of economic models in formulation of fiscal policy; potential role of taxes, expenditures, and debt management in stabilizing the economy; and administrative, legislative, and political barriers to formulation of a consistent national fiscal policy. Prereq.: 20 cred. in soc. sci. including B.A. 58 and Econ. 142 or equiv. 3 cred. Heller.
- 196. Advanced International Economics.** Recent developments in international price theory and in the application of employment and cycle theory in the international field. Analysis of the gains from trade, foreign trade multiplier, balance of payments disequilibrium, and the theory of fluctuating exchange rates. Prereq.: 176. 3 cred. Uppgren.
- 197. Business Cycles and the Structure of Production.** Study of accepted interpretation of business cycle theory and its setting in the structure of production of the United States. Emphasis on the application of business cycle theory to specific problems in maintenance of high productive employment and facilitating economic adjustments. Prereq.: 149. 3 cred. Uppgren.

§ Credit may not be received for both Course 185 and B.A. 77.

† Not open for credit to graduate majors in economics or business administration.

§§ Credit may not be received for both Course 191-192 and either B.A. 58 or Course 189.

- 200-201. **Theory of Employment and Resources.** 3 cred. per qtr. Brownlee.  
 202. **Methodology in Economics.** 3 cred. Papandreou.  
 205. **Seminar in Economic Structure and Behavior.** 3 cred. Papandreou.  
 206. **Seminar in Market Prices.** 3 cred. Vaile.  
 210. **Seminar in Business Cycle and Employment Theory.** 3 cred. Upgren.  
 213. **General Equilibrium Theory.** Prereq.: 104, 142. 3 cred. Papandreou.  
 214. **Theory of Monopolistic Competition.** Prereq.: 213. 3 cred. Boddy.  
 215. **Welfare Economics.** Prereq.: 213. 3 cred. Brownlee.  
 216. **Topics in Mathematical Economics.** Prereq.: Math. 50-51 desirable; 100 or equiv., or permission. 3 cred. Hurwicz.  
 233-234. **Seminar in Public Finance.** 3 cred. per qtr. Heller.  
 235. **Federal Tax Policy.** 3 cred. Heller.  
 243-244. **Seminar in Money and Banking.** 3 cred. per qtr. Upgren.  
 251-252. **Seminar in Industrial Relations.** 3 cred. per qtr. Yoder.  
 253. **Seminar in Labor Marketing.** 3 cred. Heneman.  
 254. **Seminar in Trade Unionism.** 3 cred. Ulman.  
 255. **Seminar in Economic Security.** 3 cred. Turnbull.  
 299. **Graduate Research.** Cred. ar. Staff.

## BUSINESS ADMINISTRATION

109. **Business Policy.** Study of problems of a general administrative character: integration of management, methods of analysis and budgetary control used to establish policies with respect to recurring and new developments. Case studies and student reports. Prereq.: Econ. 81 or equiv. 3 cred. Reighard.  
 111. **Purchasing.** Purchasing of materials, supplies, and equipment considered as a major function in business. Study of basic principles of purchasing in industrial, governmental, and institutional organizations. Prereq.: 77. 3 cred. Holloway.  
 112. **Time Series Analysis and Quality Control.** An intermediate course dealing with (a) the explanation and criticism of statistical techniques applied to time series analysis including measurements of trend and seasonal and cyclical movements, (b) index numbers, and (c) statistical control of quality in manufacturing operations. Prereq.: Econ. 5 or equiv. 3 cred. Ar.  
 113. **Sales Management.** Basic study of the major functions and responsibilities of sales executives including sales policies and planning, sales promotion, sales organization, and channels of distribution, selection, training and compensation of salesmen, control of sales performance, sales budgets and cost control. Extensive use of case materials. Prereq.: 77. 3 cred. Lewis.  
 114. **Retail Store Management.** Comprehensive treatment of retailing principles and methods; relation of retailing to other parts of the economy; and problems associated with the operation of stores of various types. Prereq.: 77. 3 cred. Canoyer.  
 115. **Life Insurance.** Economic significance of life insurance. Types of policies and analysis of the policy contract. Principles underlying the determination of premiums and reserves. Industrial, fraternal, and group insurance. Prereq.: Econ. 50. 3 cred. Ar.  
 116. **Fire and Marine Insurance.** Fire risk and fire prevention. Fire insurance and insurance carriers. The standard policy. Methods of rate making. State regulation and supervision. Marine risks and insurance. Prereq.: Econ. 50. 3 cred. Ar.  
 117. **Casualty Insurance.** Detailed study of risks, insurance coverages, and policy provisions in the more important lines of casualty insurance. Accident and health insurance; employers' liability and workmen's compensation; automobile; robbery and theft; miscellaneous types of insurance. Prereq.: Econ. 50. 3 cred. Ar.  
 118. **Auditing Principles and Procedures.** Combines class instruction in auditing principles and procedures and a laboratory in which a complete set of working papers and an audit report are prepared. Prereq.: 151. 4 cred. Lund and others.

119. **Correlation.** Normal correlation and its interpretation. Homogeneity, significance tests, treatment of nonlinear relationships. Applications in marketing, production, etc. Prereq.: Econ. 5 or equiv. 3 cred. Ar.
120. **Index Numbers.** Emphasis on both theory and practice in the construction and interpretation of index numbers of prices, production, employment, etc. Prereq.: Econ. 5 or equiv. 3 cred. Ar.
130. **Managerial Cost Accounting.** Cost accounting and analysis from the point of view of its use by management in making decisions and setting policies, and in establishing controls over costs. Prereq.: Econ. 26 or equiv. 3 cred. Ostlund.
131. **Distribution Cost Accounting.** Principles and procedures involved in handling cost accounting in retailing, wholesaling, and the distributive divisions of manufacturing enterprises. Prereq.: 153. 3 cred. Ostlund.
133. **Standard Costs.** Methods of standard costs. The meaning of standards. The setting of standards for materials, labor, and overhead. Analysis of and accounting for variations. Development and application of standards to distribution as well as to production activities. Prereq.: 153. 3 cred. Ostlund.
134. **Income Tax Accounting.** Principles involved in determining taxable net income and the computation of federal and state income taxes for individuals, partnerships, and corporations. Prereq.: 151. 3 cred. Reighard, Nelson.
135. **Auditing and Public Accounting.** Independent auditing in relation to function, fraud prevention, types of investigation, accepted standards, regulations of S.E.C. and A.I.A., problems and ethics of professional practice. Study of case and problem material. Prereq.: 118. 3 cred. Reighard.
136. **Controllership Functions and Procedures.** Study of the place and functions of the controller and internal auditor in business enterprises. Examination of the accounting systems and methods related to such functions as internal check and audit control of routine transactions. Prereq.: 151. 3 cred. Reighard.
139. **Corporate Statements.** Preparation of corporate statements and analysis from management, investment, and credit viewpoint. Report required analyzing statement of an assigned corporation. Prereq.: Econ. 26 or equiv. 3 cred. Heilman.
141. **Real Estate.** Emphasis on valuation of urban real estate; consideration of problems of real estate financing, rent control, housing, land development, zoning, and other factors affecting real estate values. Prereq.: 7. 3 cred. Sutton.
145. **International Finance and Foreign Exchange.** Problems of international equilibrium as reflected chiefly in the forces that influence the levels of foreign exchange rates. Prereq.: Econ. 64 or 142. 3 cred. Ar.
146. **Investments.** A general or "cross cut" survey of the external and internal factors influencing the prices of securities, and of the principles of an investment policy for the individual investor. Emphasis on objective analysis from source materials of factors explaining price differentiation. Prereq.: Econ. 75 or 155. 3 cred. Stehman.
148. **The Securities Market.** Consideration of behavior over time or "longitudinal" analysis of prices of individual and groups of securities. Emphasis on relationship of economic conditions to security values, particularly the effects of cyclical fluctuations. Prereq.: 146, Econ. 149. 3 cred. Sutton.
150. **Intermediate Accounting I.** Principles and procedures involved in the valuation of assets and the determination of periodic income. Prereq.: Econ. 26 or equiv., Math. 20. 3 cred. Heilman, Nelson, Lund, and others.
151. **Intermediate Accounting II.** Principles and procedures involved in the valuation of liabilities and stockholders' interest, formation and dissolution of partnerships, analysis of financial statements. Prereq.: 150. 3 cred. Heilman, Nelson, Lund, and others.
- 152-153. **Cost Accounting.** Practices and procedures. Principles and methods of handling material, labor, and overhead costs. Procedures in job order and process cost systems. Introduction to budgets, standard costs, and cost analysis. Prereq.: Econ. 26 or equiv. 3 cred. per qtr. Ostlund, Wheeler.

- 154. Budgetary Control.** Fundamentals of establishing and operating a budget. Budgetary control and the relationship to break-even analysis. Prereq.: 153. 3 cred. Wheeler.
- 156. Finance Management.** Duties of the financial manager of a modern business. Various sources from which capital may be secured, the best use of a company's funds, and special financial problems of the typical business. Prereq.: Econ. 75 or 155. 3 cred. Stehman.
- 158. Governmental Accounting.** Government budgets and fund accounting. Prereq.: 151. 2 cred. Heilman.
- 159. Advanced Accounting.** Branch accounting, consolidated statements, estates and trusts, concerns in financial difficulties, and other specialized problems. Prereq.: 151. 3 cred. Heilman, Nelson, Lund, and others.
- 167. Introduction to Industrial Relations.** Survey of policy and practice in manpower management. The course provides a professional viewpoint toward major functions, including policy formulation, determination of labor needs, job analysis, recruitment, selection, training and safety, service rating, employment stabilization, collective bargaining, and wage and salary administration. Prereq.: Econ. 73 or 161. 3 cred. Yoder and others.
- 168. Advanced Personnel Administration.** Administrative aspects of industrial relations in both unions and managements. Mechanisms and practices of manpower management policy determination and review. Development and use of personnel records and reports. Prereq.: 167. 3 cred. Heneman.
- 170. Methods Analysis and Work Measurement.** Process and operation analysis, work simplification, motion study, and micro-motion study principles and applications. Work measurement, job standardization, time study, motion-time analysis. Production standards and their application for planning and control purposes. (Course given by the Industrial Engineering Division, Institute of Technology, primarily for students in the School of Business Administration.) Prereq.: 89 or 187. 3 cred. Ar.
- 171. Motion Study Applications.** Laboratory projects selected from, and contributory to, improvement of basic clerical, office practice, and merchandising procedures, emphasizing application of motion economy principles. Final report required for each project. Prereq.: 170. 3 cred. Ar.
- 173. Market Analysis and Research.** A systematic survey of the techniques used in market research. Selected problems in the analysis of sales records, sales forecasting, estimating sales potentials, sampling consumer demand, determining the factors which influence demand for specific goods, and so on. Prereq.: 77 or equiv., Econ. 5. 3 cred. Holloway.
- 174. Transportation: Services and Charges II.** Analysis of the principles relating to construction, interpretation, and application of rail, water, express, and air freight classifications and tariffs. Analysis of railway freight structures. Problems relating to the determination of charges on typical movements within and between major railway freight-rate territories. Prereq.: 71 or Econ. 172. 3 cred. Nightingale.
- 177. Foreign Trade.** Export and import procedures and practices. Organization for exporting, channels of distribution, foreign trade promotion, financing shipment, insurance and shipping, tariffs and governmental export and import regulations. Character and development of United States trade. Prereq.: Econ. 6-7 or equiv. 3 cred. Holloway.
- 180-181-182. Senior Topics Courses.** Intensive study of problems in respective fields of specialization.
- 181A. Readings in Accounting Literature.** Discussion and reports on selected topics in practice and theory as found in the Accountant's Handbook and current accounting literature. Prereq.: 12 cred. in accounting at the Senior College level. 3 cred. Reighard.
- 181-182B. Business Finance.** Individual research and discussion of important current financial developments. 3 cred. per qtr. Stehman.
- 180-181-182C. Marketing.** Selected topics in management problems. 180C: Market price and price policies. Prereq.: 77. 3 cred. Vaile. 181C: Management problems dealing specifically with sales forecasting and the analysis of distribution costs. Prereq.: 77. 3 cred. Lewis. 182C: Retail store management. Prereq.: 114. 3 cred. Canoyer.

- 180-181-182D.† Industrial Relations.** Develops familiarity with an evaluation of professional procedures and techniques used in each of the major functions of manpower management. Individual and group projects to prepare the student for employment in industrial relations at the staff level. Limited to majors in industrial relations and others who have satisfactorily completed 167 or its equivalent. 3 cred. per qtr. Yoder.
- 180-181-182F. Statistics.** Intensive study of original sources dealing with selected topics in the theory of statistics. Both oral and written reports are prepared by the students. Prereq.: Econ. 123 or parallel. 3 cred. per qtr. Ar.
- 180-181-182G.§ Production Management.** Selected problems in management; studies in the technique of executive control in manufacturing enterprises; field research and surveys in organization and methods of management of Northwest industrial concerns. Prereq.: 89 or 187. 3 cred. per qtr. Filipetti.
- 180-181-182I. Transportation.** 180I: Traffic management, including transportation rates and practices and the individual firm; 181I: Motor and air transportation; 182I: Regulation and management of transportation agencies with intensive analysis of recent leading decisions of the Interstate Commerce Commission and Civil Aeronautics Board. Prereq.: 174 or permission. 3 cred. per qtr. Nightingale.
- 182H. Insurance.** Each student is expected to do independent work in the insurance area of his special interest. Prereq.: 6 cred. in insurance. 3 cred. Ar.
- 183. Practice or Internship Course.** Students engaged in outside work on the Cooperative Plan may receive graduate credit for this course provided the individual case has approval of the student's adviser, the member of the graduate faculty by whom the outside work is supervised, and the chairman of the Graduate Committee of the School of Business Administration. Staff.
- 184.§ Scientific Management in Industry.** The origin and development of the movement to apply the methods of science to management of industrial enterprises; the effects upon individual plant management and the influence upon "rationalization" in industrial society. Prereq.: 89 or 187. 3 cred. Filipetti.
- 187. Administration of Production.** This nontechnical course develops the production function of business from the general management viewpoint. Prereq.: Econ. 7 or equiv. 3 cred. Filipetti.
- 188. Advertising.** Two important phases of advertising: (1) the place of advertising in business, (2) advertising procedure. An advertising campaign is planned, including market research, appropriation, choice of media, scheduling, preparation of copy, and layout. Prereq.: 77 and Psy. 56. 3 cred. Lewis.
- 194. Advanced Advertising Procedure.** Problems and case work in advertising research. Preparation and criticism of advertisements and of advertising campaigns. Prereq.: 87 or 188, Econ. 5. 3 cred. Longstaff.
- 198. Internship in Public Accounting.** (See 183.) Staff.
- 199. Internship in Internal Accounting.** (See 183.) Staff.
- 211. Seminar in Marketing.** 3 cred. Vaile.
- 258. Seminar in Cost Accounting.** 3 cred. Ostlund.
- 259. Case Studies in Specialized Accounting.** 3 cred. Wheeler.
- 260. Tax Accounting Problems.** 3 cred. Nelson.
- 261-262. Advanced Accounting Problems.** 3 cred. per qtr. Nelson.
- 263. Seminar in Accounting Theory—Valuation and Principles.** 3 cred. Heilman.
- 264. Seminar in Accounting Theory—Income Determination and Statement Presentation.** 3 cred. Nelson.
- 265. Accounting under Government Regulation.** 3 cred. Heilman.
- 281. Seminar in Industrial Management.** Prereq.: 184 or 180G and 182G. 3 cred. Filipetti.

† Credit may not be received for both B.A. 180G and B.A. 184.  
 ‡ 180-181-182D must be taken in sequential order.

## EDUCATION

Professors Marcia Edwards, John E. Anderson, Clifford P. Archer, Clara Brown Arny, Gertrude M. Baker, Robert H. Beck, Charles W. Boardman, Guy L. Bond, Nelson L. Bossing, Leo J. Brueckner, Walter W. Cook, Willis E. Dugan, Ruth E. Eckert, Paul R. Grim, Palmer O. Johnson, Louis F. Keller, George H. McCune, William J. Micheels, Horace T. Morse, Mervin G. Neale, Carl L. Nordly, Paul M. Oberg, Milo J. Peterson, Ralph A. Piper, Raymond G. Price, Ella J. Rose, Dora V. Smith, Homer J. Smith, C. Gilbert Wrenn; Associate Professors David C. Bartelma, Emma Birkmaier, Roxana R. Ford, Elizabeth M. Fuller, Carl V. Goossen, Ruth E. Grout, Cyril J. Hoyt, Donovan A. Johnson, Robert J. Keller, Harry W. Kitts, Warren G. Meyer, Minard W. Stout, Tracy F. Tyler, Marvin J. Van Wagenen, Marjorie U. Wilson; Assistant Professors Jean H. Alexander, Ned A. Flanders, Paul S. Ivory, Maynard C. Reynolds; Lecturer Gerald B. Fitzgerald.

**Prerequisites**—For major work in education at least 6 quarter credits in psychology and also a total of not less than 18 quarter credits of undergraduate work in education including Ed. 51A-B-C or Ed. 55A-B or Ed. 71A-B-C or the equivalent. 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.

**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 fields listed below, excluding the field of his minor, centering about his special interest in education:

Agricultural education	History and philosophy of education
Curriculum and instruction§	Home economics education
Education§	Industrial education
Educational administration§	Music education
Educational psychology§	Physical education

Minors may be chosen as follows:

1. From any of the groups of courses enumerated above 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, which encourages a wider selection of courses, 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

§ See Notes to Applicants for Admission to Graduate School on page 90.

will indicate his field of concentration according to the general arrangement of courses required for a major. This arrangement is as follows:

Agricultural education	History and philosophy of education
Curriculum and instruction§	Home economics education
Education (in special cases)§	Industrial education
Educational administration§	Music education
Educational psychology§	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. Further work in subject-matter areas is encouraged.

**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 guidance and counseling, measurement, research, or another main interest.)

Curriculum and instruction (specify whether your general interest is at the elementary or secondary level, or in a principal teaching field such as business and distributive education, English education, etc.)

Education (at the 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 most, or all, of the related work taken in specific teaching fields, such as English, mathematics or science.)

**Doctor's Degree**—Major work will be chosen in the following manner:

With the approval of his adviser the student will select a group of courses, excluding the field of his minor, centering about his special interest in education. Major fields are:

Education  
Educational administration  
Educational psychology

Minors may be chosen as follows:

1. From one of the following fields not represented in the major:

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

2. Any other field of study offered in the University of Minnesota in which satisfactory courses of graduate character are available and which is obviously related to the field of major interest.

3. Students majoring in fields other than education may choose education, or any of its subdivisions enumerated above under 1, as a minor when it appears that such a minor is appropriately related to a major field.

**(Master of Education Degree**—Advanced work leading to the professional degree of master of education is offered by the College of Educa-

§ See Notes to Applicants for Admission to Graduate School above.

tion in agricultural education, art education, elementary education, English education, home economics education, industrial education, music education, natural sciences, physical education, recreation leadership, rural education, and social studies. Students interested in any of these programs should secure a *Bulletin of the College of Education* and consult an adviser.)

## Courses

### AGRICULTURAL EDUCATION

**Prerequisites**—Preparation in agricultural subjects satisfactory to the Department of Agricultural Education.

- Agr.Ed.101f.w. Young Farmer Education in Agriculture.** Organizing a continuing program of educational activities for farm youth not in school and not established in an occupation. Methods and techniques of instruction. Observation of young farmer programs. Prereq.: 81 or permission. 2 cred. Ar.
- Agr.Ed.102f.w. Adult Education in Agriculture.** Systematic instruction for established farmers. Analysis of the farming situation with emphasis on improved farm management. Methods and techniques of instruction, and observation of adult education program. Prereq.: 81 or permission. 2 cred. Ar.
- Agr.Ed.103f. Methods of Instruction in Mechanized Farming.** Methods of teaching mechanized farming including organization of shop program, equipment, and management of farm shop. Preparation and use of job sheets, instruction units, and demonstrations in presenting materials and problems. Prereq.: 81 or permission. 3 cred. Ar.
- Agr.Ed.104f.w.s. Planning Program.** Developing a program of agricultural education in a community school. Integration with total school program. Administrative relationships and professional improvement. 2 cred. Ar.
- Agr.Ed.121su. 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 cred. Ar.
- Agr.Ed.141f. 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. Prereq.: 10 cred. in education. 3 to 9 cred. Ar.
- Agr.Ed.145w. The Integrated Course of Study in Agriculture.** Philosophy, organization, and administration of instruction in agriculture departments in the secondary schools. Prereq.: 10 cred. in ed. 2 cred. Ar.
- Agr.Ed.154su.\* Rural Education and Community Leadership.** An appraisal of community educational agencies; the process of and responsibilities for community leadership; the role of the school in the rural community; coordination of the school with nonschool educational agencies. 3 cred. Ar.
- Agr.Ed.221f.w.s. Field Problems.** Making investigations, gathering data, and formulating plans regarding agricultural education. 3 cred. Peterson, Kitts.
- Agr.Ed.232f.w.s.\* Research in Agricultural Education.** Introduction to investigational work in problems of teaching agriculture in high schools. Experience in selecting problems, preparation of bibliographies, analyzing and interpreting data, and preparing manuscripts. Prereq.: 15 cred. in ed. Cred. ar. Peterson, Kitts.
- Agr.Ed.250f.w.s. Supervision of Vocational Agriculture.** Supervision of vocational agriculture at the secondary level. Objectives, functions, responsibilities of state and local supervision; role of supervision in the teaching-learning process; organizing supervisory activities; aids to effective supervision. Prereq.: permission. 1 to 3 cred. Peterson, Kitts.
- Agr.Ed.286w. Current Issues in Agricultural Education.** Analysis and discussion of significant issues. Opportunity for intensive study of problems related to local school programs. Prereq.: permission. Cred. ar. Peterson, Kitts.
- Agr.Ed.291f.w.s. Seminar in Agricultural Education.** Cred. ar. Peterson, Kitts.

## ART EDUCATION

- ArtEd.151w-152s-153. Curriculum Building in Art Education.** Functions of art in society for educational potentialities toward social improvement. Selection, evaluation, and organization of subject matter for the purpose of creating original teaching units, projects, etc. 3 cred. per qtr. Hastie. (153 not offered 1952-53.)
- ArtEd.156s. Intercultural Education through Art.** Approaches to international understanding and cooperation through recognition of esthetic contributions of diverse peoples to American life. 3 cred. Ar.
- ArtEd.158s. Art Education in Europe.** Examination of current practices, problems, and achievements in art education in countries of western Europe with particular reference to sources for and comparisons with practices in American art education. 3 cred. Ar.
- ArtEd.184f. Advanced Course in the Teaching and Supervision of Art in the Elementary School.** Improving current practices through critical evaluation and utilization of research findings and introduction of new materials. Development of closer cooperation between classroom teachers and art education specialists. 3 cred. Gayne.
- ArtEd.185s. Advanced Course in the Teaching of Art in the Secondary School.** For experienced teachers of art and advanced students planning to teach in secondary schools. Emphasis on general research and critical examination of high school art programs. 3 cred. Hastie.
- ArtEd.189f. Application of Esthetic Theory in Education.** Contemporary theories of art, their psychological and philosophical foundations with experimental evidence. Open to teachers, supervisors, and administrators concerned with making art function in general education at all levels. 3 cred. Hastie.
- ArtEd.284w. Research in Art Education.** Application of research techniques to the field of art education, with experience in locating, defining, and studying basic problems through the use of objective tools of research. 2 cred. Gayne.
- ArtEd.295f.w.s. Problems in Art Education.** Course content determined by the individual specialization and creative projects selected. Projects may include advanced studio practice or technical solution of problems involving research or reading in a chosen field. Prereq.: permission. Cred. ar. Gayne and staff.
- ArtEd.296f.w.s. Seminar in Art Education.** Reports, evaluation of problems, recent literature. Participation by art education staff and guest specialists from related departments and from off campus. Open to advanced students in education. No cred. Staff.

## CURRICULUM AND INSTRUCTION

*General Courses*

- Ed.C.I.104s. Adult Education.** A survey course of the field of adult education dealing with agencies, programs, philosophies, history, and trends. Each student may devote some time to a field of special interest. 3 cred. Nolte.
- Ed.C.I.105f.w.s. Visual Materials in Education.** Characteristics, advantages, limitations, and practical schoolroom use of visual aids of nonprojection and projection types. Practice in operation of projection machines. 3 cred. Ar.
- Ed.C.I.106w. Coordinating a Visual Education Program.** For persons having part-time or full-time responsibility for an audio-visual program. Criteria of equipment, facilities, materials; in-service training of teachers, and special problems encountered in small and large systems. Prereq.: 105 or permission. 3 cred. Ar.
- Ed.C.I.107f.w.s. Radio in Education.** Effective use of radio in the classroom. Production, techniques of classroom use, selection of equipment, teaching appreciation, and the administration of radio in the schools. Prereq.: 9 cred. in ed. 3 cred. Tyler.

- Ed.C.I.107-108. Radio in Education.** Same content as Ed.C.I. 107 but expanded somewhat and offered during two quarters in alternate years. 2 cred. per qtr. Tyler. (Not offered 1952-53.)
- Ed.C.I.109f,w.s. Audio-Visual Materials and Equipment Laboratory.** Practice in planning and making materials for audio-visual education and in the use of machines and equipment. Prereq.: 105 or permission. 3 cred. Ar.
- Ed.C.I.117s. Rural Education for Administrators and Teachers.** 3 cred. Archer.
- Ed.C.I.129su. Principles and Problems of Teaching Social Hygiene.** Social hygiene or sex education in its broadest aspects—physical, sociological, and psychological. Methods of social hygiene education and integration of material with total health curriculum. Primarily for teachers. Prereq.: 9 cred. in ed. 3 cred. Ar.
- Ed.C.I.133f. Consumer Education in the Schools.** Need for consumer education, organizing a program in the school. Prereq.: permission. 3 cred. Price.
- Ed.C.I.145f.s. Reading Difficulties.** Study of reading difficulties—their causes, prevention, and correction. Remedial practices in reading useful to the classroom teacher, school counselor, and reading specialist. Prereq.: course in reading or basic training in counseling or school psychological work. 3 cred. Bond.
- Ed.C.I.151w. Diagnosis and Treatment of Learning Difficulties.** Evaluation of the results of teaching; diagnosis of pupil difficulty; development and prevention; tests as aids to teaching; following up a testing program. 3 cred. Brueckner.
- Ed.C.I.152. Adjustment of Schools to Individual Differences.** Prereq.: 10 cred. in ed. 3 cred. Ar.
- Ed.C.I.171f,w.s. Curriculum Laboratory Practice.** A practice course in the analysis and construction of units, courses of study, and curricula according to needs, interests, level, and specialization. Prereq.: 170A or B, permission. 2 cred. per qtr. Bossing, Cook, Archer.
- Ed.C.I.174f,w.s-175f,w.s-176f,w.s. 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. Prereq.: Spch. 61, 67, 119, 162, 163 or parallel. 3 cred. per qtr. Bryngelson.
- Ed.C.I.205f,w.s.\* Problems in Visual Education.** Prereq.: permission. Cred ar. Ar.
- Ed.C.I.207f,w.s.\* Problems in Radio Education.** Individual problems for students whose work in Ed.C.I. 107 has indicated an aptitude and interest in the field. Prereq.: 107. 1 to 3 cred. per qtr. Tyler.
- Ed.C.I.215f,w.s.\* Problems in the School Health Education Program.** For advanced students who wish to pursue independent study and experimentation in school health education. Prereq.: permission. Cred. ar. Grout.
- Ed.C.I.216f,w.s. Field Work in the School Health Education Program.** Practical field experience in school health education under the supervision of qualified health educators. Details will be worked out in accordance with individual needs. Prereq.: permission. Cred. ar. Grout.
- Ed.C.I.217f,w.s. Seminar in the School Health Education Program.** Discussion and reports on current problems in school health education. Prereq.: permission. Cred. ar. Grout.
- Ed.C.I.227f,w.s.\* Problems in Rural Education.** Prereq.: 117. Cred. ar. Archer.
- Ed.C.I.243s. Recent Research in Reading.** Critical analysis of methodology and findings of current research in the field of reading. Appraising research methods, population limitations, and educational implications. Prereq.: permission. 3 cred. Bond.
- Ed.C.I.271f,w.s.\* Problems in Curriculum Construction.** Special problems in the field of the student's individual choice. Prereq.: permission. 3 cred. per qtr. Bossing, Cook, Archer, D. Johnson.
- Ed.C.I.273f,w.s.\* Problems in Reading.** Recent problems, 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. Prereq.: 143 or 144 or permission. 3 cred. per qtr. Bond.

*Elementary Education*

- Ed.C.I.102f. Teaching the Social Studies in the Elementary School.** Primarily for teachers in service. Prereq.: Ed. 71C or equiv. 3 cred. Ar.
- Ed.C.I.119w. Elementary School Curriculum.** Principles underlying the selection and organization of subject matter for courses in the elementary school and a survey of the methods, problems, and findings of research by subjects. Prereq.: Ed. 71C or equiv. 3 cred. Goossen.
- Ed.C.I.143f. Teaching and Supervision of Reading in the Elementary School.** Objectives, materials, and teaching procedures in lower and intermediate grades; survey of current practices and curricula; class and individual projects; observation of reading techniques and materials in the demonstration school. Prereq.: 9 cred. in ed. 3 cred. Bond.
- Ed.C.I.146. Current Developments in Language Expression in the Elementary School.** Materials, methods, and current philosophies of language instruction in the elementary school. Prereq.: Ed. 71C or equiv. Not open to students who have had 64. 2 cred. Archer.
- Ed.C.I.149w. Teaching and Supervision of Arithmetic in the Elementary School.** Functions of arithmetic instruction; curriculum studies; development of socialized units; measurement and diagnosis; experimental research on methods of arithmetic instruction; literature on arithmetic. Prereq.: Ed. 71C or equiv. Not open to students who have had 62A or B. 3 cred. Brueckner.
- Ed.C.I.150f. Supervision and Improvement of Instruction.** Functions and duties of a supervisor as related to the improvement of instruction; specific supervisory technique, objective analysis of classroom activity; concrete applications to present-day problems; case studies. Prereq.: Ed. 71C or equiv. 3 cred. Brueckner.
- Ed.C.I.153w. Supervision and Teaching of English in the Elementary Schools.** Improvement of instruction in language, grammar, spelling, and handwriting. Prereq.: Ed. 71C or equiv. 3 cred. Archer.
- Ed.C.I.157f.w.s. Practice in Supervision.** Individual research on special supervisory problems, especially for supervisors in training. Prereq.: permission. 3 cred. per qtr. Brueckner.
- Ed.C.I.170A. Curriculum and Course of Study Construction.** Principles and methods for the selection and organization of units, courses of study, and curricula at the elementary school level. Prereq.: 119 or permission. 3 cred. Ar.
- Ed.C.I.173As. Organizing Units of Instruction in the Elementary School.** Principles and procedures involved in the organization of units utilizing natural science and social studies in the development of skills in reading and study, oral and written composition, arithmetic, and the arts. Prereq.: 119 or teaching experience. 3 cred. Cook.
- Ed.C.I.181w. Foundations of Elementary School Methods.** Survey of current philosophy and research which form the bases for improvement of elementary school instruction. Prereq.: 9 cred. in ed. 3 cred. Brueckner.
- Ed.C.I.226f.w.s. Seminar in Elementary School Problems.** No cred. Bond, Brueckner, Cook, Archer.
- Ed.C.I.261f.w.s.\* Special Problems in the Improvement of Instruction.** Primarily for students majoring in supervision and others qualified to make intensive studies of specific problems related to school supervision. Fall: surveys of instruction; winter: construction of tests measuring the extent to which objectives are achieved; spring: problems in the evaluation of teaching. Prereq.: permission. Cred. ar. Brueckner.
- Ed.C.I.263w.\* Research in Arithmetic Instruction.** Recent research in curriculum, gradation of subject matter, methods, materials, and supervision of arithmetic. 3 cred. Brueckner.
- Ed.C.I.264s.\* Research in Educational Diagnosis.** Recent research in methods of diagnosis in education, and techniques of preventive and remedial teaching. 3 cred. Brueckner.
- Ed.C.I.265f.w.s.\* Research in Supervision.** Recent research in supervision, teacher rating, surveys of instruction, and school and community relations. Prereq.: permission. Cred. ar. Brueckner.

*Secondary Education*

- Ed.C.I.113f.w. High School Curriculum.** Viewpoints and curriculum issues, organization trends, typical research findings by subjects, and analysis of state and local curricula. Prereq.: Ed. 55A-B or equiv. 3 cred. Bossing.
- Ed.C.I.122s. Literature for Adolescents.** Background for pupil guidance in extensive reading in junior and senior high schools. Prereq.: Ed. 55B or junior-senior high school teaching experience. 2 cred. D. V. Smith.
- Ed.C.I.125w.s. Occupational Information Laboratory.** Experience in using, reviewing, and evaluating occupational information. Study of sources and types of material, occupational filing plans, and practical techniques at the secondary school level. Prereq.: permission. 1 to 3 cred. Dugan.
- Ed.C.I.131f. Advanced Course in Teaching Technical Business Subjects.** Recent research and trends in teaching the technical business subjects. 3 cred. Price.
- Ed.C.I.132s. Teaching the Basic Business Subjects.** Recent trends and developments in teaching junior business training, economic geography, marketing, business law, consumer education, and bookkeeping. 3 cred. Price.
- Ed.C.I.134s. Materials and Methods in Consumer Education.** Development of teaching units; emphasis on teaching methods, and recent aids and materials. Prereq.: permission. 3 cred. Price.
- Ed.C.I.135s. Group Procedures in Guidance.** Problems of group work in guidance in secondary schools. Content and materials for home room groups, occupational units, and other guidance courses in junior and senior high school. Prereq.: 9 cred. in education, Ed.Psy. 133 or permission. 3 cred. Dugan.
- Ed.C.I.136f. Business and Distributive Education under the Vocational Acts.** Principles, practices and legislation followed in developing cooperative part-time, extension part-time and evening school programs under Smith-Hughes and George-Barden Acts. Basic course for teacher coordinators and vocational administrators. 3 cred. Meyer.
- Ed.C.I.137A. Materials and Methods in Cooperative Part-Time Classes.** Related vocational materials and methods for cooperative part-time distributive, office, miscellaneous trades and diversified occupations classes. 3 cred. Meyer.
- Ed.C.I.137B. Advanced Materials and Methods in Cooperative Part-Time Classes.** Individual and group work on related vocational materials. New methods of teaching cooperative part-time distributive, office, miscellaneous trades and diversified occupations classes. Prereq.: permission. 3 cred. Meyer.
- Ed.C.I.138. Training Store and Office Supervisors.** Supervisory training problems and elementary training techniques used in stores and offices. Enables coordinator to conduct short unit courses for store and office supervisors. Prereq.: permission. 3 cred. Meyer.
- Ed.C.I.139w. Coordination Techniques.** Practical problems encountered by the coordinator in his daily work concerning the cooperative part-time program. Guidance and selection; placing of students in work stations; assisting job adjustments; developing the training program. 3 cred. Meyer.
- Ed.C.I.141s. Cooperative Part-Time Work Experience Programs.** Planning, organizing, curriculum building, plant and equipment, promoting and evaluating cooperative part-time distributive, office, miscellaneous trades and diversified occupations programs. 3 cred. Meyer.
- Ed.C.I.142. Business and Distributive Programs for Adults.** Selection and training of evening school instructors; planning and promoting evening school distributive education classes. 3 cred. Meyer.
- Ed.C.I.144w. Teaching of Reading in Secondary Schools.** Teaching procedures, objectives, and materials, with special consideration for the teaching of reading in the various subject-matter fields. Prereq.: 9 cred. in ed. 3 cred. Bond.
- Ed.C.I.154. Materials and Methods in Adult Distributive Education Classes.** Survey of course outlines, reference materials, and teaching aids. Construction of units of instruction. Prereq.: permission. 3 cred. Meyer.

- Ed.C.I.156s. Trends in Business Education.** Historical development of business education; trends in philosophy, curriculum, and teaching procedures. 3 cred. Price.
- Ed.C.I.161s. Curriculum Construction in Business Education.** Curriculum problems in business education, including organization, with emphasis on preparation of teaching units. Prereq.: 113. 3 cred. Price.
- Ed.C.I.168f. Current Developments in the Social Studies.** A survey of contemporary literature, curricular trends, and developments in methods. 2 cred. McCune.
- Ed.C.I.169w. Extracurricular Activities.** Types of activities in junior and senior high schools; aims and values; practices in organizing, administering, and supervising; methods of evaluation. Prereq.: Ed. 55A-B or equiv. 4 cred. Bossing.
- Ed.C.I.170B. Curriculum and Course of Study Construction.** Principles and methods for the selection and organization of units, courses of study, and curricula. Prereq.: 113 or 119 or permission. 3 cred. Bossing.
- Ed.C.I.173B. Organizing Units of Instruction in the Secondary School.** Development of principles and procedures for construction and teaching of units of instruction. Prereq.: 113 or permission. 3 cred. Bossing.
- Ed.C.I.191s. Advanced Course in Teaching and Supervision of Secondary Mathematics.** Present practices in methods, materials, and curriculum development in secondary mathematics; principles of learning applied to mathematics; review of research; preparation and evaluation of units, tests, and materials of instruction. 3 cred. D. Johnson.
- Ed.C.I.201f.w.s.\* Problems in Teaching the Social Studies.** Each student concentrates on one problem intensively and gives oral reports and a final written report. Prereq.: 168, 204 or permission. 3 cred. per qtr. Morse, McCune, West.
- Ed.C.I.204w. Social Studies Curriculum.** Review of techniques and practices of curriculum-making in the social studies at all grade levels. 3 cred. McCune.
- Ed.C.I.222f.w.s. Seminar—Current Problems in the Techniques of High School Instruction.** Required with or without credit of candidates for M.A. or Ph.D. in the secondary field. Prereq.: Ed. 55A-B and senior methods. Bossing, Boardman, D. V. Smith, Stout.
- Ed.C.I.225f.w.s.\* Special Problems in Supervision of Instruction in Secondary Schools.** Primarily for graduate students and supervisors in schools who are qualified to make intensive studies. Prereq.: permission. Cred. ar. Boardman, R. Keller.
- Ed.C.I.238f.w.s.\* Problems in Distributive Education.** Investigation of particular problems in the field of distributive education. Prereq.: permission. Cred. ar. Meyer.
- Ed.C.I.239f.w.s.\* Problems in Business Education.** Special investigations in the field of the student's interest. Prereq.: permission. Cred. ar. Price.
- Ed.C.I.255s. Materials Laboratory for Social Studies Teachers.** A seminar in the study of printed and audio-visual materials, with reference to their use in social studies classes. Prereq.: permission. 3 cred. McCune, West.
- Ed.C.I.266s. Supervision of High School Instruction.** The present status of high school supervision; its proper scope and function. Combines principles and their application to improving high school instruction. Prereq.: Ed.Psy. 293 or permission. 3 cred. Boardman.
- Ed.C.I.287f.\* Advanced Course in the Teaching of Science.** A study of recent developments in the teaching of science and a critical evaluation of the investigations dealing with science teaching. 3 cred. P. O. Johnson.
- Ed.C.I.294f.w.\* Advanced Course in Curriculum and Methods in Secondary School English.** Evaluates present content and method in the light of research and recent trends in teaching. Prereq.: Ed.T. 75A-B-C or equiv. 2 cred. per qtr. D. V. Smith.
- Ed.C.I.296f.w.s.\* Special Problems in Teaching English.** Special research problems in the field of the student's individual choice. Cred. ar. Smith.

*Higher Education*

- Ed.C.I.184f. Supervision of Student Teaching.** Designed for persons planning to supervise or administer student teaching and other professional laboratory experiences in elementary and secondary education. Prereq.: 15 cred. in ed. or permission. 3 cred. Grim.
- Ed.C.I.228f,w.s.\* Problems of Higher Education and Teacher Education.** Problems of student personnel, college curricula and instruction, organization and administration. Offered as a seminar one quarter a year and as an individual problems course each quarter. Prereq.: permission. Cred. ar. Cooper, Eckert, Grim.
- Ed.C.I.250f.w. Higher Education in the United States.** The development, present status, and outlook for American colleges. Topics considered include: the purposes of higher education; types of program divided, trends in curriculum, instruction, and administration; and the evaluation of outcomes. Prereq.: a year of grad. study in any field or 18 cred. in ed. 3 cred. Eckert.
- Ed.C.I.251w. Curriculum Trends in American Colleges.** Basic principles involved in the development of college programs. After examining the curriculum as a whole, certain recurrent problems in designing general education courses and sequences will be studied critically. Prereq.: a year of grad. study in any field or 18 cred. in ed. 3 cred. Eckert.
- Ed.C.I.252s. Effective College Teaching.** A review of the philosophical and psychological bases of instruction, followed by careful study of methods currently employed to encourage, guide, and appraise students' learning. The college teacher's status and services are also examined. Prereq.: a year of grad. study in any field or 18 cred. in ed. 3 cred. Eckert.
- Ed.C.I.253f,w.s. Seminar on the Improvement of College Instruction.** Planned for instructors, teaching assistants and mature graduate students from various departments of the University and instructors from other institutions. Current problems, research and trends in the area of instruction. Offered with cooperating staff of various teaching departments. Emphasis determined by immediate and future needs of the students enrolled. Prereq.: permission. Cred. ar. or non-cred. Eckert, Wrenn, and others.
- Ed.C.I.254f,w.s. Directed Experience in College Instruction.** An individualized program under guidance of an instructor or department. Planned to provide understandings, procedures, and skills related to application of instructional theory, curriculum development, observation, and evaluation practices. Offered with cooperating staff of various teaching departments. Prereq.: permission. Cred. ar. Eckert, Wrenn, and others.
- Ed.C.I.284f,w.s.\* Problems in Student Teaching.** Research problems in the supervision, organization, and administration of student teaching and laboratory experiences on the elementary and secondary levels. 3 to 9 cred. Grim.
- Ed.C.I.285w,286s. The Professional Education of Teachers.** For instructors, administrators, and personnel workers in teacher educating institutions. First quarter is general and can be taken independently; second quarter is for persons planning to work in the professional curriculum of teacher education. Status of teacher education, selection, curriculum, certification, graduate programs, trends, and research. Prereq.: 285; 15 cred. in ed. including H.Ed. 182 or Ed.C.I. 184 and Ed.C.I. 250 or Ed.Psy. 250, or permission; 286: 285 or permission. 3 cred. per qtr. Grim.

## EDUCATIONAL ADMINISTRATION

*General Courses*

- Ed.Ad.124f. Public School Administration.** Organization, administration, and general support of public schools in state and local school districts. Prereq.: 9 cred. in ed. 3 cred. Neale.
- Ed.Ad.210s.\* Financial Aspects of School Business Administration.** Financial program planning, budgeting, accounting, cost finding, income and expenditure control; and the preparation and analysis of financial reports. Prereq.: 227. 3 cred. Neale.
- Ed.Ad.225f.\* Pupil Personnel Administration.** Child accounting records and reports, attendance department, school census, pupil adjustment and progress, pupil health and safety, and legal aspects of pupil personnel administration. Prereq.: 124. 3 cred. Neale.

- Ed.Ad.226s.\* School Plant Planning and Management.** Plant program planning and financing, including operation and maintenance of public school buildings. Prereq.: 227. 3 cred. Neale.
- Ed.Ad.227w.\* Teacher and Employee Administration.** Selection and placement of school employees, salary schedules, conditions of service, records and reports, and legal aspects of teacher and employee personnel administration. Prereq.: 225. 3 cred. Neale.
- Ed.Ad.228f.w.s.\* Special Problems in Educational Administration.** Designed primarily for superintendents and principals qualified to make intensive studies of specific problems related to the administration of a school system. Prereq.: 225. 1 or 3 cred. per qtr. Neale.
- Ed.Ad.230f.\* Public Relations for Schools.** Theory and practice of educational interpretation. Principles involved; machinery and personnel; techniques of working with groups; the teacher's contacts with the community; the role of the pupil; professional and lay organization. Prereq.: 225. 3 cred. Neale.
- Ed.Ad.235f.w.s. Seminar in Educational Administration.** Enrolment limited to candidates for Master's degree under Plan A and candidates for Ph.D. degree in educational administration. No cred. Neale.

#### *Elementary Education*

- Ed.Ad.115w. Organization of the Elementary School.** Problems relating to the organization for instruction and classification of pupils in elementary schools with critical examination of current practices. Prereq.: 9 cred. in ed. 3 cred. Neale.

#### *Secondary Education*

- Ed.Ad.133f. Basic Procedures in Student Personnel Work.** Basic principles and current practices in development and operation of a student personnel program. Emphasis on broad areas of guidance services and related techniques. Prereq.: 9 cred. in ed. 3 cred. Dugan.
- Ed.Ad.167f. Junior High School.** Sources of the movement; purposes, functions, and limitations; types of reorganization; fundamental problems of reorganization; reorganization of subject matter. Prereq.: 9 cred. in ed. 3 cred. Bossing.
- Ed.Ad.218f.w.s. Recent Literature in Secondary Education.** Seminar on current problems and literature in secondary education. Cred. ar. Boardman, Bossing, Stout.
- Ed.Ad.263f. Organization of the Secondary School.** Organization of secondary school units, internal organization for administration and supervision. 3 cred. Boardman.
- Ed.Ad.264w. Administration of Instructional Activities in the Secondary School.** Curriculum, teacher selection, schedule making, extracurricular activities, guidance, pupil control. 3 cred. Boardman.
- Ed.Ad.265s. Administration of the Noninstructional Activities of the Secondary School.** Housing, forms, records, marks, finance, reports, and community relationships. 3 cred. Boardman.
- Ed.Ad.270f.w.s.\* Special Problems in Secondary Education.** Primarily for those qualified to undertake research. Prereq.: permission. Cred. ar., maximum 9 cred. Boardman, Bossing, R. Keller, Stout.

#### *Higher Education*

- Ed.Ad.253f. Administration in Higher Education.** Control, faculty and employee personnel administration, budget making and administration, financial accounting and reporting, protection of college funds, public relations. Prereq.: permission. 3 cred. Neale. (Not offered 1952-53.)
- Ed.Ad.274w. The Junior College.** Present status of the junior college, its development, purposes and functions, organization, curriculum, and probable trends. 3 cred. Boardman.
- Ed.Ad.290. Financing Higher Education.** Prereq.: permission. 3 cred. Neale. (Not offered 1952-53.)
- Ed.Ad.291s. Public Relations for Colleges and Universities.** Prereq.: permission. 3 cred. Neale. (Not offered 1952-53.)

## EDUCATIONAL PSYCHOLOGY

## General Courses

- Ed.Psy.120f.s. Basic Principles of Measurement.** Principles of measurement applied to the construction and evaluation of tests and to the interpretation of scores. Prereq.: 60 or equiv. 3 cred. Cook.
- Ed.Psy.125f.w. Social Structure of Student Groups.** Survey of selected literature on group dynamics; practical application of social-psychological concepts to the analysis of group behavior by experimentation. 3 cred. Flanders.
- Ed.Psy.126s. Advanced Analysis of Behavior in Groups.** Practice in the analysis of group behavior by laboratory experimentation. Prereq.: 125. 3 cred. Flanders.
- Ed.Psy.133f. Basic Procedures in Student Personnel Work.** (See Ed.Ad.133.) 3 cred. Dugan.
- Ed.Psy.140w. Instruments and Techniques of Measurement.** An intensive study of selected instruments for measuring intelligence, achievement, interests, attitudes, and personality traits with emphasis upon their use in educational guidance, personnel work, administration, and supervision. Prereq.: 120 or equiv. 3 cred. Cook.
- Ed.Psy.142f.w. Individual Mental Testing.** Revised Stanford-Binet and Wechsler-Bellevue Adult or Wechsler Intelligence Scale for Children. Student supplies materials for at least one test. One full day or two mornings per week required for practice administration of tests. Prereq.: 120 or equiv. 3 cred. Reynolds.
- Ed.Psy.143s. Advanced Individual Mental Testing.** Development of proficiency in administering and interpreting three or four selected individual mental tests. Prereq.: 142, permission. 3 cred. Reynolds.
- Ed.Psy.148w.s. Clinical Diagnosis of Reading Difficulties.** Psychology of reading difficulties; emphasis on clinical diagnosis of reading problems, their relationship to psychological factors, and their clinical remedial correction. Prereq.: Ed.C.I. 145 and 9 hours of psy. or ed. psy. 3 cred. Bond, Reynolds.
- Ed.Psy.150f.w.s. Clinical Practice in Remedial Teaching.** Practice in remedial tutoring of individual children who have experienced difficulty in school learning. Prereq.: Ed.C.I. 145 or 151, permission. 3 cred. Bond, Reynolds.
- Ed.Psy.151f.w.s. Clinical Practice in Educational Diagnosis.** Practice in diagnosis of school learning problems. Includes measurement, interview technique, preparation of case reports, etc. Work with children referred to the Psycho-Educational Clinic. Prereq.: 142 and others depending upon type of project, permission. 2 to 6 cred. Bond, Reynolds.
- Ed.Psy.159f.s. Personality Development and Mental Hygiene.** Survey course emphasizing understanding of personality development and mental hygiene for self and others. 159f for seniors and first year graduate students only—special reference to elementary and secondary classroom conditions. 159s for graduate students only—attention given to basic theory, group and individual procedures in treatment. 3 cred. Wrenn.
- Ed.Psy.182f. Education of Exceptional Children.** Overview of the field of special education. Especially for classroom teachers, counselors, supervisors, and administrators; also the initial course for students working for special class certificates. Prereq.: Ed. 55B or 71C or equiv. 3 cred. Reynolds.
- Ed.Psy.183f. Education of Gifted Children.** Abilities and characteristics of intellectually gifted children and adults. Prereq.: Ed. 55B or 71C or equiv. 2 cred. Van Wagenen.
- Ed.Psy.184s. Education of the Slow-learning Child.** Prereq.: 182. 2 cred. Reynolds.
- Note**—Courses 185, 186, 187 pertaining to the education of the auditorially handicapped child, the visually handicapped child and the crippled child are offered periodically in Summer Sessions.
- Ed.Psy.208w.\* Methods in Educational Research.** Methods and techniques employed in the investigation and report of educational problems. Suggested for all candidates for degrees. 3 cred. P. O. Johnson.

- Ed.Psy.216f-217w-218s. Statistical Methods in Education.** Designed to lay the foundations of statistical theory and to give practice in applying the theories in the solution of educational and psychological problems. 3 cred. per qtr. P. O. Johnson.
- Ed.Psy.216Af-217Aw-218As. Statistical Methods in Education—Laboratory.** For students who wish more experience in the solution of problems and the use of machines than is obtained in the lecture course 216-217-218. 2 cred. per qtr. P. O. Johnson.
- Ed.Psy.219f. Design and Analysis of Statistical Investigations.** For students who desire a functional knowledge of modern principles of designing efficient experiments and other types of observational programs, improved sampling techniques, and the correspondingly appropriate methods of analyzing observational results. Prereq.: 218 or permission. 3 cred. P. O. Johnson.
- Ed.Psy.220w-221s. Advanced Theory of Measurements.** Principles 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. Prereq.: 60 or 120, 216 or equiv. 2 cred. per qtr. Van Wagenen.
- Ed.Psy.225w.\* Diagnosis as a Phase of Counseling.** An advanced course covering the personality concepts involved in diagnosis, essential skills and common errors, principles of diagnosis. Prereq.: 140 (or parallel), 133, or 250, or Psy. 130. 3 cred. per qtr. Wrenn.
- Ed.Psy.226s.\* Interviewing Procedures in Counseling.** An advanced course covering various philosophies and approaches in counseling, interviewing skills, concepts of therapy, analysis of student and counselor attitudes in counseling. Prereq.: as for 225, and 225 or equiv. 3 cred. per qtr. Wrenn.
- Ed.Psy.233f.w.s.\* Problems in Guidance and Personnel Work.** Investigation of particular problems in the personnel field on an individual basis. No class meetings. 1 to 9 cred. Edwards, Dugan, Wrenn.
- Ed.Psy.240f.w.s.\* Problems in Measurement.** Intensive study and individual research in problems of educational measurement. 3 cred. P. O. Johnson.
- Ed.Psy.243f.w.s.\* Problems in Statistics for Students in Education and Psychology.** A problems course devoted to their application to educational and psychological problems. 3 cred. P. O. Johnson.
- Ed.Psy.253f.w.s.\* Research Problems.** Prereq.: consult instructor. Cred. ar. Educational Psychology staff.
- Ed.Psy.260f.w.s. Educational Psychology Seminar.** For all Ph.D. majors in educational psychology. Purposes include: integrating course work in all areas of educational psychology and related fields, analyzing new developments, and presenting Ph.D. dissertation outlines. No cred. Educational Psychology staff.
- Ed.Psy.280f.w.s. Practicum in Group Leadership.** Supervised practice in leading a discussion or activity group. Prereq.: permission. 3 cred. Flanders.
- Ed.Psy.290s. Individual Differences.** A study of group and individual differences and their relations to educational practice. 3 cred. Flanders.
- Ed.Psy.293w.\* Psychology of Learning.** Principles and research in human learning and their implications for curriculum and instruction. Prereq.: 12 cred. in psy. and ed. psy. 3 cred. Mork.
- Ed.Psy.294s.\* Recent Theory and Research in Human Learning.** Prereq.: permission. 3 cred. Mork.

#### *Elementary Education*

- Ed.Psy.113f-114w-115s. Psychology of Elementary School Subjects.** Research studies in the field of psychology of elementary school subjects. Prereq.: 9 cred. in ed. and psy. 2 cred. per qtr. Van Wagenen.

See also courses under Child Welfare.

#### *Secondary Education*

- Ed.Psy.134w. School Counseling Procedures.** Principal emphasis upon 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. Prereq.: 120, 133, permission. 3 cred. Dugan.

**Ed.Psy.158s. Psychology of Adolescence.** A study of the physical and mental changes that characterize the transition from childhood to adult life. Prereq.: Ed. 55B or equiv. 3 cred. Edwards.

**Ed.Psy.282s. Practice in High School Personnel Work.** Experience in counseling, testing, and related personnel work procedures in the high school program. Prereq.: permission. 3 cred. Dugan.

#### *Higher Education*

**Ed.Psy.250f. College Student Personnel Work—Development and Administration.** For advanced students planning to become personnel workers, teachers, or administrators in college or university. Place of student personnel program in the institution and administration of program. Prereq.: one course in higher education or permission. 3 cred. Wrenn.

**Ed.Psy.251f.w.s.\* College Student Personnel Work.** Weekly seminar discussions of specialized phases of college student personnel and noneducational personnel work. Fall: Student Activities; winter: Personnel Services; spring: Coordination with Nonacademic Personnel Procedures. Prereq.: 250 or other courses in higher education. 1-3 cred. per qtr. Wrenn.

**Ed.Psy.254s. Measurement and Evaluation in Higher Education.** A consideration of the examination program in American institutions of higher learning; principles of examination construction at the college level; the design of investigations and the critical evaluation of investigations in higher education. 3 cred. P. O. Johnson.

**Ed.Psy.281f.w.s. Practice in Personnel Work.** Supervised experience in counseling at college and adult levels. When assigned to Student Counseling Bureau, requirement is three consecutive quarters beginning fall; other assignments any quarter. Prereq.: 225-226, permission. 3 cred. per qtr. Edwards, Wrenn, Hagenah.

#### 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.

**Phys.Ed.101w. Principles of Physical Education.** The aims and scope of physical education with special treatment of its place in education. Prereq.: 55. 3 cred. L. F. Keller.

**Phys.Ed.103s. Physical Inspection.** The responsibility of the physical education instructor in the examination of pupils, assisting the physician, follow-up procedures, and keeping of records. Prereq.: 51, Anat. 57, P.H. 91, 92. 3 cred. Osell.

**Phys.Ed.105f. Conservation of Natural Resources.** To develop an understanding of the importance of our national resources and of their relation to recreation and outdoor education. Prereq.: 64A-B. 2 cred. L. F. Keller.

**Phys.Ed.107w. Camp Administration.** To help prepare personnel qualified for responsibilities of camp administration. Prereq.: 46, permission. 3 cred. Osell, Ostrander, Thorpe.

**Phys.Ed.110w. Recreation Surveys.** The techniques of and practice in making community recreation surveys. Prereq.: 57, 58. 3 cred. Fitzgerald.

**Phys.Ed.111f. Recreation Areas and Facilities.** A study of orientation, design, planning, and standards for recreation buildings and areas. Prereq.: 57, 58. 3 cred. Giles.

**Phys.Ed.112s. Programming in Recreation.** Principles of program planning for an organized offering of recreation opportunities. Prereq.: 57, 58. 3 cred. Giles.

**Phys.Ed.113w. Physical Education in the Elementary School.** The elementary school child, curriculum, adaptations of instructional procedures, classification, evaluation, and the influence of modern educational thinking upon problems commonly met at this level. Prereq.: experience with the elementary school age level or permission. 3 cred. Baker.

- Phys.Ed.114s. School Health Education Program.** Curriculum construction, health supervision and guidance, relationships between public schools and governmental health organizations and agencies, and evaluation. Guidance in the solution of individual professional problems. Prereq.: 83, P.H. 50 or equiv. or permission. 3 cred. Ericson.
- Phys.Ed.115s. Recent Literature and Research in Mechanics of Movement.** Techniques of mechanics and kinesiology of movement; consideration of a variety of skills; an evaluation of pertinent methods and devices used in current research; application to individual projects. Prereq.: undergraduate course in kinesiology or permission. 3 cred. Wilson.
- Phys.Ed.116s. Community Recreation Resources and Organizations.** Presentation of community recreation agencies; interpretation of relationships among agencies in the field of recreation. Prereq.: 110, 111, 112. 3 cred. Ostrander.
- Phys.Ed.117w. Advanced Course in School Health Instruction.** Instructional problems in school health education at all levels. Application of course to individual problems. Prereq.: 83 or permission. 3 cred. Ericson.
- Phys.Ed.121s. Principles of Recreation Methods.** Stresses leadership methodology in all aspects of recreation. Prereq.: Ed.T. 84A-B-C. 3 cred. Fitzgerald.
- Phys.Ed.123f. An Advanced Course in Methods of Teaching Physical Education.** Instructional procedures for the activity program. Method problems common in the various activities, as well as those peculiar to each activity; possible solutions for current instructional problems. Prereq.: permission. 3 cred. Baker, Ericson.
- Phys.Ed.124s. Supervision of Physical Education.** Function, organization, and administration of supervision in physical education; adaptations of accepted procedures for observation, guidance, and training of teachers in the field; problems peculiar to supervision of physical education. Prereq.: permission. 3 cred. Baker, Ericson.
- Phys.Ed.131f. Industrial Recreation.** History, scope, place, and relationship of management-employee recreation. Prereq.: permission. 3 cred. Fitzgerald.
- Phys.Ed.135w.s. Tests and Measurements in Physical Education.** Critical analysis of existing tests and testing methods in physical education. Use of tests in physical activity programs. Application of the principles of test construction to specific problems. Prereq.: 10 cred. in phys. ed., Ed.Psy. 60 or equiv. 3 cred. (w) Wilson, for women, including elementary level; (s) L. F. Keller, for men.
- Phys.Ed.141f. Introduction to Hospital Recreation.** The general field of recreation in hospitals as background for the recreation leader, hospital administrator, and other personnel. Prereq.: permission. 3 cred. Ar.
- Phys.Ed.142w. Leadership in Hospital Recreation.** The purpose is to develop an understanding of the application of leadership methodology to recreation in hospitals. Prereq.: 141. 3 cred. Ar.
- Phys.Ed.143s. Programming in Hospital Recreation.** All aspects of planning recreation programs for various types of hospital patients. Prereq.: 141, 142. 3 cred. Ar.
- Phys.Ed.155s. Instructional Aids in Health, Physical Education, and Recreation.** Evaluation, construction, and use of instructional materials including audio-visual aids, 3 cred. Ar.
- Phys.Ed.221f.w.s. Seminar in Physical Education.** Discussion of individual projects and current problems in physical education. Consult adviser. No cred.
- Phys.Ed.224f.w.s.\* Research Problems in School Health Education and Physical Education for Women.** Individual problems in areas of philosophy, methods, curriculum, evaluation and measurement; all curricular levels. Prereq.: permission. Cred. ar. Baker, Ericson, Wilson.
- Phys.Ed.233w.\* Administrative Problems in Physical Education in Secondary Schools.** Staff organization; supervision; required and adapted program; intramural and interscholastic athletic problems; legal aspects; professional and public relations. Prereq.: 63 or equiv. 3 cred. Nordly.

- Phys.Ed.234s. The Secondary School and College Curriculum in Physical Education.** Practical applications of principles of curriculum construction and evaluation to physical education. Prereq.: 63, 101 or equiv. 3 cred. Nordly.
- Phys.Ed.236f. Recent Literature and Research in Physical Education and Recreation.** Research methods applied to physical education; the selection and analysis and preparation of outlines of research problems. 3 cred. Nordly.
- Phys.Ed.238f.\* Administration of Physical Education in Colleges and Universities.** Problems connected with the administration of facilities and programs in physical education and athletics in institutions of higher education. Prereq.: 63, 233 or equiv. 3 cred. L. F. Keller.
- Phys.Ed.240f. Legal and Financial Aspects of Recreation.** Federal, state, and local recreation laws; sources of funds for public and private recreation agencies; and agency liability. 3 cred. Fitzgerald.
- Phys.Ed.241w. Administration of Public Recreation.** Basic principles in the administration of recreation as a governmental service. 3 cred. Fitzgerald.
- Phys.Ed.242s. Community Organization for Recreation.** Nature, scope, principles, and procedures in community organization with particular attention to those principles and practices that have reference to community organization for recreation. Prereq.: permission. 3 cred. Fitzgerald.
- Phys.Ed.247f.w.s.\* Problems in Physical Education and Recreation.** Independent study on current problems. Individual conferences with instructor. Prereq.: 236. Cred. ar. Nordly.
- Phys.Ed.250w. The Administration of Health Education, Physical Education, and Recreation.** Current problems of school administrators. Not for physical education majors. 3 cred. Nordly and others.
- Phys.Ed.261As. Seminar in Contemporary Problems in Physical Education.** Prereq.: permission of adviser. 3 cred. Nordly and others.
- Phys.Ed.261Bf. Seminar in Contemporary Problems in Recreation.** Prereq.: permission of adviser. 3 cred. Fitzgerald and others.

## HISTORY AND PHILOSOPHY OF EDUCATION

### *General Courses*

- H.Ed.101f. Historical Foundations of Modern Education.** Historical analysis and interpretation of important elements in modern education derived from the Greeks, Romans, the Middle Ages, and the Renaissance. 3 cred. Alexander.
- H.Ed.102w. History of Modern Secondary and Higher Education.** Historical study of the origin, aims, growth, and existing types of European and American secondary schools. 3 cred. Alexander.
- H.Ed.103. History of Modern Elementary Education.** The development of educational theory and the evolution of the common school. Not open to those with cred. in H.Ed. 71. 3 cred. Alexander. (Not offered 1952-53.)
- H.Ed.110w,s. Intercultural Education.** A study of racial, religious, and nationality problems with special reference to their importance for the schools. 3 cred. Ar.
- H.Ed.131w. Comparative Education.** Compares European, Asiatic, and American systems and philosophies of education. Emphasis on exploring the possibilities of international education. 3 cred. Beck.
- H.Ed.141f. Critical Issues in Contemporary Education.** Designed to introduce graduate students to ideas involved in current theory and practice. 3 cred. Beck.
- H.Ed.155s. History of Education in the United States.** Development of elementary and secondary schools in the United States with emphasis on the nineteenth century. 3 cred. Alexander.
- H.Ed.178w. Education and Problems of American Democracy.** An exploration of the possibilities of building a democratic discipline in the school. 3 cred. Ar. (Not offered 1952-53.)
- H.Ed.179f. Critical Thinking for Teachers.** Examination of typical education materials for the purpose of increasing the ability of teachers to think more logically, to read and listen more critically, and to convey these abilities to students. 3 cred. Ar.

- H.Ed.180f.w.s. The School and Society.** Selected readings in social science and philosophy give the student an opportunity to integrate points of view in thinking about the roles that the school plays in present-day society. Prereq.: Ed. 55A-B or 71A-B-C. 3 cred. Beck and others.
- H.Ed.182s. Comparative Philosophies of Education.** An intensive examination of competing philosophies of education. Prereq.: 76 or 141. 3 cred. Beck.
- H.Ed.241f.w.s.\* Problems in the History and Philosophy of Education.** For students interested in research and original work in these areas. Prereq.: permission. Cred. ar. Beck, Alexander.
- H.Ed.242s. Seminar in Educational Philosophy.** For advanced students of educational philosophy; critical study and discussion of special problems in educational philosophy. Prereq.: permission. 3 cred. Beck.

#### HOME ECONOMICS EDUCATION

**Prerequisites**—For a major or a minor in Home Economics Education, prerequisites that are satisfactory to the major advisers in this field must be presented.

**Master's Degree**—Requirements for the Master's degree (Plan A or B) will be found on page 7 of this bulletin.

**Doctor's Degree**—Students with a primary interest in home economics education may become candidates for the Ph.D. with a major in education toward which they may count credits earned in home economics education courses. For general requirements see page 13.

#### Courses

- H.E.Ed.192f. Evaluation in Home Economics.** Measuring progress toward important goals in different areas of home economics; available tests and other evaluation materials; construction and refinement of various evaluation instruments. Elementary statistical techniques useful to home economics teachers. Prereq.: 91, 93, Ed. 55A-B. 3 cred. Army, Rose.
- H.E.Ed.193Aw.s. Home Economics Curriculum.** (Secondary level) Contributions of home economics at elementary and secondary levels; techniques employed in curriculum planning and reconstruction. Prereq.: 94 or permission. 3 cred. Army, Rose.
- H.E.Ed.193Bs. Home Economics Curriculum.** (College level) The place of home economics in higher education and problems which are acute today; curriculum offerings; teaching schedules and load; appropriate reference materials. Prereq.: permission. 3 cred. Army, Rose.
- H.E.Ed.194Af.w.s. Adult Education in Home Economics.** Objectives of adult education in homemaking; problems affecting community and family life; methods of helping adults and out-of-school youth in solving problems in home living. Prereq.: 91, 93 or equiv. 3 cred. Ford.
- H.E.Ed.194Bs. Adult Education in Home Economics.** Planning a community program; teaching procedures; special problems. Planned for teachers and supervisors of adult education. Prereq.: 91, 93 or equiv., 194A or permission. 3 cred. Ford.
- H.E.Ed.195s. Space, Equipment, Furnishings, and Materials for Home Economics Departments.** Study of remodeling old and planning new departments, and equipping and furnishing them. Review of research; investigation of special problems. Prereq.: H.E. 49, H.E.Ed. 91, 93. 3 cred. Rose, Kafka.
- H.E.Ed.197f.w.s. Organization and Methods for Related Art Teaching.** Aims to develop a working philosophy of related art. Courses planned and methods studied to relate art and home economics subject matter in various aspects of home and community life. Prereq.: 91, H.E.180 or equiv. 1 to 3 cred. Esteros.
- H.E.Ed.243f.w.s. Trends in Home Economics.** The place of home economics in the educational program today; the ways in which content and procedures are being modified to meet changing conditions. Prereq.: permission. 3 cred. Rose.

- H.E.Ed.292s.\* Problems in Evaluation.** A continuation of 192, with emphasis upon individual problems in the field of evaluation. Prereq.: permission. 3 cred. Army.
- H.E.Ed.293f.w.s.\* Problems in Home Economics Education.** Designed to meet the needs of advanced students for independent study of current educational problems. Prereq.: 294 recommended, permission. 1 to 9 cred. Army, Rose, Ford, Esteros.
- H.E.Ed.294f.w.s.\* Research Methods.** Study of methods used in collection, treatment, and interpretation of data in areas of home economics; the writing of a technical report. Prereq.: 192, permission. 3 to 6 cred. Army, Rose.
- H.E.Ed.295f.w.s.\* Seminar in Home Economics Education.** Discussion and reports on problems in the field of home economics education. 1 cred. per qtr. Army, Rose, Esteros, Ford.

## INDUSTRIAL EDUCATION

- Ind.100w. Industrial Instruction.** Concepts and techniques of instruction in three phases of industrial teaching—industrial arts, trade and industrial schools and classes, and training-within-industry programs. Not open to those with credit in 70. 3 cred. Smith.
- Ind.101s. Tests in Industrial Subjects.** Study and application of principles of evaluation to shop and drawing subjects. Prereq.: Ed. 55B. 3 cred. Micheels.
- Ind.102w. The General Shop (not a shop course).** Purpose of general shop organization; current practice as to types of shops, equipment, instructional materials and procedures, pupil personnel plans, etc. 2 cred. Nelson.
- Ind.103w. Instructional Aids.** Consideration of various instructional aids; planning, constructing, using. Prereq.: 70 or equiv. 3 cred. Micheels.
- Ind.105s. Administration of Industrial Education.** General and vocational phases considered; objectives, programs, and practices; laws, rulings, and standards for aid; significant literature. Prereq.: 61, 80 or equiv. 3 cred. Smith.
- Ind.107f. Coordination.** Province and duties of coordinators in trade schools, part-time programs, and cosmopolitan high schools. Information, guidance, and training for those having interest in this new type of school work. Prereq.: 60, 61, or 105 or permission. 3 cred. Widdowson.
- Ind.109w.s. Conference Leading for Industry.** Purposes, advantages and limitations of conference method. Instruction in techniques of conference procedure. Experience in planning, leading and evaluating conferences and in writing summaries. Prereq.: permission. 3 cred. Widdowson.
- Ind.110w. Vocational Guidance.** History of the educational and vocational guidance movement; typical public school means and methods; types and uses of occupational information; duties of the counselor; organization and relationships. Prereq.: Ed. 55B. 3 cred. Smith.
- Ind.115. Supervision of Industrial Education.** Principles of creative supervision applied in industrial teaching; analysis of duties, organization for supervision. Prereq.: 60, 80, or 105. 3 cred. Micheels.
- Ind.125s. Philosophy and Practice of Industrial Education.** History, objectives, development, and current practices of the field. Industrial arts as general education and school preparation and upgrading for trade pursuits. Not open to those with credit in 60, 61. 3 cred. Widdowson.
- Ind.135f. Industrial Course Construction.** Principles and techniques of course construction and unit development; experience in planning, organizing, and building a teaching guide. Not open to those with credit in 40, 42. 3 cred. Micheels.
- Ind.172s. Part-time Education.** Covers justification for part-time education; social and economic background; organization of classes, study of special student groups, courses of study; typical schools; comparative state legislation and plans, reimbursement. Prereq.: 60, 61 or 125. 3 cred. Smith.
- Ind.200f.w.s.\* Research Problems.** Independent work for the degrees, master of arts, Plan B, and master of education, Plan Y. Prereq.: approval of candidacy. Individual conferences. 3, 6, or 9 cred. per enrolment. Smith, Micheels.
- Ind.205. Seminar in Industrial Education.** Required of all candidates for advanced degrees. No cred.

**Ind.250f-251w. Literature of Industrial Education.** Survey of printed reports; critical analysis; selection of thesis problems; formulation of work plans; reports of progress; organization and presentation; acquaintance with types of literature. Prereq.: permission. 6 cred. Smith.

#### MUSIC EDUCATION

**Mu.Ed.103f. Psychological Foundations of Music Education.** Prereq.: permission. 3 cred. Ar.

**Mu.Ed.104s. Advanced Topics in Vocal Music Education.** Designed for experienced teachers and qualified students, this course deals with special topics in vocal and choral music education. Prereq.: permission. 3 cred. Ar.

**Mu.Ed.105w. Advanced Topics in Instrumental Music Education.** Designed for experienced teachers and qualified students. Prereq.: permission. 3 cred. Ivory.

**Mu.Ed.150su. The Organization and Supervision of Vocal and Instrumental Music in Elementary Schools.** Prereq.: 6 cred. in mu. ed., 9 cred. in music, 6 cred. in general ed. 3 cred. Ivory.

**Mu.Ed.224f.w.s. Seminar and Individual Research Problems in Music Education.** Individual projects; guidance; remedial procedures; interrelationships. Prereq.: knowledge of elementary statistics. 2 cred. per qtr. Ivory.

#### ELECTRICAL ENGINEERING

Professors Henry E. Hartig, Loyst C. Caverley, John H. Kuhlmann, William G. Shepherd, Aldert van der Ziel; Associate Professors LeRoy T. Anderson, Sidney C. Larson, O. William Muckenhirn, James S. Webb; Assistant Professors James C. Barnes, Lawrence A. Harris.

**Prerequisites**—For work in electrical communication, industrial electronics, or power engineering, completion of the corresponding work required by the current *Institute of Technology Bulletin* of candidates for the B.E.E. or B.S. degree.

**Language Requirement**—For the Ph.D. degree either (a) two foreign languages or (b) one foreign language and the option of a special research technique.

**Master's Degree**—Offered under Plan A. Plan B will be accepted only on petition to, and action by, the Electrical Engineering Graduate Committee.

**Doctor's Degree**—The department offers work leading to the Ph.D. degree.

(Professional degrees in engineering—These degrees are administered by the Institute of Technology.)

#### Courses

*Work Offered toward the Minor Requirement for Graduate Students Not Majoring in Electrical Engineering*

**109. Electric and Magnetic Fields.** Basic static and quasi-static electric and magnetic field theory, including the dynamics of charged particles in these fields. Prereq.: 15, 16. 3 cred. per qtr. Staff.

**111-113-115. Electrical Engineering.** Alternating current circuits. Prereq.: 15, 16 for 111; 111, 112 for 113; and 113, 114 for 115. 3 cred. per qtr. Staff.

**112-114-116. Electrical Engineering Laboratory.** Experimental study of alternating current circuits. Prereq.: 111-113-115 parallel. 1 cred. per qtr. Staff.

**117-119. Engineering Electronics.** Fundamental theory of electronic devices. Prereq.: 109, 111, 112 for 117; 117 for 119. 3 cred. per qtr. Staff.

- 118-120. Electronics Laboratory.** Prereq.: 117-119 parallel. 1 cred. per qtr. Staff.
- 121-123-125. Electrical Engineering.** Theory of alternating current machinery. Prereq.: 115, 116, 119. 3 cred. per qtr. Staff.
- 122-124-126. Electrical Engineering Laboratory.** Operating characteristics of alternating current machinery. Prereq.: 116, 121-123-125 parallel. 2 cred. per qtr. Staff.
- 127-128-129. Transient Electrical Phenomena.** Mathematical study of electric circuits during sudden changes of conditions. Classical and Laplace transform methods of analysis applied to electric circuits and machines, and use of the oscillograph in the analysis of problems. Prereq.: 121-123-125 parallel. 3 cred. per qtr. Staff.
- 131-133-135. Electronic Circuit Design.** Practical circuits and components for design of industrial electronic applications, amplifiers, oscillators, power rectifiers, etc. Prereq.: 161-162-163. 3 cred. per qtr. Staff.
- 132-134-136. Electrical Design.** Design of direct current generators and motors, alternating current transformers, generators, and synchronous motors. Prereq.: for 132, 121 parallel; for 134, 123 parallel; for 136, 125 parallel. 3 cred. per qtr. Staff.
- 138-139-140. Power Systems.** Short-circuit currents in power networks, unbalanced loads in polyphase circuits, transformers and motors, harmonics, stability of power systems under steady state conditions. Application of relays, oil circuit breakers, and lightning arrestors to power systems for protection of apparatus and service. Prereq.: 121, 123, or 125 parallel. 3 cred. per qtr. Staff.
- 157-158-159. Industrial Electronics.** Theoretical and laboratory study; applications to X ray, dielectric heating, precipitation, servo-mechanisms, etc. Prereq.: 161-162-163. 3 cred. per qtr. Staff.
- 161-162-163. Electric Communication.** Theoretical and laboratory study of communication circuits and apparatus. 3 rec., 2 lab. hours per week. Prereq.: 119. 4 cred. per qtr. Staff.
- 164-165-166. Communication Circuits.** Theoretical and laboratory study of circuits and transmission lines, wave filters, balancing networks, equalizers, repeaters. 2 rec., 2 lab. hours per week. Prereq.: 161-162-163. 3 cred. per qtr. Staff.
- 167-168-169. Radio Communication.** Maxwell's equations. U.H. frequency transmission and reception, micro-waves, waves guides. 2 rec., 2 lab. hours per week. Prereq.: 163. 3 cred. per qtr. Staff.

#### *Advanced Courses in Electrical Engineering*

- 187-188-189. Communication Seminar.** Study and discussion of current articles on communication or allied topics. Prereq.: permission. 1 cred. per qtr. Hartig.
- 191-192-193. Graduate Seminar.** Discussions of problems in power circuits and machinery. Prereq.: permission. 1 cred. per qtr. Caverley.
- 197-198-199. Advanced Electrical Design.** Special problems in rotating machinery design; study of starting of synchronous motors. Transformers for control and electronic applications including audio-transformers. Prereq.: 132-134-136. 3 cred. per qtr. Kuhlmann.
- 201-202-203. Advanced Industrial Electronics.** Continuation of 157-158-159. 3 cred. per qtr. Staff.
- 211-212-213. Advanced Network Analysis.** Study of networks principally by Bode's methods; applications to servo-mechanisms. Prereq.: 161-162-163, M.&M. 150, 152-153. 3 cred. per qtr. Hartig.
- 227-228-229. Stability of A.C. Power Systems.** A.C. power systems, including system design factors which affect the problem of stability. Relation of both steady state and transient conditions to stable operation of power distribution systems. Prereq.: 138-139-140. 3 cred. per qtr. Caverley.

§ One sequence may be included in the major work by M.S. candidates who have satisfied the Electrical Engineering Department's requirements for the undesignated B.S. degree (*Institute of Technology Bulletin*).

- 230-231-232. Solid State Devices.** Applications of solid state theory to engineering problems. Introduction to solid state theory, conduction, dielectric breakdown, piezoelectricity, ferromagnetism, thermionic emission, secondary emission, thermistors, resistors, crystal rectifiers, transistors. 3 cred. per qtr. van der Ziel.
- 233-234-235. Fluctuation Phenomena.** Application of the theory of fluctuating quantities to engineering problems such as thermionic tube noise, circuit noise. 2 cred. per qtr. van der Ziel.
- 251. High Voltage Engineering.** Study of insulation and generating equipment for high voltage; measurements of electrical quantities at high voltage; surges and surge-proof equipment. Prereq.: 121-123-125. 2 or 3 cred. per qtr. Caverley.
- 255-256-257. Analysis of A.C. Power-Systems Circuits.** Study of the behavior of A.C. equipment under unbalanced conditions by the use of symmetrical components. Transients in machines and associated circuits. Prereq.: 138-139-140. 3 cred. per qtr. Caverley.
- 261-263-265. Applied Electromagnetic Theory.** Studies of antennas, free space transmission including refraction and diffraction phenomena, wave guides, and circuits. Static electric and magnetic fields. Prereq.: Phys. 105 or equiv. 3 cred. per qtr. Shepherd.
- 262-264-266.\* Communications Seminar.** Study and discussion of current literature. Prereq.: permission. 1 cred. per qtr. Shepherd.
- 267-268-269. Theory of Communication.** Emphasis on amplitude, frequency, phase, time division, pulse code modulation. Conservation of frequency space. Advanced study of communication networks and their synthesis, filters, phase and amplitude corrective networks. Prereq.: permission. 3 cred. per qtr. Harris.
- 272-273-274. Electromechanical Vibrating Systems and Engineering Acoustics.** Theory of the production of sound by electrically driven vibrating systems, sound transmission, reflection, absorption. Prereq.: M.&M. 150, 152-153. 3 cred. per qtr. Hartig.
- 275-276-277. Advanced Electrical Design.** Special problems. Prereq.: 132-134-136. 3 cred. per qtr. Kuhlmann.
- 287-288-289. Vacuum Tube Analysis.** Theoretical and laboratory investigations of vacuum tubes used for communication purposes with emphasis on high frequency applications. Space charge control tubes, deflection control, electron multipliers, klystrons, magnetrons and traveling wave amplifiers, transit time effects and noise. Prereq.: permission. 3 cred. per qtr. Shepherd.
- 291-292-293.\* Electronics Seminar.** Study and discussion of current literature. Prereq.: permission. 1 to 3 cred. per qtr. van der Ziel.

## ENGLISH

Professors Theodore Hornberger, Huntington Brown, James Gray, James T. Hillhouse, Tremaine McDowell, Samuel H. Monk, Henry N. Smith, Allen Tate; Associate Professors Bernard R. Bowron, John W. Clark, Elizabeth Jackson, William Van O'Connor, Leonard H. Unger; Assistant Professors Harold B. Allen, Elizabeth Atkins, Morgan Blum, Frank Buckley, Louis O. Coxe, David V. Erdman, Leo Marx, Franz J. Montgomery, Robert E. Moore, Mary C. Turpie.

**Prerequisites**—For major work, not less than 27 quarter credits in English literature, 12 of which must be of Senior College grade, including satisfactory courses in Chaucer and Shakespeare.

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 study for the department, Mr. Smith. Thereafter they need confer only with their own advisers.

#### REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS

Work for the Master's degree is offered under both Plan A and Plan B.

**Major**—The minimum requirement of 18 quarter credits in the major under Plan A and 21 to 27 credits under Plan B is interpreted to mean credits in courses in English listed under Language and Literature, below.

Under both plans, the candidate who has not previously had an elementary course in Old English (Anglo-Saxon) must include this subject in his program of graduate study.

All candidates for the M.A., Plan B., must take 213.

Under both plans, the candidate will be given a written examination which calls for some acquaintance with each of the following periods of English literature: Old and Middle English literature, Renaissance, seventeenth century, eighteenth century, and English or American literature of the nineteenth and twentieth centuries. While the examination is designed primarily as a test of knowledge, it affords opportunity for the display of critical judgment. The general written examination is given during each term except the second summer term. A specimen of the examination questions may be consulted in 219 Folwell Hall.

**Language Requirement**—The candidate must pass his examination in a foreign language before taking the general examination.

Candidates under Plan B must submit to their examining committees, at least one week in advance of the oral examination, three papers written in courses numbered above 100, either in the major field or in the related fields.

**Minor (Plan A)**—In addition to the option of electing work in some related field for a minor for the Master's degree, the candidate may select courses from one of the following groups as a minor:

##### *Composition.*

*Linguistics and Comparative Philology*, including 100 (Old English), 102 (Old English Prose and Verse), 103 (Beowulf), 174 (American English), 204-205-206 (The Rise and Development of Standard English), and certain related courses.

*Foreign Literature in Translation*, including 123-124-125 (The Technique of the Novel), 147-148-149 (Middle English Literature Exclusive of Chaucer), 152 (Medieval and Early Elizabethan Drama), 184-185-186 (The Interpretation of Drama), 234-235-236 (Studies in Medieval English Culture), and courses in foreign literature in translation offered by the foreign language departments.

*American Literature*, including all graduate courses in that subject.

**Related Fields (Plan B)**—The candidate under Plan B may select courses from the groups listed under the Plan A minor, but a substantial portion of his work must be taken outside the Department of English.

**Language Requirement**—Unless special exception is made upon petition the candidate is required to have a reading knowledge of one of the following languages: French, German, Latin, Greek.

## REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

The program of course work for the Doctor's degree should be filled out by the candidate in consultation with a member of the Graduate Faculty during the first or second term after he has completed his work for the Master's degree, or, if he does not propose to take an M.A. degree, during his second or third term of graduate study.

Candidates who have not already taken the comprehensive written examination given to M.A. candidates must take it at a time to be designated after consultation with the director of graduate study.

Candidates may choose either of the following groups of courses in satisfaction of the requirements for the study of the English language: (1) Old English (course 100) plus six credits in Old English Prose and Verse (102) and Beowulf (103); (2) Old English (100) plus nine credits in The Rise and Development of Standard English (204-205-206).

**Examinations**—The candidate for the Doctor's degree is required to take the following examinations: (1) a written critical examination, (2) preliminary examinations (consisting of two parts, one written and one oral), and (3) a final oral examination.

During his second year of graduate work the candidate should take the three-hour written critical examination intended to test his ability to analyze and appraise specific works of literature, whether poetry, drama, or fiction. The examination is given during the fall, winter, and spring terms. The candidate should consult the director of graduate study not later than the first week of the term during which he proposes to take the examination. He will then be given the titles of several works which he is to study closely. Ordinarily he will be allowed to refer to the text he is analyzing during the examination.

The candidate must have completed, before the preliminary examinations, Courses 200-201 (Advanced Chaucer) and 136 (Advanced Shakespeare),<sup>o</sup> or their equivalents.

The candidate presenting himself for the preliminary examination is assumed to have the knowledge of the English and American language and literature implied by successful completion of the courses listed in his program, plus extensive independent reading. A list of works (and in the field of linguistics, of topics) with which the doctoral candidates are expected to be especially familiar may be secured in 219 Folwell Hall. All candidates, in addition to a mastery of the works and topics named in the departmental list, are expected to acquire a command of the principal scholarly and critical studies bearing upon these texts and topics.

The preliminary examinations consist of: (1) a six-hour written examination (divided into sections of three hours each) covering works and topics specified in the departmental list and the relevant scholarship and criticism mentioned above (except that the candidate omits on this examination his special field); and (2) an oral examination devoted to the minor subject and to six of the seven fields into which the study of English and American language and literature is divided by this department, as follows: (1) The English Language or Old English Language and Literature, (2) Middle English, (3) Renaissance, (4) The Seventeenth Century, (5) The Restoration and Eighteenth Century, (6) The Nineteenth and Twentieth Centuries, and (7) American Literature.

the field which is omitted from these examinations is that within which the candidate proposes to write his Doctor's thesis.

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

**Language Requirement**—Reading knowledge of two of the following: French, German, Latin, Greek. Good reading knowledge of Latin is in all cases desirable, and in some cases may be indicated by the candidate's adviser as indispensable. The candidate must satisfy language requirements before taking the preliminary examinations.

#### THE GRADUATE MINOR IN ENGLISH

The candidate for the Master's degree (Plan A) taking a minor in English is expected to present a minimum of 9 credits in one of the seven fields listed above in connection with the oral preliminary examination for the Ph.D. or in the courses in critical analysis (120-121-122, 123-124-125, 184-185-186).

A minor sequence in English for the Doctor's degree must include one graduate course in Shakespeare and nine credits in one of the graduate courses devoted to a chronological period of English literature.

In addition to satisfying the general requirements established by the Graduate School, the candidate for the Doctor's degree offering English as a minor must pass an examination (either written or oral, depending on the usual practice of the department of the candidate's major subject) covering *two* of the seven fields listed above in connection with the oral preliminary examination for the Ph.D. If the candidate wishes, he may substitute the written critical examination taken by all Ph.D. candidates in English for his examination in *one* of the two required fields.

**Note**—For information on work in Comparative Literature, see page 21.

#### Courses§

##### LANGUAGE AND LITERATURE

- 100f.s. Old English (Anglo-Saxon).** An introduction to the sounds and grammar, with some prose reading. The relation to modern English is stressed. 4 cred. Clark (f), Ar (s).
- 102w. Readings in Old English Prose and Verse.** Introduction to Old English versification, and critical reading of texts. Prereq.: 100. 3 cred. Clark.
- 103s. Beowulf.** An introduction to the Old English poem, with reading of considerable portions of the text. Prereq.: 100. 3 cred. Clark.
- 104f. Emerson and Thoreau.** 3 cred. Turpie.
- 105w. Hawthorne and Melville.** 3 cred. Marx.
- 106s. Whitman and Mark Twain.** 3 cred. Marx.
- 109f-110w. The Romantic Poets of the Early Nineteenth Century.** From Wordsworth to Keats. 3 cred. per qtr. Jackson.
- 113s. American Short Story.** A historical examination of the American short story from the eighteenth century to the present. 3 cred. McDowell.
- 114s. The Midwest in Literature.** 3 cred. Buckley.
- 115w-116s. The Development of English Prose Style.** 115: Definition of six broad types of prose style on historical principles; 116: (Not offered 1952-53.) Studies in the styles of selected writers since 1700. 3 cred. per qtr. Brown.

§ Unless otherwise noted, the prerequisite for all graduate courses is six credits in literature in this department, exclusive of Course A-B-C or the equivalent.

117. **American Essay.** 3 cred. (Not offered 1952-53.)
- 118w-119s. **Nineteenth-Century Prose.** 118: The literature of social critic. Carlyle, Ruskin, Arnold, and others. 119: Literature concerned largely with science and religion—Newman, Huxley, Spencer, Butler, and others. 3 cred. per qtr. (Not offered 1952-53.)
- 120f-121w-122s. **The Interpretation of Poetry.** Certain technical aspects of poetry in relation to poetic meaning. (See also Comp. 104-105-106 for the writing of poetry.) 3 cred. per qtr. Tate.
- 123f-124w-125s. **The Technique of the Novel.** Special studies in novels of the late nineteenth and twentieth centuries, with particular regard to structure. (See also Comp. 101-102-103 for the writing of fiction.) Prereq.: 6 cred. in literature in this department, exclusive of classics and A-B-C, and permission. 3 cred. per qtr. Ar.
- 126f-127w. **Drama, 1660-1870.** History of English drama from the opening of the theaters in 1660. 126: The heroic play, tragedy, comedy of manners, beginnings of sentimental comedy; 127: Development of sentimentalism. The reaction: Goldsmith and Sheridan. Early nineteenth-century drama. 3 cred. per qtr. Hillhouse.
- 129s. **Modern Drama, 1880 to the Present.** A survey of the chief dramatists, English, American, and Continental, from the time of Ibsen. Prereq.: 55-56 or 126-127. 3 cred. Hillhouse.
- 130w-131s. **English Poetry, 1832-1914.** 3 cred. per qtr. Montgomery.
133. **Ballads.** A study of a large number of traditional ballads, English and foreign, and of ballad style and origins. 3 cred. (Not offered 1952-53.)
- 134s. **The Origins of American Naturalism.** 3 cred. Bowron.
- 135f. **Spenser.** Selections from the minor poems; The Faerie Queene; attention to classical and foreign influence on Spenser and his influence on later English poets. 3 cred. (Not offered 1952-53.)
- 136s. **Advanced Shakespeare.** The work of the poet's maturity. Special attention to Othello, King Lear, Antony and Cleopatra, Cymbeline, The Winter's Tale. Prereq.: 55-56. 4 cred. Brown.
- 137f-138w-139s. **The Nineteenth Century in English Literature.** Napoleonic wars, industrial revolution, Darwinism, imperialism and democracy, estheticism; prose of social criticism from Hazlitt to Morris; problem of the poet's responsibility from Shelley to Yeats. 3 cred. per qtr. Erdman.
- 142f-143w. **Twentieth-Century Literature.** Survey of British and American literature from 1890 to 1952, studied for theme and technique and as part of literary and intellectual history. 3 cred. per qtr. O'Connor.
- 147f-148w-149s. **Middle English Literature Exclusive of Chaucer.** A historical, critical, and linguistic survey, including some reading in translations of medieval English writers of Latin. Prereq.: 75 or 175 or equiv., 100 or equiv. (or 100 parallel). 3 cred. per qtr. (Not offered 1952-53.)
- 151s. **Recent Poetry.** Development of twentieth-century poetry in England and America. Yeats, Hardy, Housman, Robinson. Movements in the second decade—Georgians, Imagists, etc.; Lawrence, Sandburg, Frost, Eliot, Jeffers, younger poets. 4 cred. Jackson.
- 152f. **Medieval and Early Elizabethan Drama.** Selected mystery and morality plays and farces; Ralph Roister Doister, Gammer Gurtons Nedle; Kyd, Marlowe, Lyly, Greene, Peele. Prereq.: 55-56. 3 cred. Brown.
- 154w-155s. **The American Novel.** History of the American novel from the beginning to the present. 3 cred. per qtr. Bowron.
- 156s. **The American Drama.** Survey of American drama in the eighteenth and nineteenth centuries. 3 cred. Hornberger.
- 159w-160s. **Colonial Literature in America.** Covers the period from 1608 to 1783. 3 cred. per qtr. Hornberger.
- 162f.w.s. **Milton.** The minor poems, Areopagitica, Paradise Lost, and Samson Agonistes. Prereq.: 21-22 or 55-56. 3 cred. Ar. (f,s), Unger (w).
- 163f-164w. **Restoration Drama.** 3 cred. per qtr. (Not offered 1952-53.)
- 165f.w. **Introduction to Modern English.** A scientific approach to the sounds and grammar of present-day English, with some attention to syntax; implications for a reasonable attitude toward English usage in America. 3 cred. Allen.

- 166s. Historical Backgrounds of Modern English.** A study of those distinctive aspects of the sounds and grammar of Early Modern, Middle, and Old English which are significant for the language of the present day. Prereq.: 165. 3 cred. Allen.
- 168s. Browning and Tennyson.** Most of the time will be spent on Browning. 3 cred. (Not offered 1952-53.)
- 170s. Shakespeare's Later Contemporaries.** Selected plays of Chapman, Jonson, Dekker, Marston, Webster, Heywood, Beaumont and Fletcher, Middleton, Ford, and Shirley. Prereq.: 55-56. 3 cred. Brown.
- 174s. American English.** The development of a distinctive vocabulary and pronunciation of American English; differences between it and British English; dialects in the United States. Prereq.: 6 cred. in English literature, including language, above A-B-C. 3 cred. Allen.
- 175s. Chaucer.** The reading of *The Canterbury Tales* with introduction dealing with the grammar and literary forms of fourteenth-century English. Prereq.: 100 or parallel; not open to students who have had 75 or equiv. 4 cred. Jackson.
- 176f-177w. The History of English Verse.** Origin and development of standard forms—ballad stanza, heroic couplet, blank verse, sonnet, etc. Discussion of metrical technique. 3 cred. per qtr. Jackson.
- 181s. Recent Trends in Literary Criticism.** Criticism and scholarship; structure and form; science and literature; imagination and myth; isolation of the artist; political emphasis; experiments with language. 3 cred. O'Connor.
- 182w. The Far West in Literature.** Expansion beyond the Mississippi as a force in American thought and letters: the literature of exploration and travel; the Pacific Coast regional movement; Mark Twain. 3 cred. H. N. Smith.
- 183f. The Poetry of T. S. Eliot.** 3 cred. Unger. (Not offered 1952-53.)
- 184f-185w-186s. The Interpretation of Drama.** Critical analysis of plays: modern, Renaissance, and ancient. (The same as Speech 184-185-186.) Prereq.: 6 cred. in literature in this department, exclusive of classics and A-B-C or equiv.; 55-56 recommended. 3 cred. per qtr. Reisman (f), Coxe (w,s).
- 187f-188w-189s. Eighteenth-Century Literature.** Survey of English literature from 1700 to 1790. 3 cred. per qtr. Monk.
- 191f. Imagery and Symbolism in English and American Literature.** A study of manifold literary influences, from the seventeenth century onward, upon T. S. Eliot and other twentieth-century writers. 3 cred. Atkins.
- 193f. The Poetry of Yeats.** 3 cred. Unger.
- 197f-198w-199s. Seventeenth-Century Literature.** 197-198: A survey of the prose and nondramatic poetry of the century, exclusive of Milton, down to 1660. 199: Dryden and his contemporaries. 3 cred. per qtr. Unger (f,w), Monk (s).
- 200w-201s. Advanced Chaucer.** The more important poems apart from *The Canterbury Tales*; Chaucer's biography and literary reputation. The treatment will be primarily literary and historical, linguistic proficiency being presumed. Prereq.: 75 or 175 or equiv. 3 cred. per qtr. Clark.
- 202f-203w. Elizabethan Nondramatic Literature.** 202: Tudor prose: "courtesy books" (Eliot, Ascham), voyages (Drake, Raleigh), criticism (Gascoigne, Sidney, and others), fiction (Lyly, Sidney, Nashe), history (More, Fox, Holinshed, and others), tracts and essays (Nashe, Bacon, and others). 203: Tudor lyric and narrative poetry. 3 cred. per qtr. Brown.
- 204f-205w-206s. The Rise and Development of Standard English.** An inductive study of the development of the English vocabulary and lexicography (204), historical phonology (205), and historical morphology and syntax (206), with some attention to the history of attitudes toward usage. Prereq.: 100 or equiv. 3 cred. per qtr. Allen.
- 207. Dr. Johnson and His Circle.** Particular attention to Boswell and to Johnson's influence on his contemporaries. Prereq.: permission of department. 3 cred. (Not offered 1952-53.)
- 210f-211w-212s. Studies in Seventeenth-Century Literature.** Selected authors to 1660 exclusive of Milton and the dramatists; emphasis on style and on ideological questions. 9 cred. Unger.

- 213f.w.s. Bibliography and Methods of Literary Research.** Examination of 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 cred. O'Connor.
- 225f-226w-227s. Elizabethan Drama.** Elizabethan and Jacobean dramatists, from Lyly to Shirley. Problems assigned may involve Shakespeare, and in general his contemporaries will be studied less for their own sake than for the light they shed upon him. 3 cred. per qtr. (Not offered 1952-53.)
- 228f-229w-230s. Eighteenth-Century Novel.** The rise and development of the novel as a form of literature; the use made of the novel as a medium of religious, social, and political theory. 3 cred. per qtr. Hillhouse.
- 231f-232w-233s. Shakespeare's Tragic and Comic Art.** 3 cred. per qtr. Brown.
- 234f-235w-236s. Studies in Medieval English Culture.** Prereq.: 75 or 175. 3 cred. per qtr. Clark.
- 237f-238w-239s. Chaucer.** Some of the important problems in the Chaucer canon and in the works of Chaucer. 3 cred. per qtr. (Not offered 1952-53.)
- 240f-241w-242s. The Canterbury Tales.** 3 cred. per qtr. (Not offered 1952-53.)
- 243f-244w-245s. Nondramatic Literature of the Sixteenth Century.** Renaissance prose and poetry, with special attention to Spenser and his contemporaries. 3 cred. per qtr. Brown. (Not offered 1952-53.)
- 246f-247w. English Literary Criticism.** A study of the basic historical texts, also an examination of those principles and issues which have special relevance for modern criticism. 3 cred. per qtr. O'Connor. (Not offered 1952-53.)
- 253f-254w-255s. American Romanticism I: New England.** Bryant, Hawthorne, Emerson, Thoreau, and their contemporaries. 3 cred. per qtr. (Not offered 1952-53.)
- 256f-257w-258s. Spenser and Milton.** Prereq.: 3 cred. above 50 in medieval or Elizabethan literature and 3 cred. in lit. of the period 1600-1660. 3 cred. per qtr. Brown. (Not offered 1952-53.)
- 259f-260w-261s. Nineteenth-Century Novel I.** The Gothic romances and the Revolutionary novel, the realistic novel of national manners, and Jane Austen, Sir Walter Scott, Dickens. 3 cred. per qtr. Hillhouse. (Not offered 1952-53.)
- 262f-263w-264s. Nineteenth-Century Novel II.** Thackeray and the Brontës; George Eliot and Trollope; Hardy and Meredith. 3 cred. per qtr. Hillhouse. (Not offered 1952-53.)
- 265f-266w-267s. American Romanticism II.** Cooper, Poe, Whitman, and Melville. 3 cred. per qtr. McDowell.
- 274f-275w-276s. The Age of Queen Anne.** The literature of the first half of the eighteenth century in the light of critical theories and currents of thought. 3 cred. per qtr. Monk.
- 277f-278w-279s. American Realism.** Mark Twain; Howells and his contemporaries; Henry James. Prereq.: permission. 3 cred. per qtr. H. N. Smith (f,s), Hornberger (w).
- 281f-282w-283s. Studies in the English Romantic Movement.** 3 cred. per qtr. Erdman.
- 284f-285w-286s. Dryden and His Age.** 3 cred. per qtr. Monk. (Not offered 1952-53.)
- 287f-288w-289s. Studies in Victorian Literature.** 3 cred. per qtr. Erdman. (Not offered 1952-53.)
- 290f-291w-292s. Studies in Critical Theory.** An intensive study, from the point of view of the philosophy of criticism, of the works of certain great critics. 3 cred. per qtr. Tate.
- 297f-298w-299s. Independent Reading.** Prereq.: M.A. degree or equiv. 3 cred. per qtr. 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: Classics 106-107-108, 191-192-193; Italian 164; Russian 101-102-103; Scandinavian 161-162, 171-172-173.

## COMPOSITIONS

**101f-102w-103s. The Writing of Fiction.** A study of the principles of the composition of fiction. Class meetings are devoted to the analysis of examples drawn from standard sources. Writing by students is criticized in individual conferences. For a second year of writing, consult Mr. Gray. Prereq.: none for students registered as English majors in the Graduate School; for all others, permission. 3 cred. per qtr. Blum, Ross.

**104f-105w-106s. The Writing of Poetry.** For a second year of writing, consult Mr. Tate. Prereq.: none for students registered as English majors in the Graduate School; for all others, permission. 3 cred. per qtr. Ar.

**200f-201w-202s. Graduate Seminar in Writing.** Prereq.: permission. 3 cred. per qtr. Tate.

**Note**—Students interested in major work in American Studies will find a description of this work on pages 20 and 46.

## ENTOMOLOGY AND ECONOMIC ZOOLOGY

Professors Clarence E. Mickel, Alexander A. Granovsky, Alexander C. Hodson, William H. Marshall, A. Glenn Richards, Herman T. Spieth; Associate Professors Mykola H. Haydak, Lloyd L. Smith, Jr.; Assistant Professors Torfine L. Aamodt, James R. Beer, Laurence K. Cutkomp; Lecturer Frederick G. Holdaway; Instructor Edwin F. Cook.

**Prerequisites**—Twenty-seven credits in zoology and entomology. Depending on the proposed field of specialization within the division, such courses as bacteriology, plant pathology, or biochemistry may be accepted in partial fulfillment of this requirement.

**Language Requirement**—For the Master's degree either German or French. In special cases, where other languages are needed for development of the thesis, Russian, Italian, or the Scandinavian languages may be substituted by petition. For the Ph.D. degree two foreign languages, usually German and French. Substitutions may be made for French under the conditions specified above.

**Master's Degree**—Offered under Plan A. In exceptional cases Plan B may be followed by petition approved by the major advisers of the division.

The written examination for this degree will be given at least three weeks before the final oral examination.

Course 200 is required of all majors throughout the period of resident studies.

An additional copy of the thesis is required for deposit in the divisional library.

**Doctor's Degree**—Candidates for the Ph.D. degree should earn the Master's degree under Plan A.

Course 200 is required of all majors throughout the period of resident studies.

The written examination for this degree will be given at least one month prior to the oral preliminary examination.

An additional copy of the thesis is required for deposit in the divisional library.

‡ The student, in registering for these courses, must use the form: Comp. 101-102-103, Comp. 104-105-106, Comp. 200-201-202.

### Courses

- 114s. Apiculture.** Problems of bee management, disease control, wintering, bee breeding, processing and marketing bee products. Lect., lab., field practice. Prereq.: 9 cred. in ent. 3 cred. Haydak.
- 117f. Animal Ecology.** General ecology stressing ecological principles and land communities. Prereq.: 15 cred. in zool. or ent. 3 cred. Eddy.
- 118w.\* Animal Ecology.** Experimental approach to the study of environmental factors affecting animal populations. Prereq.: 15 cred. in zool. or ent., permission. 3 cred. Hodson.
- 119su. Limnology.** Conditions for life in the water and distribution of aquatic animals. Prereq.: 15 cred. in zool. or ent. 3 cred. Eddy. (Offered at Itasca Park Biological Station.)
- 120s.\* General Ecology of Insects.** Ecology with special reference to insects, their dispersal, distribution, abundance, natural control, and related problems. Lect., field trips, and reading. Prereq.: 117, 118. 3 cred. Hodson. (Offered alternate years. Offered 1952-53.)
- 121f. Ichthyology.** Taxonomy and habits of North American fishes, especially those of upper Mississippi drainage. Lect. and lab. Prereq.: 15 cred. in zool. 3 cred. Eddy.
- 124su. Biology of Immature Insects.** Habits, habitat, life history, and identification of immature insects with emphasis on aquatic forms. Prereq.: 15 cred. in zool., 52 or equiv., or permission. 4 cred. Spieth. (Offered at Itasca Park Biological Station.)
- 125f-126w-127s. Advanced General Entomology.** Morphology, biology, and classification of insects. Lect., lab. Frequent field trips in 127s. Prereq.: 52 or equiv. or permission. 3 cred. per qtr. Mickel.
- 128f-129w.\* Insect Physiology.** General and comparative physiology, survey of the organ systems and their functioning. Emphasis on research methods and evaluation of data. Lect., lab., reading. Prereq.: 15 cred. in zool. or ent., permission. Zool. 50 or equiv. recommended. 4 cred. per qtr. Richards.
- 140s. Biological Microscopy.** A survey of microscopic optics, histology, and histochemistry with emphasis on the limits and the interpretation of microscopical data. Prereq.: permission. 4 cred. Richards. (Offered 1953-54 and alternate years.)
- 141f-142w. Insects in Relation to Plant Diseases.** Principal insect vectors and their habits, types of insect injuries affecting the health of plants, modes of insect transmission and dissemination of plant diseases, methods of rearing and handling insect vectors. Prereq.: 8 cred. in ent. or pl. path. 3 cred. per qtr. J. J. Christensen, Granovsky.
- 144f. Medical Entomology.** Principal arthropods noxious to man and animals. Emphasis on arthropods that serve as pathogenic organisms of man and animals. Lect., lab. Prereq.: Zool. 52 or equiv. or permission. 3 cred. Ar.
- 145w. Parasitic Protozoa.** The structure, life histories, and economic relations of protozoal parasites of man and animals. Lect., lab. diagnosis. Prereq.: 15 cred. in zool. 3 cred. Wallace.
- 146s. Helminthology.** Worm parasites of man and animals, their structure, life histories, and biological relationships. Lect., lab. Prereq.: 15 cred. in zool. 3 cred. Wallace.
- 150s. Introduction to Aphidology.** The biology and taxonomy of the Aphididae. Prereq.: 52 or equiv. or permission. 3 cred. Granovsky.
- 162su. Ecology of Terrestrial Vertebrates.** Ecological relationships of northern Minnesota terrestrial vertebrates. Prereq.: 68 or Zool. 57-58, Course 63 or equiv., Bot. 20. 4 cred. Marshall.
- 164f-165w-166s. Wildlife Management.** Life histories, ecology, and management of North American game animals including field studies of research and management techniques at appropriate times during the year. Lect., library, lab., field work. Prereq.: 63, 64, Zool. 57-58, Bot. 50, Pl.Path. 53. 3 cred. per qtr. Marshall.
- 167s. Techniques in Forest Wildlife Management.** Largely field work; use of censuses applicable to the major local forms of forest wildlife; preparation of a wildlife management plan for a small forested area. (Given at Cloquet.) Prereq.: 64. 3 cred. Marshall.

- 168f-169w. Fishery Biology and Management.** Methods and theory of fishery biology; age and rate of growth, populations, mortality and harvest, indices of productivity, lake and stream survey methods, planning, and improvement, fish pond management. Lect., lab. Prereq.: 64, Zool. 53, 117, 118, 119, 121, Bot. 176 or equiv., Agr. Econ. 90 or equiv., or permission. 3 cred. per qtr. Smith.
- 170s. Fisheries Resources.** Fisheries resources of the United States; fisheries products; methods and description of commercial fisheries; state, federal, and international administration and regulation of fisheries; organization of fishery programs. Prereq.: 168, 169 or permission. 3 cred. Smith.
- 175w. Principles of Economic Entomology.** Methods and principles of insect control. Lect. and demonstration labs. Prereq.: 15 cred. in entomology including 5 or equiv., or permission. 4 cred. Cutkomp. (Offered 1952-53 and alternate years.)
- 176w. Legal and Regulatory Aspects of Pest Control.** Principles of quarantine and administration of control campaigns. Lect., discussions, and demonstrations. Prereq.: 15 cred. in entomology including 5 or equiv., or permission. 3 cred. Aamodt.
- 177s. Insecticides and Their Action.** Chemistry, physiological action, toxicology, and laboratory testing of insecticides. Lect., lab. Prereq.: 15 cred. in entomology including 5 or equiv., or permission; inorganic and organic chemistry. 5 cred. Cutkomp. (Offered 1953-54 and alternate years.)
- 179s. Recent Advances in Entomology.** Lectures in special fields of entomological research given by a visiting professor. Cred. ar. Ar.
- 197f.w.s.su. Introduction to Research.** Special problems involving library and laboratory research in various lines of entomology and economic zoology. 1 or more cred. per qtr. Staff.
- 200f.w. Seminar.** Assigned topics dealing with some special fields of work of the division. 1 cred. per qtr. Staff.
- 201-204. Research in Systematic Entomology.** Cred. ar. Mickel.
- 205-208. Research in Insect Transmission of Plant Diseases.** Cred. ar. Granovsky.
- 209-212. Research in Soil Insect Ecology.** Cred. ar. Granovsky.
- 213-216. Research in Insect Ecology.** Cred. ar. Hodson.
- 217-220. Research in Forest Entomology.** Cred. ar. Hodson.
- 221-224. Research in Economic Entomology.** Cred. ar. Granovsky, Hodson.
- 225-228. Research in Insect Physiology.** Cred. ar. Richards.
- 229-232. Research in Insect Histology.** Cred. ar. Richards.
- 233-236. Research in Economic Vertebrate Zoology.** Cred. ar. Marshall.
- 237-240. Research in Fishery Biology.** Cred. ar. Smith.
- 261-264. Research in Medical Entomology.** Cred. ar. Ar.
- 265-268. Research in Insecticides.** Cred. ar. Cutkomp.
- 269-272. Research in Apiculture.** Cred. ar. Haydak.

## FARM MANAGEMENT AND AGRICULTURAL ECONOMICS

For courses and staff, see Agricultural Economics on page 42.

## FORESTRY

Professors Frank H. Kaufert, Thorvald Schantz-Hansen; Associate Professors Randolph M. Brown, Henry L. Hansen, Ralph L. Hossfeld, Louis W. Rees, Arthur E. Schneider; Assistant Professors Donald P. Duncan, Otis F. Hall.

**Prerequisites**—Students normally are expected to have an undergraduate degree in forestry, or its equivalent. The facilities of the Cloquet Experimental Forest and the Forestry and Biological Station at Lake Itasca are available to students taking this work.

**Language Requirement**—For the M.S. degree one foreign language selected in consultation with the student's adviser. For the M.F. degree

none. For the Ph.D. degree either (a) 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 Science Degree**—Offered only under Plan A. This program is intended for graduates preparing for research or teaching in such branches of forestry as silviculture, management, measurements, and wood technology.

**Master of Forestry Degree**—Students registered for the master of forestry degree will fulfill the requirements for the master of science degree under Plan B. This program is designed to meet the needs for added professional study by qualified forestry graduates primarily interested in administrative and technical work in forest management.

**Doctor's Degree**—The School of Forestry offers work in all fields of forestry leading to the Ph.D. degree under the general requirements for that degree.

### Courses

- 101w. Advanced Dendrology.** Classification and distribution of important timber species of the world. Prereq.: 4. 3 cred. Rees.
- 104w. Forest Influences.** Influence of woody vegetation upon microclimate, soil water, runoff, stream flow, and erosion. Prereq.: 126. 3 cred. Duncan.
- 111f-112w. Advanced Forest Measurements.** Special mensurational techniques. Statistical methods in forest measurements. Prereq.: 9 or permission. 3 cred. per qtr. Brown.
- 113w. Wood Pulp and Paper.** Production of wood pulp and paper products. Prereq.: 53-54, 5 cred. org. chem. 3 cred. Hossfeld.
- 114f-115w. Mechanical and Physical Properties of Wood.** Formulae used in determining stresses of wood. Laboratory methods in timber mechanics. Prereq.: 53-54, Math. 7. 3 cred. per qtr. Rees.
- 116s. Fabrication and Properties of Wood Products.** Timber connectors, plywood, fiber boards, and glued-wood construction. Prereq.: 114. 3 cred. Rees.
- 119s. Advanced Wood Structure.** Microtechnique of woody tissues and identification of tropical woods. Prereq.: 53-54. 4 cred. Rees, Hossfeld.
- 120s. Building Cost Estimating.** A general course in building cost estimating. 3 cred. Ar.
- 121f. Wood Finishing.** Materials and methods for finishing of wood products. Prereq.: org. chem. 3 cred. Hossfeld.
- 123f. Introduction to Forest Economics and Valuation.** The economic approach to forestry, including the appraisal of forest values. Prereq.: Ag.Ec. 2. 3 cred. Hall.
- 124w. Introduction to Forest Management.** Forest policy. Organization and administration of lands. Determination of cut. Prereq.: 123. 3 cred. Hall.
- 125s. Wood Preservation.** History, development, and methods. Systems and preservatives now in use. Prereq.: 53-54. 3 cred. Kaufert.
- 126f. Forest Ecology.** Fundamental characteristics and environmental relationships of trees in forest stands as the basis of silviculture. Prereq.: 4 or equiv. 3 cred. Hansen.
- 127w. Introduction to Silviculture.** Basic silvicultural systems. The forest regions of the U. S. and the silvicultural management of the major forest types. Prereq.: 126. 3 cred. Hansen.
- 128s-129s. Field Silviculture I and II.** Laboratory and field work on Cloquet Experimental Forest. Courses taken concurrently. Prereq.: 126, 127. 3 cred. per qtr. Schantz-Hansen, Schneider.
- 130f. Forest Valuation.** Financial aspects of forest management. Prereq.: 123. 3 cred. Duncan.
- 131w. Forest Policy.** Present-day problems in forestry and their historical background. 3 cred. Schneider.

- 133s. Forest Management and Utilization.** Field work on Cloquet Experimental Forest. 4 cred. Schneider, Schantz-Hansen.
- 134s. Forest Inventory and Photographic Interpretation.** Laboratory and field work on Cloquet Experimental Forest. Prereq.: 9. 4 cred. Ar.
- 136s. Forest Economics.** Economic principles of forest resource management from the viewpoint of the firm, the market, and the nation. Prereq.: 123. 3 cred. Hall.
- 137f. Seeding and Planting.** Principles of seeding, planting, and nursery practices. Tree seed identification. Special planting problems. 3 cred. Hansen, Duncan.
- 140w. Forest Management.** Advanced forest organization, regulation of cut, and administration. Prereq.: 124. 3 cred. Ar.
- 141w. Principles of Silvics.** Silvical characteristics of trees and their reactions to environment. Significant research and literature. Prereq.: 126, 127 or permission. 3 cred. Hansen.
- 142s. Wood Chemistry.** Chemistry of wood components, analysis and chemical technology of wood and wood products. Prereq.: 54, org. chem. 3 cred. Hossfeld.
- 143w. Forest Recreation.** From an economic, sociological, and technical point of view. Administrative and technical problems arising from recreation. 3 cred. Duncan.
- 145f. Advanced Silviculture.** Recent research and published information on American silvicultural problems. Prereq.: 127, 129. 3 cred. Hansen.
- 146f. Forest Aerial Photogrammetry.** Aerial photographs, aerial surveying, photo interpretation and forestry applications. Prereq.: 9, 134 or permission. 3 cred. Ar.
- 147w. Forest Inventory.** Volume, growth, sampling, and inventory design. Prereq.: 9, 134 or permission. 3 cred. Ar.
- 156f. Research Methods.** Scientific method, bibliography, instrumentation, reduction of data, report writing, publication procedure. 3 cred. Hossfeld, Duncan, Hall.
- 200-201-202. Research Problems in Silviculture.** Cred. ar. Hansen, Schantz-Hansen, Schneider, Duncan.
- 203-204. Research Problems in Forest Management.** Cred. ar. Schantz-Hansen, Schneider, Hall.
- 205-206. Research Problems in Forest Economics.** Cred. ar. Hall, Kaufert.
- 207-208-209. Research Problems in Wood Technology.** Cred. ar. Kaufert, Hossfeld, Rees.
- 213-214-215. Research Problems in Forest Utilization.** Cred. ar. Kaufert, Hossfeld, Rees.
- 218-219. Research Problems in Forest Measurements and Photogrammetry.** Cred. ar. Brown.
- 223f-224w-225s. Seminar.** Assigned topics with special reference to current forestry problems and current forestry literature. 1 cred. each qtr. Staff.

### GENERAL STUDIES COURSES CARRYING GRADUATE CREDIT

- Hum.131f-132w-133s. Humanities Proseminar.** Topic for course: The Place of the Humanities in an Age of Science. 2 cred. per qtr. Ar.
- Nat.Sci.171f-172w-173s. The Development of the Sciences.** Prereq.: 1 year of biol. and of phys. sci. or permission. 3 cred. per qtr. Graubard.

### GEOGRAPHY

Professors Jan O. M. Broek, John C. Weaver; Associate Professor John R. Borchert; Visiting Professor.

**Prerequisites**—Geography majors are expected to have taken introductory courses in physical and human geography, similar to Courses 1 and 4, and at least seven Senior College courses in systematic and regional geography and also to have a substantial minor in some related

biological, physical, or social science. *For minor work*, 12 credits in geography.

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

### Courses

- 101w.\* Geography of Western and Central Europe.** An introduction to the major physical and cultural regions of Europe as a whole, followed by a discussion of the population patterns, resources, and industries in the individual countries of western and central Europe. Prereq.: 5 cred. in geog. or permission. 3 cred. Ar.
- 105. Geography of the Mediterranean Region.** A regional survey of the lands adjacent to the Mediterranean Sea, in southern Europe, western Asia, and northern Africa. Prereq.: 5 cred. in geog. or permission. 3 cred. Ar. (Not offered 1952-53.)
- 106f. Geography of Scandinavia.** Physical and human geography of Denmark, Finland, Iceland, Norway, and Sweden considered both by individual countries and as a region. Prereq.: 5 cred. in geog. or permission. 3 cred. Ar.
- 107w. Geography of the Soviet Union.** The character of and bases for the regional diversity of physical resources, population, agriculture, manufacturing, and transportation in the U.S.S.R. Prereq.: 5 cred. in geog. or permission. 3 cred. Borchert.
- 109. Geography of Middle America.** Physical and human geography of the West Indies and the mainland from Mexico to Panama. Prereq.: 5 cred. in geog. or permission. 3 cred. Ar. (Not offered 1952-53.)
- 110s. Geography of South America.** A regional survey of the physical resources, population, agriculture, manufacturing, and transportation in the countries of South America. Prereq.: 5 cred. in geog. or permission. 3 cred. Borchert (1953: Ar.).
- 112f.\* Geography of Western Anglo-America.** A regional examination of the physical and human geographic patterns of the United States and Canada west of the eastern margins of the Great Plains. Prereq.: 5 cred. in geog. or permission. 3 cred. Weaver. (Not open to students who have taken 71.)
- 113w.\* Geography of Eastern Anglo-America.** A regional examination of the physical and human geographical patterns of the United States and Canada east of the eastern margins of the Great Plains. Prereq.: 5 cred. in geog. or permission. 3 cred. Weaver. (Not open to students who have taken 71.)
- 114. Historical Geography of North America.** Prereq.: 1, and 10 additional cred. in geog. or hist. 3 cred. Ar. (Not offered 1952-53.)
- 117s. The Middle East.** Environment and human occupation in their relationship to present regional differentiation within Southwestern Asia. Natural resources of the area and their development. Problems of international relations. Prereq.: 5 cred. in geog. or permission. 3 cred. Sopher.
- 118. Geography of Africa.** The physical resources of Africa and their use, in the light of the competing cultures and economic forces that have helped to shape the human geography of the continent. Prereq.: 5 cred. in geog. 3 cred. Ar. (Not offered 1953.)

- 121w.\* Geography of India and Southeast Asia.** India and Pakistan, Farther India, Indonesia, and the Philippine Islands. Areal differentiation of social-economic structure within the framework of physiographic regions. Geographic aspects of the problems of population pressure, development of resources, and international relations. Prereq.: 5 cred. in geog. or permission. 3 cred. Broek.
- 122f. Geography of East Asia.** China, Korea, and Japan. Physiographic features of the area; forms of resource utilization in their regional diversity. Geographic aspects of the problems of population pressure, development of resources, and international trade. Prereq.: 5 cred. in geog. 3 cred. Sopher. (Not open to students who have taken 120.)
- 126s. Geography of Australia and New Zealand.** A geographic survey of the physical and human resources of Australia and New Zealand. Prereq.: 5 cred. in geog. or permission. 2 cred. Weaver. (Not offered 1952-53.)
- 128s.\* Geography of the Polar Regions.** A systematic and regional examination of the physical environment and of man and his way of life in the Arctic, Subarctic, and Antarctic realms. A survey of the principal eras of geographic discovery in those regions. Prereq.: 1 or permission. 3 cred. Weaver. (Not open to students who have taken 125. Not offered 1952-53.)
- 133f. Introduction to Climatology.** The content and uses of our climatic record; world patterns of temperature, atmospheric circulation, moisture, and related elements; the world regional pattern of climate and its basis; uses and limitations of climatic classifications. Prereq.: 1 or permission. 3 cred. Borchert.
- 134w.\* Advanced Climatology.** The major climatic regions of the United States, Canada, and Central America; regional types of weather, their synthesis into climatic patterns; problems of long-term changes in the climatic pattern; introduction to the literature on regional climatic problems; analogous regions on the other continents. Prereq.: 133, Aero.Eng. 173, or permission. 3 cred. Borchert.
- 138w-139s. Advanced Cartography.** Exercises in use and construction of map projections. Compilation of maps from surveys, statistical and descriptive sources, and aerial photographs. Preparation of maps for display and reproduction. Prereq.: 70 or permission. 3 cred. per qtr. Sopher.
- 143w-144s.\* Political Geography.** Scope and content of political geography as exemplified by various writers, followed by an analysis of politically important areas. Prereq.: 12 cred. in geog., hist., or pol. sci., or permission. 3 cred. per qtr. Broek. (Not open to students who have taken 43.)
- 150w.\* Agricultural Geography.** Analysis of the geographic patterns of the world's principal commercial and subsistence crops and the more broadly inclusive agricultural systems of which they are a part. Emphasis on the ecologic, economic, and human factors that have operated in creating the defined distributions. Prereq.: 1 or 41 and 10 additional cred. in geog. or econ., or permission. 3 cred. Ar.
- 160w.\* Development of Geographic Thought.** Objectives, subdivisions, concepts, and methods of geography, with special reference to different schools of geographic thought as expressed in the literature of the last century. Prereq.: 15 cred. in geog. 3 cred. Broek. (Not open to students who have taken 155.)
- 170s.\* Field Course.** Field trips in the vicinity of the Twin Cities. Reports on selected topics. Prereq.: 15 cred. in geog. 3 cred. Borchert, Sopher.
- 251f-252w-253s-254f-255w.\* Seminars in Geography.** Topic for each seminar to be announced later. Prereq.: permission. Cred. ar. Staff.
- 301f.w.s.\* Research Problems in Geography.** Cred. ar. Staff.

## GEOLOGY AND MINERALOGY

Professors George A. Thiel, John W. Gruner, George M. Schwartz, Samuel S. Goldich; Associate Professors W. Charles Bell, Frederick M. Swain, Herbert E. Wright, Jr.

**Prerequisites**—For major work in geology, elementary courses in geology, such as Course 1-2 and A-B or equivalent; Course 23-24, Mineralogy; Course 25, Rock Study; general chemistry, such as Inorg.Chem. 6-7, or

9-10, or equivalent and Inorg.Chem. 11 or 12, and elementary physics, such as Phys. 7-8-9 or equivalent. Students who have not had the necessary undergraduate prerequisites may take them without credit.

**Major and Minor**—A student selecting some branch of geology as a major may not select general geology as a minor; it is preferable that the minor be taken outside of the major department.

**Language Requirement**—For the Master's degree one language acceptable to the department. For the Doctor's degree German is required, plus an additional language acceptable to the department or the option of a special research technique.

**Master's Degree**—Offered under both Plan A and Plan B. A field course or geologic field experience is required.

**Doctor's Degree**—Whatever field of special interest is pursued, it is expected that the student registering for the doctorate will take some courses in each of the major divisions of geology. Some geologic field experience is required.

### Courses

- 100su.\*§ Field Work, Northern Minnesota**—July 15 to 30, approximately. Students interested should consult the department. Prereq.: 25. 3 cred. Thiel, Wright.
- 101f.\* Sedimentation.** Origin of sedimentary rocks and their lithologic associations. Lect. and assigned readings. Prereq.: 24. 3 cred. Thiel.
- 102w. Methods of Study of Sediments.** Textural and mineralogical analyses of clastic and nonclastic sediments. Prereq.: 101, 106. 3 cred. Thiel.
- 103w-104s. Micropaleontology.** Biological and stratigraphic aspects of microfossils, especially Foraminifera and Ostracoda. Prereq.: 107. 3 cred. per qtr. Swain.
- 106f. Petrography.** Optical methods; introduction to microscopic work on rocks. Prereq.: 25. 3 cred. Goldich.
- 107f. Invertebrate Paleontology.** Morphology and classification of important fossil groups other than Foraminifera and Ostracoda. Prereq.: 25, or permission. 3 cred. Bell.
- 108w-109s. Advanced Invertebrate Paleontology.** Procedures in taxonomy; preparation of a paleontologic report. Prereq.: 107. 3 cred. per qtr. Bell.
- 110f-111w. Economic Geology.** The nature, genesis, and distribution of mineral deposits. Prereq.: 25. 3 cred. per qtr. Schwartz.
- 112s. Petroleum Geology.** Petroleum origin; structure and stratigraphy of major oil fields. Prereq.: 125, 151. 3 cred. Swain.
- 114s. Geology of Minnesota and Adjoining Areas.** Structure and lithology of the rocks and their associated mineral resources. Prereq.: 25. 3 cred. Thiel.
- 115su. Field Work, Southeastern Minnesota**—July 15 to 30, approximately. Stratigraphic field methods and principles. Prereq.: 25. 3 cred. Bell.
- 118f.\* Geomorphology.** Origin and evolution of landforms in different climatic and geologic environments. Field trips. Prereq.: 2 and A. 3 cred. Wright.
- 119aw.\* Geomorphology of Eastern United States.** General geology, with emphasis on the landforms and the Cenozoic history. Map study. Prereq.: 118 or 125. 3 cred. Wright. (Offered 1953-54 and alternate years.)
- 119bw.\* Geomorphology of Western United States.** Complementary to 119a. Map study. Prereq.: 118 or 125. 3 cred. Wright. (Offered 1952-53 and alternate years.)
- 120s. Glacial Geology.** Glaciers, glacial deposits, and Pleistocene history. Field trips. Prereq.: A and 2. 3 cred. Wright.
- 121f. Crystallography.** Symmetry relations in crystal classes. Crystal drawings and measurements. Prereq.: Math. 7, Inorg.Chem. 6-7 or 9-10. 3 cred. Gruner.

§ A comprehensive report will be required for Graduate School credit.

- 124w.\* **Metamorphic Geology.** Conditions, processes, and results of metamorphism. Prereq.: 131. 3 cred. Schwartz. (Not offered 1952-53.)
- 125f.\* **Structural Geology.** Primary and secondary structures of rocks; mechanics of rock deformation; field use. Prereq.: 2, 25. 3 cred. Wright.
- 131w-132s.\* **Petrology.** Microscopic study of igneous, metamorphic, and sedimentary rocks. Prereq.: 106. 4 cred. per qtr. Goldich.
- 137s.\* **Principles of Chemical Geology.** Geochemical literature. Methods in research and application of physical chemical principles to geologic problems. Prereq.: one year of college chem. and 25. 3 cred. Gruner.
- 140w-141s. **Applied Petrography.** Paragenesis of ores and other mineral associations; practical problems in mining and geology. Prereq.: 131. 3 cred. per qtr. Goldich.
- 144w. **Geologic Maps.** Construction and interpretation of geologic maps, cross sections and structure contour maps. Fault problems. Prereq.: 125. 3 cred. Wright.
- 145s. **Aerial Photographs.** Elements of photogrammetry, stereovision, geologic and geomorphic interpretation, field use. Prereq.: A and 2. 3 cred. Wright.
- 146f-147w. **Soil Mineralogy.** The crystal systems; morphological, physical, and chemical characters of minerals. Blowpipe analysis, sight identification. For students in soil science and civil engineering. Prereq.: a year of college chemistry. 4 cred. per qtr. Gruner.
- 150su.\*§ **Field Geology**—June 15 to July 15. Detailed systematic work conforming with standards of official surveys. Preparation of geologic maps, structure sections, reports; paragenesis of ores and their relations to geologic structures. Field: Black Hills, South Dakota. Prereq.: 125. Cred. ar. Swain.
- 151w-152s.\* **Stratigraphy.** Principles and methods of stratigraphic analysis; selected index fossils; term paper in 152. Prereq.: 107. 3 cred. per qtr. Bell.
- 153f. **Subsurface Stratigraphy.** Theory and methods of subsurface stratigraphy as applied to selected oil fields. Prereq.: 151. 3 cred. Swain.
- 161w. **Advanced Mineralogy.** Use of X rays for identification. The crystalline state. Isomorphism and polymorphism. Structures of silicates. Synthesis of minerals. Prereq.: 25, 121 or permission. 3 cred. Gruner.
- 166w-167s.\* **Mineralography.** Methods of studying opaque minerals and applications to problems in ore genesis. Prereq.: 111, 131. 3 cred. per qtr. Schwartz.
- 170f.w.s.\* **Geologic Problems.** Individual research in laboratory or field problems. Prereq.: permission of major adviser. Cred. ar. Staff.
- 175s. **Field Work in Glacial Geology and Geomorphology.** Mapping surficial deposits and landforms. One day in field each week. Prereq.: 118, 120. 3 cred. Wright.
- 211f-212w-213s.\* **Stratigraphic Paleontology.** Analyses of selected fossil populations. Prereq.: 104 or 108, and 151. 3 cred. per qtr. Bell, Swain.
- 214.\* **Seminar in Economic Geology.** Prereq.: 111. Cred. ar. Goldich, Gruner, Schwartz.
- 215.\* **Advanced Course in Principles of Economic Geology.** Detailed study of fundamental principles involved in the origin of ore deposits. Prereq.: 111. 3 cred. Schwartz. (Alternates with 216. Offered spring quarter 1952-53.)
- 216.\* **Mining Geology.** Fundamental principles of economic geology applied to problems in mining. Prereq.: 111. 3 cred. Schwartz. (Alternates with 215.)
- 217.\* **Research Course in Petroleum Geology.** Prereq.: 112, 153 or permission. Cred. ar. Swain.
- 218.\* **Advanced Structural Geology.** Fundamental problems of primary and secondary structures. Prereq.: 125, 132. 3 cred. Schwartz. (Offered fall quarter 1952.)
- 241.\* **Field Course in Geology.** To be arranged with individual students upon application to the department. Cred. ar. Staff.
- 243-244.\* **Research Course in Geology.** Advanced work in geology; chiefly individual work on selected subjects. Cred. ar. Staff.
- 245-246.\* **Research in Sedimentation.** Prereq.: 102. 3 cred. per qtr. Thiel.
- 247.\* **Research in Geomorphology and Pleistocene Geology.** Prereq.: 118, 120. Cred. ar. Wright.
- 248.\* **Seminar in Geomorphology and Pleistocene Geology.** Prereq.: 118, 120. Cred. ar. Wright.

‡ A maximum of 6 credits will be granted after field report is completed.

- 251-252.\* Mineralogical Problems.** Morphology and physical measurements of minerals. Prereq.: 121, 161. Cred. ar. Gruner.  
**253-254.\* Research Course in Economic Geology.** Prereq.: 111. Cred. ar. Goldich, Gruner, Schwartz.  
**263-264.\* Research Course in Petrology.** Prereq.: 132. 3 cred. per qtr. Goldich.  
**265. Seminar in Special Research Fields.** Ar.

## GEOPHYSICS

Assistant Professor Harold M. Mooney (adviser for Geophysics); Professor J. William Buchta (adviser for Physics); Associate Professor Frederick M. Swain (adviser for Geology); Assistant Professor William D. Munro (adviser for Mathematics).

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

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

**Language Requirement**—One foreign language, preferably German.

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

### Courses

- 108f. Introduction to General Geophysics.** Physics of the earth; evidence and data on age and shape of the earth, internal constitution, gravity and magnetic fields. Prereq.: Phys. 9, Geol. 2; Geol. 125 recommended. 3 cred. Mooney.
- 109w. Elementary Seismology.** Physics and geology of earthquakes; causes, effects, and distribution. Theory of seismic waves. Prereq.: Phys. 9, Geol. 125. 3 cred. Mooney.
- 110s. Introduction to Exploration Geophysics.** Principles of exploration by gravitational, magnetic, seismic, and electrical measurements. Prereq.: Phys. 9, Geol. 2; Geol. 125 recommended. 3 cred. Mooney.
- 125f. Principles of Gravity and Magnetic Exploration.** Techniques of interpretation; use in geologic and mining problems. Prereq.: Phys. 9, Geol. 125, M.&M.25. 2 cred. Mooney.
- 126w. Principles of Seismic Exploration.** Reflection and refraction shooting, interpretation of data. Prereq.: Phys. 9, Geol. 125, M.&M. 25. 2 cred. Mooney.
- 127s. Principles of Electrical Exploration.** Resistivity method and others; theory, interpretation, and instruments. Prereq.: Phys. 9, Geol. 125, M.&M. 25. 2 cred. Mooney.
- 130f.w.s.\* Special Problems.** Prereq.: permission. Cred. ar. Mooney.
- Phys.101f-103w-105s. Theoretical Physics.**
- Phys.131f-133w. Geometrical and Physical Optics.**
- Geol.110f-111w. Economic Geology.**
- Geol.112s. Petroleum Geology.**
- Geol.125f.\* Structural Geology.**
- M.&M.132f-133w-134s. Industrial Statistics.**
- M.&M.150f or 105f.w.s. Intermediate Calculus.**
- M.&M.151w.s.\* or 106f.w. Differential Equations.**
- M.&M.152w-153s or 107s. Advanced Calculus.**
- M.&M.154f.\* Vector Analysis.**

## GERMAN

Associate Professors Frank H. Wood, Lynwood G. Downs; Assistant Professors Frederick L. Pfeiffer, Hermann Ramras.

**Prerequisites**—For major work, 27 Senior College quarter credits or equivalent. For minor work, 18 Senior College quarter credits or equivalent. All candidates for advanced degrees shall understand spoken German and speak and write the language with some facility.

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

**Doctor's Degree**—In German, major work may be done in either of two historical subdivisions of the general field. The first, German Literature, embraces New High German literature and extends from the end of the Middle Ages to the present. The second, Linguistics and Philology, embraces the dialects, culture, and literature of the Germanic peoples and of Germany from early times through the Middle Ages.

#### DOCTOR'S DEGREE IN GERMAN LITERATURE

Candidates must offer at least 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 presenting 18 credits in linguistics and philology and not less than 12 credits in one of the following fields: classics, English literature, fine arts, foreign literature, history, philosophy. In any case, it is strongly recommended that candidates in German literature supplement their major by courses chosen from one or more of these fields.

#### DOCTOR'S DEGREE IN LINGUISTICS AND PHILOLOGY

Candidates must offer at least 18 credits in German literature.

A substantial knowledge of Latin is expected of all candidates. An elementary knowledge of Greek is strongly recommended.

**Note**—For information on work in Comparative Literature, see page 21.

### Courses

#### GERMAN LITERATURE

- 130f-131w-132s.\* The Age of Luther.** Prereq.: 70 and 11 cred. above 59 or equiv. 3 cred. per qtr. Downs. (Not offered in 1952-53.)
- 143bf-144bw-145bs.\* The Classical Period: Goethe.** (a) Lessing, Wieland, Herder (1952-53); (b) Goethe; (c) Schiller; (d) Goethe and His Literary Relations to France, England, and the United States. Prereq.: 71 and 11 cred. above 59 or equiv. 3 cred. per qtr. Ramras.
- 150af-151aw-152as.\* Studies in German Literature of the Nineteenth Century.** (a) Die Novelle; (b) Austrian Drama; (c) Romanticism (1952-53). Prereq.: 72 and 11 cred. above 59 or equiv. 3 cred. per qtr. Pfeiffer.
- 153f-154w-155s.\* The Modern Drama.** From Hauptmann to the present. Prereq.: 72 and 11 cred. above 59 or equiv. 3 cred. per qtr. (Not offered 1952-53.)
- 156f-157w-158s.\* Problems in German Literary Criticism.** History, methods, bibliography. Prereq.: 70-71-72 and 6 cred. above 59 or equiv. 3 cred. per qtr. Wood. (Not offered 1952-53.)
- 160f-161w-162s.\* Lyric Poetry.** 160f: From the Renaissance through Sturm und Drang; 161w: From Goethe through Romanticism; 162s: From Heine to Rilke. Prereq.: 70-71-72 or equiv. and 11 cred. above 59. 3 cred. per qtr. Wood. (Not offered 1952-53.)
- 163f-164w-165s.\* The German Novel.** (a) Development of the Novel; (b) The Nineteenth-Century Novel; (c) The Twentieth Century. Prereq.: 70-71-72 and 6 cred. above 59 or equiv. 3 cred. per qtr. Pfeiffer. (Not offered 1952-53.)
- 173f-174w-175s.\* European Literary Relations:** (a) English-German Literary Relations; (b) French-German Literary Relations. Prereq.: 70-71-72 and 6 cred. above 59 or equiv. 3 cred. per qtr. Pfeiffer, Wood. (Not offered 1952-53.)

**253f-254w-255s.\* Seminar: Literary Problems.** (a) Goethe and Schiller (1953-54); (b) Romanticism; (c) Nineteenth- and Twentieth-Century Drama: Kleist, Grillparzer, Hebbel and Hauptmann (1952-53). Prereq.: 70-71-72. 3 cred. per qtr. Wood, Pfeiffer, Ramras.

#### GERMANIC LINGUISTICS AND PHILOLOGY

**110f-111w-112s.\*† Middle High German.** Linguistic introduction and readings in Middle High German literature. Prereq.: 70 and 11 cred. above 59 or equiv. 3 cred. per qtr. Downs. (Not offered 1952-53.)

**113f-114w. Gothic.** (Same as Scandinavian 113-114.) 113: Gothic. The course is designed as an introduction to Germanic linguistics and to a comparative study of Indo-European languages. 3 cred. Downs; 114: Gothic Texts. 3 cred. Downs. (Not offered 1952-53.) Prereq.: 80 and 11 cred. above 59 or equiv.

**118f-119w-120s. Old High German.** Linguistic discussion and readings in Old High German literature. Prereq.: 70 and 11 cred. above 59 or equiv. 3 cred. per qtr. Downs.

**125s. History of the German Language.** Prereq.: 80 and 11 cred. above 59. 3 cred. Downs. (Not offered 1952-53.)

**126s. Historical German Grammar.** Prereq.: 110-111-112 or 113-114-115. 3 cred. Downs. (Not offered 1952-53.)

**176f-177w-178s. Problems and Research Trends in Germanic Philology.** 176f: The Germanic Languages. 3 cred.; 177w: The Germanic Literary Tradition. A comparative discussion of the native and foreign records of the Old Germanic Period. 3 cred.; 178s: Linguistic Geography. 3 cred. Prereq.: two Germanic dialects. (Not offered 1952-53.)

**194s. Old Saxon.** The Heliand. 3 cred. Downs. (Not offered 1952-53.)

#### GREEK

For courses and staff, see Classics, pages 76-78.

#### HISTORY

Professors August C. Krey, Alfred L. Burt, Harold C. Deutsch, Herbert Heaton, Tom B. Jones, Philip D. Jordan, Ernest S. Osgood, Lawrence D. Steefel, David H. Willson, John B. Wolf; Associate Professors William D. Beatty, John Bowditch, Rodney C. Loehr, Faith Thompson, Alice F. Tyler; Assistant Professor George W. Anderson.

**Note**—For information on work in International Relations, see page 23; for work on American Studies, see pages 20 and 46.

**Prerequisites**—Of the four fields in which general survey courses in history are usually given, namely, Ancient, American, English, and European, students entering upon graduate work in history will usually be expected to have covered two or three courses. In addition they will be expected to have taken advanced or Senior College courses in two of these fields and at least one course in which intensive work has been done.

A student who makes history a minor 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 department attaches much importance to adequate preparation in the foreign languages, which may be used by the student in the course of advanced and research work.

## REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS

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

**PLAN A**—The candidate shall select from the appended list two fields in which to do his work; for example, Group C 3 and Group D 3, or Group B 1 and Group C 3. The two fields selected shall be from different groups. While course work may be expected to cover some portion of the selected fields, and perhaps material outside of them, the candidate is expected to prepare himself to stand examination on fields rather than on courses. The thesis shall fall within one of the selected fields which shall be chosen in consultation with an adviser of the department. A minimum of 18 credits in the major (plus History 200 or equivalent) and 9 in the minor will be expected. Upon completion of the work the candidate will be given a written examination upon the two fields, and an oral examination upon the history fields, the minor field, and the thesis.

*Minor in History*

The candidate for the degree of master of arts taking a minor in history is expected to present one of the listed fields with a minimum of 9 credits therein.

<b>GROUP A</b>	<b>GROUP B</b>	<b>GROUP C</b>
The Old Orient	Europe, 395-1300	England since 1485
Greece	England to 1485	Modern Europe§
Rome	Renaissance and Reformation	Economic history, 1700 to present
	Economic history, 1300-1700	
<b>GROUP D</b>		<b>GROUP E</b>
American history to 1840		Asia
American history since 1840		European colonies and dependencies
Economic history of the United States		Latin America
		Canadian history

**PLAN B**—The program of the candidate shall be made out in consultation with an adviser in the department who will see to it that the candidate registers for courses which will give a balanced training in the general field of history together with attention to the supporting fields in the social studies (political science, economics, sociology, anthropology, geography). One of the courses in history, carrying at least 9 credits, shall be a seminar. In special cases, this requirement may be fulfilled in courses numbered 170-199 or by an equivalent amount of work done by independent reading with written reports under direction of an adviser; the reports must show familiarity with source material in some selected field.

## REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

For a major in history, the candidate shall choose five fields from those listed above. At least one period or field shall be chosen from Group A or B and at least one from Group C or D, but no more than two fields shall be selected from any one group. The subject of the thesis will be in one of the selected fields. All candidates will be expected to take 168, 169, 200 or equivalents.

§ The delineation of the field should be arranged in consultation with an adviser in the department.

*Preliminary Examination*

The preliminary examination for candidates majoring in history is both written and oral, and will cover the minor and four of the periods or fields chosen for the major. That field in which the candidate intends to do special work shall be reserved for the final examination.

*Final Examination*

In this examination, taken after the successful completion of the preliminary examination and the acceptance of the candidate's thesis, the emphasis shall be placed upon testing the highly detailed knowledge of the student in his special subject. It shall cover that subject reserved in the preliminary examination, and include the usual defense of the thesis, its methods, results, and contribution to the field investigated.

*Minor in History*

The candidate for the degree of doctor of philosophy taking a minor in history is required to be adequately prepared in two of the listed fields and may be required to take a written examination covering them. Normally the minor will include at least 21 credits.

*Lecture Courses*

- 100f-101w-102s. **The Ancient Near East.** 3 cred. per qtr. Jones.  
 100af-101aw-102as. **History of Greece.** 3 cred. per qtr. Jones.  
 100bf-101bw-102bs. **History of Rome.** 3 cred. per qtr. Jones.  
 103f-104w-105s. **Medieval History.** Students attend classes in 65f-66w-67s. 3 cred. per qtr. Krey.  
 103af-104aw-105as. **Renaissance and Reformation.** Students attend classes in 65af-66aw-67as. 3 cred. per qtr. Krey.  
 106f-107w-108s. **Continental Europe (1559 to 1815).** 3 cred. per qtr. Steefel.  
 106af-107aw-108as. **Continental Europe (Nineteenth Century).** 3 cred. per qtr. Steefel.  
 109f-110w-111s. **Europe in the Twentieth Century.** 3 cred. per qtr. Deutsch.  
 112f-113w-114s. **Economic History of Europe.** 3 cred. per qtr. Heaton.  
 115f-116w-117s. **European Expansion.** 3 cred. per qtr. Willson.  
 118w-119s. **World War II.** 3 cred. per qtr. Deutsch.  
 120f-121w. **Modern France.** 3 cred. per qtr. Bowditch.  
 122f-123w-124s. **Scandinavian History.** 3 cred. per qtr. Ar.  
 125f-126w-127s. **Russian History.** 3 cred. per qtr. Anderson.  
 125af-126aw-127as. **History of Eastern Europe and the Middle East.** 3 cred. per qtr. Anderson.  
 128f-129w-130s. **Modern England (1485-1714).** 3 cred. per qtr. Willson.  
 128af-129aw-130as. **Modern England (1714 to the Present).** 3 cred. per qtr. Willson.  
 131f. **Economic Development of the Scandinavian Countries.** 3 cred. Ar.  
 134f-135w-136s. **Social and Intellectual History of Europe.** 3 cred. per qtr. (Not offered.)  
 143f-144w-145s. **American Folklore.** 3 cred. per qtr. Jordan.  
 146f-147w-148s. **American Economic History.** 3 cred. per qtr. Loehr.  
 149f-150w-151s. **Social and Intellectual History of the United States.** 3 cred. per qtr. Tyler.  
 152f-153w. **The Immigrant in American History.** 3 cred. per qtr. (Not offered.)  
 154f-155w-156s. **Canadian History and Canadian-American Relations.** Students attend classes in 76f-77w-78s. 3 cred. per qtr. Burt.  
 157f-158w-159s. **Latin-American History.** 3 cred. per qtr. Beatty.  
 168w-169s. **Readings in the Works of Great Historians.** 3 cred. per qtr. This course is required of all candidates for the Ph.D. degree. Steefel.

*Readings Courses*

- 170f-171w-172s.\*† Ancient History. 3 cred. per qtr. Jones.  
 173f-174w-175s.\*† Medieval and Renaissance History. 3 cred. per qtr. Krey, Thompson.  
 176f-177w-178s.\*† Seventeenth-Century France. (A reading knowledge of French required.) 3 cred. per qtr. Wolf.  
 176af-177aw-178as.\*† Russian History. 3 cred. per qtr. Anderson.  
 176bf-177bw-178bs.\*† Scandinavian History. 3 cred. per qtr. Ar.  
 176cf-177cw-178cs.\*† Recent European History. 3 cred. per qtr. Deutsch.  
 179f-180w-181s.\*† European Economic History. 3 cred. per qtr. Heaton.  
 182f-183w-184s.\*† English History, Tudor and Stuart Periods. 3 cred. per qtr. Willson.  
 185f-186w-187s.\*† Problems of the Eighteenth Century: Some Phases of Early American Social and Intellectual History. 3 cred. per qtr. Tyler.  
 185af-186aw-187as.\*† The West in American History. 3 cred. per qtr. Osgood.  
 185bf-186bw-187bs.\*† American Diplomatic History. 3 cred. per qtr. Beatty.  
 185cf-186cw-187cs.\*† Third Party Movement since the Civil War. 3 cred. per qtr. Ar.  
 185df-186dw-187ds.\*† Minnesota and the Northwest. 3 cred. per qtr. Jordan.  
 188f-189w-190s.\*† American Economic History. 3 cred. per qtr. Loehr.  
 191f-192w-193s.\*† Canadian History and Canadian-American Relations. 3 cred. per qtr. Burt.  
 194f-195w-196s.\*† Latin-American History. 3 cred. per qtr. Beatty.  
 200f. Historical Bibliography and Criticism. 3 cred. Required of candidates for advanced degrees in history who do not present evidence of similar training elsewhere. Steefel and others.

*Seminars*

- 204f-205w-206s. Medieval History. 3 cred. per qtr. Krey.  
 208f-209w-210s.\*† American Economic History. 3 cred. per qtr. Loehr.  
 208af-209aw-210as.\*† The American West. 3 cred. per qtr. Osgood.  
 208bf-209bw-210bs.\*† The Slavery Controversy. 3 cred. per qtr. Ar.  
 221f-222w-223s.\*† European Economic History. 3 cred. per qtr. Heaton.  
 224f-225w-226s.\*† Modern European History. 3 cred. per qtr. Steefel.  
 230f-231w-232s.\*† Ancient History. 3 cred. per qtr. Jones.  
 240f-241w-242s.\*† Latin-American History. 3 cred. per qtr. Jones, Beatty.

## HOME ECONOMICS

Professors Louise A. Stedman, Clara B. Army, Alice Biester, Jane M. Leichsenring, Isabel Noble, Ethel L. Phelps, Ella J. Rose; Associate Professors Gertrude Esteros, Roxana Ford; Assistant Professor Kathleen Jeary; Instructors Joan Gordon, Mavis C. Nymon.

**Prerequisites**—Students desiring to major in home economics must present undergraduate credits in such of the following—social sciences, physical sciences, biological sciences, art, and education—as shall be satisfactory to the adviser under whose direction the major work is to be done. In addition the student must have adequate undergraduate training in that field of home economics in which she wishes to specialize.

**Major and Minor**—Students majoring in home economics for a Master's or a Doctor's degree and those minoring in this school for the Doctor's degree must include either Course 209, 249, 279, or 299 in the study program.

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

**Doctor's Degree**—Work for the Ph.D. degree is offered in certain fields of Home Economics.

### Courses

- 102f. Advanced Textiles.** The 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. Prereq.: 50, Ag.Bi. 1, Ag.Ec. 3 or parallel. 3 cred. Phelps.
- 107w. Textile Analysis.** Application of quantitative methods in the analysis of textile materials, with special reference to fiber composition and finishes. Prereq.: 50, Ag.Bi. 1, 2, 3 cred. Phelps.
- 115s. Economic and Social Aspects of Clothing.** Trends in clothing consumption, clothing expenditure patterns, clothing budgets for low-income and dependent groups, motivation in dress, sociological and economic aspects of fashion in dress, ready-to-wear industry. Prereq.: 50, Ag.Ec. 3. 3 cred. Ar.
- 116f.w. or s. Family Clothing Problems.** Buying, simplification, labeling, and standardization of clothing; sizing of garments and patterns; recent developments in choice of clothing for specific uses. Prereq.: 50. 3 cred. Ar.
- 120f.w.s. Art History.** A general view of the history of art from the Egyptian period to the present. Painting, sculpture, architecture, furniture, and costume of the past studied for their present influences and contributions and their significance to contemporary houses and furnishings and to dress. Field trips. 3 cred. Esteros.
- 121f. Textile Design.** Historic and modern textile designs and designers. Original designs applied to textiles by means of silk screen, batik, and block print techniques. Prereq.: 27, 50, 23 advised, or permission. 3 cred. Esteros, Anderson.
- 122s. Advanced Interior Design.** Small-house interiors designed and elevation drawings rendered in color. Studies and reports on modern trends, designers and their work, and other topics of practical and historic interest. Actual materials used as far as possible. Field trips to shops and homes. Prereq.: 27, 120 or permission. 3 cred. Esteros, Ludwig.
- 123w. Advanced Costume Design.** Modern and historic costume. Studies and reports on selected topics. Problems in draping and sketching designs for various figure types. Pencil, crayon, and watercolor techniques. Prereq.: 3, 22, 25 recommended, or permission. 3 cred. Esteros.
- 140f. New Developments in Food Preparation.** Survey of recent trends in food preparation. Prereq.: 40 or equiv. 3 cred. Gordon.
- 142f.w.s. Experimental Cookery.** An intensive study of food problems. Prereq.: 40 and Ag.Bi. 1. 3 cred. Noble, Gordon.
- 146s. Special Food Problems.** Class problems in foods and food preparation. Prereq.: 142. 3 cred. Noble.
- 150su. Textile Problems.** Recent developments and findings in the field of textiles. Emphasis on needs of home economics teachers in secondary schools, colleges, and adult classes. Prereq.: 3 cred. in textiles or equiv. 3 cred. Ar.
- 170f.w. Nutrition of the Family.** Fundamental principles of human nutrition and their application in promotion and maintenance of optimal health of the family. Prereq.: 31, 40, Ag.Bi. 1, Physiol. 4. 3 cred. Biester, Leichsenring.
- 171w.s. Child Nutrition.** Lectures and discussions dealing with the principles of child nutrition and with the formation of desirable food habits. Observation of children at mealtime is included. Prereq.: 170, H.E.Ed. 90. 3 cred. Leichsenring.
- 172. Current Developments in Nutrition.** Provides fundamental facts and techniques for solving current nutrition problems. Prereq.: 31, 40, Ag.Bi. 1, Physiol. 4 or permission. 3 cred. Biester, Leichsenring. (Not offered 1952-53.)
- 173s. Nutrition in Disease.** Fundamental principles involved in using diet in treatment of certain diseases. Prereq.: 170, 35 advised. 4 cred. Ar.

- 175w. Nutrition.** Tissues and tissue metabolism as well as work on blood, milk, and urine. Prereq.: 33. 4 cred. Nymon.
- 176w. Advanced Nutrition.** Selected quantitative methods applicable to investigations relating to digestion and metabolism. Prereq.: 35 or parallel, Ag.Bi. 2. 4 cred. Biester.
- 177s. Digestion and Metabolism.** Selected problems relating to digestion and metabolism. Lect., readings, lab. Prereq.: 35. 3 cred. Leichsenring, Nymon.
- 178f.w.s. Clinical Problems in Nutrition.** Application of nutrition information to problems in health and disease, involving assigned readings, discussions, and experience in a clinic. Prereq.: 170, 35 or parallel. 2 cred. Ar.
- 179f.w. Readings in Nutrition.** Experience in use of nutrition books and periodicals. Readings, oral and written reports. Prereq.: 170. 2 cred. Biester, Leichsenring, Nymon.
- 180f.w.s. Home Planning and Furnishing.** Problems in planning and furnishing a home to meet family needs. Esthetic, economic, social, and managerial aspects considered. Each student develops a plan for a house and its furnishings based on family living. Field trips. Prereq.: 27, 49, 120 advised. 5 cred. Myren, Ludwig, Esteros.
- 181s. Housing Problems of the Family.** Plans for both urban and rural homes will be considered, and the economic, art, and social aspects will be evaluated. Discussion, field trips, and classroom analyses will be a part of the work. Prereq.: 24 or 27. 3 cred. Ar.
- 184s. Home-Management Principles.** Discussion of the management aspects of homemaking with emphasis on problems involved in use of time, energy, and money. Prereq.: H.E.Ed. 90 or parallel. 3 cred. Ar.
- 185w. Family Relationships.** Factors that promote satisfaction within the immediate family, and relations of the family to the community. Prereq.: 85 or parallel; H.E.Ed. 90. 2 cred. Ar.
- 186s. Problems in Income Management.** Problems relating to individual and family budgets. Readings, discussions, field work. Prereq.: 85 or parallel, 86 or parallel, 34 or equiv., Ag.Ec. 126 or parallel. 3 cred. Ar.
- 195s. Development of Home Economics.** A discussion of the development of home economics with emphasis upon current problems. 2 cred. Stedman.
- 202f.w or s. Animal Fibers.** Advanced study of structure, composition, properties, and special problems of manufacture of wool, silk, and other protein and protein-like fibers in relation to use. Prereq.: advanced textiles, permission. 2 cred. Phelps.
- 204f.w or s. Plant and Other Cellulosic Fibers.** Advanced study of structure, composition, properties, and special problems of manufacture of cotton, flax, rayon, and certain minor and chemically manufactured fibers in relation to use. Prereq.: bot., advanced textiles, permission. 2 cred. Phelps.
- 208f.w. or s. Microanalysis of Textile Fibers.** Laboratory applications of histological and microchemical methods in the study of textile materials. Prereq.: bot., zool., advanced textiles, permission. Cred. ar. Phelps.
- 209f.w.s.\* Seminar in Textiles and Clothing.** Reviews and interpretations of the literature of this field, emphasizing recent advances. Individual oral and written reports. Prereq.: permission. 1 cred. Phelps.
- 247w. Special Food Problems.** Review of recent research in experimental foods. Prereq.: 142, Ag.Bi. 1, permission. 3 cred. Noble.
- 249f.w.s.\* Seminar in Foods.** Review and interpretation of the literature in the field of foods and experimental food preparation. Prereq.: permission. 1 or 2 cred. Noble.
- 270f-271f. Principles of Human Nutrition.** An advanced course dealing with certain aspects of digestion, metabolism, excretion, and food requirements under various conditions. Prereq.: 170, permission. 3 cred. per qtr. Leichsenring.
- 279w.s.\* Seminar in Nutrition.** Reviews and interpretations of the literature of this field, emphasizing recent advances. Individual oral and written reports. Prereq.: permission. 1 cred. Biester, Leichsenring.
- 295f.w.s-296f.w.s.\* Home Economics Problems.** Investigation of selected problems in home economics in fields such as foods, nutrition, textiles and clothing, home management, and related art. Independent study and written reports. Prereq.: permission. 1 to 5 cred. per qtr. Army, Biester, Leichsenring, Noble, Phelps, Rose, Esteros, Stedman.

**299f.w.s.\* Home Economics Problems.** Recent advances in the field of home economics, involving independent study, reading, and oral or written reports. Prereq.: permission. Cred. ar. Stedman, Army, Biester, Leichsenring, Noble, Phelps, Rose, Esteros, Ford.

## HORTICULTURE

Professors William H. Alderman, Wilfrid G. Brierley, Troy M. Currence, Fred A. Krantz; Associate Professors Arthur E. Hutchins, Robert E. Nylund, Arthur N. Wilcox, James D. Winter.

**Prerequisites**—For a major in horticulture a student must have completed a sufficient amount of work in plant sciences to satisfy the adviser that graduate study in this field may be satisfactorily undertaken. In certain cases further foundation courses may be required without credit.

**Language Requirement**—For the Master's degree under Plan A 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 (German, French, Swedish, Russian, and Spanish are acceptable) or (b) one acceptable language and either a special research technique or a collateral field of knowledge.

**Major**—With the approval of the adviser, courses in closely related fields may be accepted as part of the major work.

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

**Doctor's Degree**—Work for the Ph.D. degree is offered by the Division of Horticulture.

### Courses

- 107f. Orchard Management.** Orchard operations and costs. Lect., lab. 3 cred. Brierley. (Offered 1952-53 and alternate years.)
- 110w. Horticultural Crop Breeding.** Applied genetics. Principles and methods of breeding fruits, vegetables, ornamentals. Prereq.: Agron. 31 or 131. 3 cred. Wilcox.
- 111f. Systematic Pomology.** Description, classification and identification of fruit varieties. Lect., lab. 3 cred. Brierley. (Offered 1953-54 and alternate years.)
- 121w. Small Fruit Culture.** Cultural practices; botanic relationships. Lect., problems. 3 cred. Brierley.
- 135f. Potatoes.** Production, improvement, and use. 3 cred. Krantz.
- 136f. Adaptation and Maintenance of Vegetable Varieties.** Origin and history, adaptation, and seed production. Organizations working toward variety improvement. Prereq.: 32 or equiv. 3 cred. Currence. (Offered 1953-54 and alternate years.)
- 138w.139w. Vegetable Crops I and II.** Relation of environmental factors to the growth and culture of vegetable crops. Prereq.: 32 or equiv. 3 cred. per qtr. Nylund. (138 and 139 offered in alternate years, 138 offered 1952-53.)
- 150s. Principles of Quality Control.** Factors influencing the quality of fruits and vegetables after harvest; methods of quality evaluation and control; prepackaging materials and methods. Prereq.: permission. 2 cred. Winter. (Offered 1953-54 and alternate years.)
- 190f-191w-192s. Special Problems.** Supervised reading or experimentation. Written report required. Prereq.: permission. 2 to 4 cred. per qtr. Staff.
- 193f-194w. Horticultural Seminar.** Reports and discussions of current problems and investigations. Required of graduate students. 1 cred. per qtr. Staff.
- 241w. Organization of Horticultural Research.** Organization and administration in agricultural experiment stations with emphasis on project development and research outlines. 2 cred. Alderman, Krantz.

- 243f\*-244w.\* Advanced Topics in Horticulture.** 3 cred. per qtr. Alderman, Brierley, Krantz, Nylund.
- 247f.w.s.su.\* Report on Special Horticultural Topics.** Written report of the literature dealing with a selected topic or problem. Not to exceed 9 cred. Final approval by graduate committee in horticulture. Staff.
- 248w. Truck Crop Breeding.** Variety improvement, selection methods, pollination control, inheritance of characters, and suitable improvement programs for different crop species. Prereq.: 110 or Agron. 132. 3 cred. Currence. (Offered 1952-53 and alternate years.)
- 249f.w.s.su.\* Research in Horticultural Crop Breeding.** Cred. ar. Currence, Krantz, Hutchins, Wilcox.
- Agron.242f.s.\* Plant Breeding Seminar.** 1 cred. per qtr. Horticulture and Agronomy staffs.
- Agron.246w.\* Genetics Seminar.** 2 cred. Horticulture, Agronomy, and Animal Husbandry staffs.
- FoodTech.104w. Frozen Food Processing and Storage.** History and development of the frozen food industry; standards, laws and regulations; quality control; packaging and wrapping; processing methods; storage and transportation. Prereq.: Ag.Bi. 5 or 6 and Bact. 53 or permission. 3 cred. Winter.
- FoodTech.105f.w.s. Frozen Food Problems.** Special problems based upon work given in Food Tech. 104w. Prereq.: Food Tech. 104. 2 to 4 cred. Winter.

## HYDROMECHANICS

### Courses

- 101. Fluid Mechanics.** Basic principles of the mechanics of fluids. 3 rec. hrs. per week. Prereq.: M.&M. 26 or 84. 3 cred. Straub and staff.
- 102. Fluid Mechanics.** Basic principles of the mechanics of fluids and applications. 4 rec. hrs. per week. Prereq.: M.&M. 26. 4 cred. Straub and staff.
- 103. Fluid Mechanics.** Physical fluid properties, fluid statics, energy principle for compressible and incompressible fluids, pressure-momentum principle, elementary principles of turbines and pumps, introduction to advanced principles of flow phenomena. 5 rec. hrs. per week. Prereq.: M.&M. 26 or 84. 5 cred. Straub and staff.
- 104. Hydraulics Laboratory.** Introduction to laboratory techniques, calibration principles, and fluid measurements. Open channel, pipe line, and hydraulic machinery experiments. Prereq.: 101, 102, 103 or parallel or Chem.E. 101. 1 cred. Straub, L. A. Johnson, and staff.
- 183f.\* Open Channel Flow.** Theory of uniform and varied flow in open channels, with practical applications to the design of hydraulic structures, computations of drawdown curves, backwater curves, hydraulic jump, measuring flumes, submerged weirs, etc. Prereq.: 101 or 102 or 103 and 104. 3 cred. Ar.
- 184f-185w-186s.\* Advanced Hydraulic Problems.** Problems in hydraulic design. Prereq.: 183 or parallel, permission. 2 cred. per qtr. (Offered only by individual arrangement.)
- 187f. Intermediate Fluid Mechanics.** One- and two-dimensional flow of an ideal fluid, energy and momentum relations, fluid forces, boundary layer theory, separation and cavitation, hydrofoils. Prereq.: 101 or 102 or 103 and 104. 3 cred. Ar.
- 190w.\* Mechanics of Similitude and Dimensional Analysis.** Theory of the use of models in design; conditions for similarity in the case of hydraulic structures, elastic structures, aircraft, ships, waves, etc. Prereq.: 101 or 102 or 103 and M.&M. 127, 128, or permission. 3 cred. Ar.
- 191w. Hydraulic Motors and Pumps.** Introductory theory of hydraulic pumps, turbines, motors, transmissions. Prereq.: 187 or permission. 3 cred. Ar.
- 192s.\* Natural and Artificial Waterways.** Wave motion, tides, ship resistance, transportation of sediment. Control and regulation of rivers, design of ship canals, locks, dry docks, movable dams, harbors. Prereq.: 183 or permission. 3 cred. Ar.
- 193s. Hydraulic Measurements.** Study of laboratory and field, methods and instruments for measurement of hydraulic pressure, velocity and discharge. Prereq.: 187 or permission. 3 cred. Ar.

- 194f-195w-196s.\* Advanced Hydraulic Laboratory.** Experimental studies concerning characteristics of turbines, pumps, etc. Hydraulic models. Prereq.: 101 or 102 or 103 and 104. 2 cred. per qtr. (Offered only by individual arrangement.)
- 287. Fluid Turbulence.** Quantitative description of turbulence; momentum and vorticity transfer theories; statistical theory of turbulence. Phenomena of turbulence diffusion and energy dissipation. Turbulence in wind-tunnels, rivers, and the atmosphere. Prereq.: 187 or permission. 3 cred. (Not offered every year.)
- 290f-291w-292s. Advanced Fluid Mechanics.** Prereq.: 190. 3 cred. per qtr. (Not offered every year.)
- 293f-294w-295s. Hydrodynamics.** Theory of fluid motion. Prereq.: 187 and differential equations or advanced calculus, or permission. 3 cred. per qtr. (Not offered every year.)
- 296f-297w-298s. Advanced Hydrodynamics.** Prereq.: 295. 3 cred. per qtr. (Not offered every year.)

### INTERNATIONAL RELATIONS AND AREA STUDIES

For general statement, see page 23.

### JOURNALISM

Professors Ralph D. Casey, Thomas F. Barnhart, Mitchell V. Charnley, J. Edward Gerald; Associate Professors W. Edwin Emery, Edwin H. Ford; Instructor Alexander G. Park.

**Prerequisites**—Courses in journalism are open to regularly enrolled graduate students who can meet the prerequisites prescribed for particular courses. Before acceptance as a candidate for a graduate degree with a major or minor in journalism, a student shall satisfy his adviser that he is sufficiently prepared to carry on graduate work in this discipline.

For major work, a total of 27 credits in journalism and the social sciences or English distributed as follows: In journalism, a minimum of 15 credits in basic courses; and 12 credits in one of the social sciences, or courses in English.

For minor work, not fewer than 12 credits in journalism courses which satisfy the journalism adviser that the student has attained some journalistic proficiency.

**Fees**—Students registered for one or more courses in any level of graduate work are required to pay a general fee of \$1 per quarter.

### REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS

Work for the Master's degree is offered under Plan A and Plan B.

Candidates preparing for professional work in communications research, with a Master's degree, should consult the adviser for the listing of special courses in this area.

**Language Requirement**—One foreign language unless special exception is made upon petition. Foreign students who have gained proficiency in English as an acquired language may be permitted to offer English on recommendation of the major adviser and with the approval of the graduate group committee.

**Minor**—A candidate who meets the prerequisites may satisfy the minor requirement by electing courses from among the following: 101,

103, 106, 109-110, 111, 112, 113, 115, 118B, 120, 121, 130-131, 177, 205, 208, 210.

#### REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN JOURNALISM

The program is intended for students whose academic and professional experience qualifies them to seek the degree, and who plan professional careers with one of the mass communications media as communications research specialists, or as journalism teachers following their doctoral work.

In planning the three-year program for doctoral candidates, individual differences in the needs and purposes of students will be taken into account. The candidate shall, with the approval of his adviser, select four from among six fields of concentration. § One field shall be designated as the thesis field. The six fields are: (1) History and development of communications, (2) Propaganda and public opinion, (3) Communications and public affairs, (4) International communications, (5) Communications research, (6) Economics of communications.

Each field is supported by course offerings from other disciplines within the university. The concept of a journalism field for the Ph.D. is that journalism is a specialized extension of the social sciences (supported, where necessary, by English, law, and education). Supporting courses will include offerings from such disciplines as history, political science, sociology, social psychology, economics, and geography. Decision as to what constitutes adequate preparation in any of the journalism fields will be made in terms both of the communications specialty and of the social science to which it relates.

**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.

**Minor in Journalism**—Candidates for the Ph.D. degree in other departments may elect a minor in journalism by obtaining the approval of the dean of the Graduate School, the candidate's adviser, and the director of the School of Journalism.

#### Courses

**101w.s.\* Reporting of Public Affairs.** Training in reporting court trials, city, county, state, federal, administrative, and legislative agencies; politics, business, and labor. Prereq.: 51. 3 cred. Staff.

**103s.\* Literary Aspects of Journalism.** The literary, creative aspects of journalism as exemplified in the works of English and American fiction writers, poets, critics, essayists, and humorists. Prereq.: permission. 3 cred. Ford.

**106f.s.\* Critical Writing.** Theory and practice of writing book, theater, and motion picture reviews. Analysis of leading critics and critical periodicals. Weekly critical writing assignments. Prereq.: a Senior College writing course, permission. 3 cred. Ford, Gray.

**109w-110s.\* History of Journalism.** 109: Development of newspapers and periodicals from early beginnings in Europe through the 1860's in the United States. 110: Emergence of modern journalism in the post-Civil War period. 3 cred. per qtr. Ford, Emery.

**111f.\* International Communications and Foreign Affairs.** The channels of international communication and the news-gathering agencies. Factors affecting flow of news throughout the world. The role of the foreign cor-

§ A detailed statement of the offerings that may support each of the six fields may be obtained from advisers or the office of the School of Journalism.

- respondent. The relation of communications to foreign affairs and international understanding. Prereq.: 15 cred. in soc. sci. including a hist. or pol. sci. course in international affairs. 3 cred. Park.
- 112w.\* Comparative Foreign Journalism.** The press in the principal foreign countries. Cultural, political, economic, and technological influences that have shaped the foreign press systems. The free press and the government-controlled press. Prereq.: 15 cred. in soc. sci. including a hist. or pol. sci. course in government and politics. 3 cred. Park.
- 113f.\* Mass Communications.** Analysis of channels and barriers between the writer and the mass audience. Emphasis upon problems of communicating information and ideas to group and mass audiences by newspaper, radio, film, television, books, and other media. Comparative studies of content and influence. Prereq.: majors in journalism; others, permission. 3 cred. Ar.
- 115s.\* Communication Media Analysis.** Scientific techniques in analyzing the content and audiences of mass communications. Social stratification and attitude studies as they relate to the utilization of the media by the public. Prereq.: 51 or Econ. 5 or Psy. 70 or equiv., permission. 3 cred. Ar.
- 118.\* Selected Topics in Journalism.** A.s: Advanced reporting of public affairs. Prereq.: 101, permission. Staff; B.s: Projects in media analysis. Prereq.: 115, permission. Staff; C.f.w.s: Selected readings in journalism. Prereq.: permission. Casey. 3 cred. per qtr.
- 120f.\* Development of Radio and Television Communications.** Historical and economic development of aural and visual broadcasting, television, and facsimile; government regulation of the media; the audience; broadcasting in other countries. Prereq.: 51 for journalism majors; 13 or permission for speech-radio majors. 3 cred. Charnley.
- 121w.\* The Press in a Dynamic Society.** Economic, political, and social determinants of the character and content of mass communications. Patterns of operation, their effect on content, and their relative social utility. Government and mass communications. Prereq.: For journalism majors, 15 or 18; others, permission of adviser. 3 cred. Gerald.
- 130f-131w.\* Communication Agencies, Propaganda, and Public Opinion.** Press, radio, and motion pictures and their role in the opinion-forming process. Theories of public opinion and propaganda. Propaganda and informational techniques of governments, political parties, pressure groups, and other organized bodies. Propaganda in war and crisis. Prereq.: for 130, 15 cred. in soc. sci.; for 131, 130. 3 cred. per qtr. Casey.
- 140f-141w.\* Interpretation of Contemporary Affairs.** Analysis of major political, economic, and social problems and their interpretation in the editorial, interpretive article, and commentary. Source materials in the background of the news. Prereq.: 51, 10 cred. in the soc. sci. or permission of major adviser in journalism. 3 cred. per qtr. Gerald and staff.
- 142s. Current Communications Problems.** The individual project method is used for analyses of journalistic problems of contemporary importance. Prereq.: 51. 3 cred. Staff.
- 150s.\* Public Relations in Community Services.** Principles and practices of public relations and educational campaigns in public health, social work, and other community service fields. Prereq.: permission of major adviser and instructor; not open to those who have completed work in 78, nor ordinarily to journalism majors. 2 or 3 cred. Emery.
- 177s.\* Freedom of the Press and Communications Law.** The Anglo-American concept of freedom of speech and press, its development under the Constitution of the United States, and the present areas of tension. Statutes and administrative regulations affecting freedom of information, publishing, and broadcasting. Prereq.: 51 or permission. 3 cred. Gerald.
- 205s.\* Topics in International News Communication.** Discussion and reports on the rise and development of international news communication and the news-gathering agencies. Prereq.: permission. 3 cred. Casey, Park.
- 208s.\* Communication Agencies as Social Institutions.** Influence of political, social, and economic forces upon the national character and performance of press, radio, and motion picture. Prereq.: permission. 3 cred. Gerald.
- 210f.w.s.\* Research in Mass Communications Problems.** Individual research in either historical or contemporary phases of newspaper, magazine, or advertising fields. Prereq.: permission of director of the school. 3 cred. Ar.

## LATIN

For courses and staff, see Classics—Latin, pages 76-78.

## LIBRARY SCIENCE

Professor Errett W. McDiarmid; Associate Professors C. Irene Hayner, Harold G. Russell, Raymond H. Shove, Edward B. Stanford.

Specialization in the graduate program in Library Science may be in any one of the following areas: (a) administration, (b) work with children and young people, (c) reading guidance and selection of materials, (d) bibliography and reference. Master's degree programs will be built around seminar courses in each of these areas. In addition students should elect appropriate courses in subjects which would contribute to their professional objectives.

**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 bibliography, administration, and reading guidance.

**Language Requirement**—Reading knowledge of one foreign language.

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

## Courses

- 151f. **Invention and Spread of Printing.** To 1600. 2 cred. Shove.  
 152w. **History of Printing to Modern Times.** 2 cred. Shove.  
 154s. **Principles of Public Library Administration.** Prereq.: permission. 3 cred.  
 Ar.  
 155s. **Administrative Problems in the College and University Library.** Prereq.: permission. 3 cred. Shove.  
 157s. **School Library Problems.** Prereq.: permission. 3 cred. Hayner.  
 164s. **Reference III.** Specialized reference tools; government publications; administration of the reference department; special problems in large libraries. Prereq.: 62, 63. 2 cred. Russell.  
 165w. **Advanced Bibliography.** Specialized trade and national bibliographies, domestic and foreign. 2 cred. Shove.  
 171w. **Principles and Problems in Reading Guidance for Children.** Prereq.: 70 or parallel. 3 cred. Hayner.  
 172s. **Principles and Problems in Reading Guidance for Adolescents.** Prereq.: 70. 3 cred. Hayner.  
 173s. **Principles and Problems in Adult Reading Guidance.** Prereq.: 70. 3 cred. Ar.  
 184s. **Advanced Cataloging.** Prereq.: 81, 82. 3 cred. (Not offered 1952-53.)  
 255f-256w-257s.\* **Seminar in Library Administration.** 3 cred. per qtr. McDiarmid, Stanford.  
 260f-261w-262s.\* **Seminar in Advanced Bibliography.** 3 cred. per qtr. Shove, Russell.  
 271f-272w-273s.\* **Seminar in Library Work with Children and Young People.** 3 cred. per qtr. Hayner.  
 274f-275w-276s.\* **Seminar in Reading Guidance.** 3 cred. per qtr. Hayner.

## LINGUISTICS AND COMPARATIVE PHILOLOGY

## A. Program in Descriptive and Comparative Linguistics

Professor Raymond L. Grismer; Associate Professors Emmert M. Brackney, John W. Clark, Lynwood G. Downs; Assistant Professors Harold

B. Allen, Thomas B. Irving, Thomas F. Magner, Robert F. Spencer, Donald C. Swanson.

**Prerequisites**—For major work, not less than six quarter credits above 50 in each of two foreign languages, one of which must be German or Latin. For minor work, not less than six quarter credits above 50 in a foreign language.

**Master's Degree**.—Offered under Plan B; Plan A may be followed by petition. Reading knowledge of Latin and German and a fair knowledge of Greek are required of all candidates.

**Doctor's Degree**—For a major, candidates are expected to have a substantial knowledge of German, French, and Latin, and an elementary knowledge of Greek. Their preparation should lead to a comprehensive knowledge of the descriptive and comparative-historical techniques of linguistic science. The comparative technique will be actualized by special attention to comparative Indo-European grammar.

Programs for candidates who wish to minor in linguistics will be planned in accordance with their background or needs.

**Program**—Candidates will work toward competence in the following fields (items 1 to 3 for majors for the M.A. degree; items 1 to 5 for majors for the doctorate).

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

**Note**—For information on work in Comparative Literature, see page 21.

## Courses

### GENERAL

**Anthr. 105f. Phonetics.** A survey of speech sounds followed by practice in phonetic recording. Analysis of phonetic patterns in language. Practical work in dictation of Chippewa, Dakota, Finnish, and other languages. No prereq.: 3 cred. (Not offered 1952-53.)

**Classics 106f.107w. Introduction to the Study of Language.** Prereq.: any two courses numbered above 50 in a foreign language. 3 cred. per qtr. Swanson.

**Classics 108s. Cultural Aspects of Language.** Prereq.: any two courses numbered above 50 in a foreign language. 3 cred. Swanson.

**Anthr. 109f. General Linguistics.** Special attention to non-Indo-European languages. 3 cred. Spencer.

**Ling. 151f-152w-153s. Honors Course.** 1 to 3 cred. per qtr. Staff.

**Ling. 201f-202w-203s. Directed Readings.** 1 to 3 cred. per qtr. Staff.

### CELTIC

**Ling.134-135-136. Introduction to Celtic Philology: Old Irish Phonology and Morphology.** Text interpretation. Prereq.: at least two Senior College courses in early Indo-European languages, preferably Linguistics 131-132 or German 113-114. 3 cred. per qtr. Magner. (Not offered 1952-53.)

### CLASSICS

**Classics 133s. Vulgar Latin.** Development of Latin into Romance. Prereq.: permission. 3 cred. (Not offered 1952-53.)

**Classics 242w.\* Historical Latin Grammar.** 3 cred. Swanson.

## ENGLISH

- Eng. 100f. Old English.** Prereq.: 6 cred. in literature in English department, exclusive of classics and Course A-B-C. 4 cred. Clark.
- Eng. 102w. Readings in Old English Prose and Verse.** Prereq.: Eng. 100. 3 cred. Clark.
- Eng. 103s. Beowulf.** Prereq.: Eng. 100. 3 cred. Clark.
- Eng. 147f-148w-149s. Middle English Literature Exclusive of Chaucer.** A historical, critical, and linguistic survey, including some reading in translations of Medieval English writers of Latin. Prereq.: For non-English majors: Eng. 100 or equiv. 3 cred. per qtr. Clark.
- Eng. 165f. Introduction to Modern English.** Prereq.: 6 cred. in Eng. lit. exclusive of classics and A-B-C. 3 cred. Allen.
- Eng. 166s. Historical Backgrounds of Modern English.** Prereq.: Eng. 165. 3 cred. Allen.
- Eng. 174s. American English.** Prereq.: 6 cred. in Eng. lit., including language, above A-B-C. 3 cred. Allen.
- Eng. 204f-205w-206s. The Development of Standard English.** Prereq.: Eng. 100. 3 cred. per qtr. Allen.

## GERMAN

- Germ. 110f-111w-112s.\*† Middle High German.** Linguistic introduction and readings in Middle High German literature. Prereq.: Germ. 70 and 11 cred. above Germ. 59. 3 cred. per qtr. Downs. (Not offered 1952-53.)
- Germ. 113f-114w. Gothic.** Introduction to Germanic linguistics and to a comparative study of the Indo-European languages. 3 cred. per qtr. Downs. (Not offered 1952-53.)
- Germ. 118f-119w-120s. Old High German.** Linguistic discussion and readings in Old High German literature. Prereq.: Germ. 70 and 11 cred. above Germ. 59 or equiv. 3 cred. per qtr. Downs.
- Germ. 125s. History of the German Language.** Prereq.: Germ. 80 and 11 cred. above Germ. 59. 3 cred. Downs.
- Germ. 126s. Historical German Grammar.** Prereq.: Germ. 110-111-112 or 113-114-115. 3 cred. Downs.
- Germ. 194s. Old Saxon.** 3 cred. Downs. (Not offered 1952-53.)

## ROMANCE LANGUAGES

- French 171f-172w-173s.\*† History of French Language.** Prereq.: one year of Latin or permission. 1 cred. per qtr. Brackney.
- French 201f-202w-203s. Old French Phonology and Morphology.** 2 cred. per qtr. Brackney.
- French 204f-205w-206s. Reading in Old French Literature.** 2 cred. per qtr. Brackney.
- Span. 241f-242w-243s.\* Old Spanish Philology.** 2 cred. per qtr. Grismer.
- Span. 244f-245w-246s. Readings in Old Spanish Literature.** 2 cred. per qtr. Irving. (Not offered 1952-53.)

## SANSKRIT

- Ling. 128f-129w-130s. Readings in Sanskrit.** Descriptive grammar; interpretation of Vedic and Classical Sanskrit texts. Prereq.: at least two Senior College courses in early Indo-European languages, preferably Greek, Gothic, or Latin. 3 cred. per qtr. (Not offered 1952-53.)
- Ling. 131f-132w. Introduction to Sanskrit.** Phonology and morphology from a comparative point of view. Prereq.: at least two Senior College courses in early Indo-European languages, preferably Greek, Gothic, or Latin. 2 cred. per qtr. Ar.

## SEMITIC

- Ling. 121f-122w-123s. Introduction to Arabic Grammar and Reading.** Prereq.: two courses above 50 in any foreign language. 3 cred. per qtr. Irving.
- Ling. 124f-125w-126s. Introduction to Biblical Hebrew.** 3 cred. per qtr. Ar.

## SLAVIC

**Ling. 113f-114w-115s. Old Church Slavic (Old Bulgarian).** An introduction to Slavic linguistics. Descriptive grammar based on earliest texts and comparison of OCS with other Indo-European languages. Prereq.: Ling. 131-132 or equiv. 3 cred. per qtr. Magner.

**Russ. 125f-126w-127s. History of the Russian Language.** Prereq.: Russ. 51-52-53 or equiv. 3 cred. per qtr. Magner.

## B. Slavic and Far Eastern Languages and Literatures

Assistant Professor Richard B. Mather; Instructor Pearl C. Niemi.

The following are offered as courses in a minor program or as related fields (in Area Studies, Comparative Literature), but, for the present, no graduate degrees are offered in these fields.

## CHINESE

**Chin. 101f-102w-103s. Advanced Chinese.** Readings in Chinese historical, literary, or philological texts, selected according to student's needs. Prereq.: 51-52-53 or equiv. 2 to 3 cred. per qtr. Mather.

**Chin. 110s. Chinese Literature in Translation.** A survey in the best available English translations of Chinese belles-lettres from the first millennium B.C. to the present. Prereq.: 8 cred. in lit.; knowledge of Chinese not required. 3 cred. Mather.

## RUSSIAN

**Russ. 101f-102w-103s. Russian Literature in Translation.** Pushkin to the present. Prereq.: 8 cred. in lit.; knowledge of Russian not required. 3 cred. per qtr. Niemi.

**Russ. 125f-126w-127s.** See A. Slavic (above).

**Russ. 131f-132w-133s. Advanced Interpretation (19th Century Russian Poetry).** Prereq.: Russ. 71-72-73 or permission. 3 cred. per qtr. Niemi.

## MATHEMATICS AND MECHANICS

Professors Raymond W. Brink, Robert H. Cameron, Harry A. Doeringsfeld, Henry C. T. Eggers, Forrest E. Miller, William L. Hart, Benjamin J. Lazan, George C. Priester, Stefan E. Warschawski, Hugh B. Wilcox; Associate Professors Elizabeth Carlson, Gladys E. C. Gibbens, Gerhard K. Kalisch, Fulton Koehler, John M. H. Olmsted, Paul C. Rosenbloom, Hugh L. Turriffin; Assistant Professors Jacob E. Bearman, Monroe D. Donsker, Watson B. Fulks, Bernard B. Gelbaum, Charles Hatfield, Jr., Warren S. Loud, Gayle W. McElrath, William D. Munro, Evar D. Nering.

Mr. Olmsted is chairman and Mr. Koehler is secretary of the group. Students majoring in mathematics or mathematics and mechanics should consult one of these two or should confer with Mr. Brink, chairman of the Department of Mathematics of the College of Science, Literature, and the Arts (119 Folwell Hall), or Mr. Priester, chairman of the Department of Mathematics and Mechanics of the Institute of Technology (208 Engineering Building).

**Prerequisites**—For major work, 10 credits in calculus and 14 other credits in non-Junior College courses. For minor work, those courses specified as prerequisite to the chosen specific graduate courses.

**Language Requirement**—For the Master's degree one foreign language. Majors in mathematics and mechanics may, in exceptional cases, be exempted from this requirement by petition. For the Ph.D. degree two foreign languages.

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

**Doctor's Degree**—A student's program of work for the Ph.D. degree is to be made in consultation with an adviser, and, in addition to the special training related to the thesis, will include the fundamentals in at least two of the five following major fields other than his specialty: (1) Algebra, (2) Analysis, (3) Applied Mathematics and/or Statistics, (4) Geometry and/or Topology, (5) Mechanics.

For more detailed information about the courses listed below and for the courses offered in 1953-54, students should consult the program of the Department of Mathematics in the *Bulletin of the College of Science, Literature, and the Arts* and the program of the Department of Mathematics and Mechanics in the *Bulletin of the Institute of Technology*.

**Note**—For information on work in Statistics, see pages 27-28.

### Courses

- 106f.s.¶ **Differential Equations.** Prereq.: differential and integral calculus. 3 cred. Ar.
- 107w-108s.\*¶ **Advanced Calculus.** Prereq.: 52 (Intermediate Calculus) or 50 and 51 taken with A grades in the College of Science, Literature, and the Arts. 3 cred. per qtr. Hatfield.
- 109s.\*¶ **Theory of Numbers.** Prereq.: differential and integral calculus. 3 cred. Carlson.
- 115w.\*¶ **Differential Geometry.** Prereq.: 136. 3 cred. Gibbens.
- 121f-122w-123s.\*¶ **Mathematical Theory of Statistics.** Prereq.: differential and integral calculus. 3 cred. per qtr. Hart.
- 127f.w.s.§ **Technical Mechanics.** Prereq.: 26 (Statics), or permission. 5 cred. Wilcox.
- 128f.w.s.§ **Strength of Materials.** Prereq.: 26 (Statics). 5 cred. Miller.
- 129f.w.s.§ **Fundamentals of Materials Engineering.** Prereq.: 128. 4 cred. Lazan.
- 132f-133w-134s.§ **Industrial Statistics.** Prereq.: differential and integral calculus. 3 cred. per qtr. McElrath.
- 136f.\*¶ **Solid Analytic Geometry.** Prereq.: differential calculus. 3 cred. Olmsted.
- 141f.w.s.§ **Materials Testing Laboratory.** Prereq.: 128 or parallel. 1 cred. Miller.
- 144f-145w-146s.\*¶ **Fourier Series and Orthogonal Functions.** Prereq.: differential and integral calculus. 3 cred. per qtr. Nering.
- 147f-148w-149s.§ **Problem Seminar.** Prereq.: permission. 3 cred. per qtr. Warschawski.
- 150f.w.s.§ **Calculus III: Intermediate Calculus.** Prereq.: 25 (Integral Calculus). 3 cred. Loye.
- 151w.s.\*§ **Differential Equations.** Prereq.: 80 (Elementary Differential Equations) or equiv. 3 cred. Polansky.
- 152w-153s.§ **Advanced Calculus with Applications.** Prereq.: 150. 3 cred. per qtr. Koehler.
- 154f.\*§ **Vector Analysis.** Prereq.: 25 (Integral Calculus). 3 cred. Wilcox.
- 155w.\*§ **Vector Analysis and Dyadics with Applications.** Prereq.: 154. 3 cred. Wilcox.
- 156s.\*§ **Elements of Tensor Analysis.** Prereq.: 154. 3 cred. Munro.
- 157f-158w-159s.\*¶ **Methods of Applied Mathematics.** Integrated study of analytic tools commonly used in applications of mathematics with many problems and emphasis on developing technique. Material will include topics from complex variables, matrices, ordinary and partial differential equations, asymptotic expansions, etc. Prereq.: intermediate calculus or permission. 3 cred. per qtr. Gelbaum.

\* This course may be taken to meet a certain requirement for the Master's degree under Plan B. (See the requirements for that degree in another part of this bulletin.) Other courses may be so marked with asterisks for individual students with the consent of their advisers and the instructors who give the courses.

§ This course is given by the Department of Mathematics and Mechanics in the Institute of Technology.

¶ This course is given by the Department of Mathematics in the College of Science, Literature, and the Arts.

- 161f-162w-163s.\*§ **Advanced Technical Mechanics.** Prereq.: 127 or permission. 3 cred. per qtr. Koehler.
- 164f-165w-166s.\*§ **Special Problems and Seminar in Materials Engineering.** Prereq.: 28 and 129 or permission. 3 cred. per qtr. Lazan.
- 168w.§ **Elementary Theory of Complex Variables.** Prereq.: 153. 3 cred. Fulks.
- 169s.§ **Mathematical Theory of Flow.** Prereq.: 168. 3 cred. Doeringsfeld.
- 170f.\*¶ **Algebraic Theory of Linear Spaces and Matrices.** Finite dimensional linear spaces over the real and complex number fields; linear transformations and matrices in such spaces. Introduction to the group and field concepts. Prereq.: 51 (Integral Calculus). 3 cred. Kalisch.
- 171w-172s.\*¶ **Introduction to Modern Algebra.** Prereq.: 170 or permission. 3 cred. per qtr. Kalisch.
- 173f-174w-175s.\*§ **Elementary Partial Differential Equations with Applications.** Prereq.: 80, 153. 3 cred. per qtr. Munro.
- 181f-182w-183s.\*§ **Applied Elasticity.** Prereq.: 128. 3 cred. per qtr. Priester.
- 184f.§ **Elementary Numerical Analysis in Engineering.** Prereq.: 80 (Elementary Differential Equations). 3 cred. Munro.
- 185w-186s.\*§ **Advanced Numerical Analysis in Engineering.** Prereq.: 151, 153, 184. 3 cred. per qtr. Munro.
- 190f-191w-192s.\*§ **Advanced Topics in Industrial Statistics.** Industrial sampling inspection methods, sequential analysis of statistical data, industrial applications of design of experiments. Prereq.: 134 or permission. 3 cred. per qtr. McElrath.
- 193f-194w-195s.\*§ **Theory of Vibrations.** Prereq.: 80 (Elementary Differential Equations), 127, and 152 parallel. 3 cred. per qtr. Young.
- 196f-197w-198s.\*§ **Special Functions in Mathematical Analysis.** Prereq.: 168. 3 cred. per qtr. Fulks.
- 203f-204w-205s.\*¶ **Advanced Mathematical Statistics.** Prereq.: 121-122-123 and either 108 or permission. 3 cred. per qtr. Donsker.
- 206f-207w-208s.\*¶ **Theory of Functions of Real and Complex Variables.** Prereq.: 108 or permission. 3 cred. per qtr. Loud.
- 212w-213s.\*¶ **Point Set Topology.** Prereq.: 206. 3 cred. per qtr. Olmsted.
- 217f-218w-219s.\*§ **Riemannian Geometry.** Prereq.: 153 or equiv. 3 cred. per qtr. Ar.
- 227f-228w-229s.\*§ **Mathematics of Computers and Control Devices.** Prereq.: 186. 3 cred. per qtr. Munro.
- 230f.\*§ **Advanced Tensor Analysis.** Prereq.: 156. 3 cred. Munro.
- 232f-233w-234s.§ **Mechanics of Continuous Media.** Prereq.: 127, 151. 3 cred. per qtr. Turrittin.
- 235f-236w-237s.§ **Advanced Materials Engineering.** Prereq.: 128 and 129 or permission. 3 cred. per qtr. Lazan.
- 245f.\*¶ **Introduction to Lebesgue Integrals.** Prereq.: 208. 4 cred. Cameron.
- 246f.\*¶ **Introduction to Wiener Integrals.** Prereq.: 208, permission. 3 cred. Cameron.
- 247w.\*¶ **Integration in Function Space.** Prereq.: 245, permission. 3 cred. Cameron.
- 248f-249w-250s.\*¶§ **Reading and Research.** Competent students will be assisted in independent reading and reports by members of the department. 1 to 3 cred. per qtr.
- 257s.¶ **Seminar in Integration in Function Space.** Prereq.: 247. 3 cred. Cameron.
- 258f-259w-260s.\*¶ **Theory of Probability.** An integrated development of selected topics in modern probability theory, including recent advances in limit theorems and an introduction to stochastic processes. Prereq.: 245 or parallel. 3 cred. per qtr. Donsker.
- 261f-262w-263s.§ **Functions of a Complex Variable.** Prereq.: 153. 3 cred. per qtr. Warschawski.

\* This course may be taken to meet a certain requirement for the Master's degree under Plan B. (See the requirements for that degree in another part of this bulletin.) Other courses may be so marked with asterisks for individual students with the consent of their advisers and the instructors who give the courses.

§ This course is given by the Department of Mathematics and Mechanics in the Institute of Technology.

¶ This course is given by the Department of Mathematics in the College of Science, Literature, and the Arts.

- 264f-265w-266s.** § Conformal Mapping. Prereq.: 261 or permission. 3 cred. per qtr. Warschawski.
- 267f-268w-269s.\*** § Selected Topics in the Theory of Analytic Functions. Prereq.: 263 or equiv. 3 cred. per qtr. Warschawski.
- 274f-275w-276s.** § Partial Differential and Integral Equations of Applied Mathematics. Prereq.: 151, 153, or permission. 3 cred. per qtr. Warschawski. (Offered in 1953-54.)
- 281f-282w-283s.** § Potential Theory. Prereq.: 80, 153. 3 cred. per qtr. Turrittin.
- 284f-285w-286s.** § Nonlinear Mechanics. Prereq.: 151, 153, and 162 or 193. 3 cred. per qtr. Turrittin.
- 290f-291w-292s.** § Theory of Plates and Shells. Prereq.: 153, 294. 3 cred. per qtr. Young.
- 294f-295w-296s.** § Mathematical Theory of Elasticity. Prereq.: 128, 153. 3 cred. per qtr. Young.
- 297f-298w-299s.** § Mathematical Foundations of Statistical Mechanics. Lagrangian and Hamiltonian equations of motion, ergodic theory, probability concepts and limits, Maxwell-Boltzman law, entropy; applications to thermodynamics. Prereq.: 208. 3 cred. per qtr. Rosenbloom.

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

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|---|--|
| 100-101.¶ Foundations of Geometry         | 176-177.¶ Intermediate Differential Equations                      |
| 102-103.¶ Advanced Analytic Geometry      | 179.¶ Special Functions  |
| 113.¶ Mathematical Recreations            | 187.¶ Non-Euclidean Geometry                                       |
| 114.¶ Mathematics of Small Vibrations     | 214.¶ Topological Algebra  |
| 118.¶ Vector Analysis                     | 221.¶ Calculus of Variations                                       |
| 119-120.¶ Matrices and Groups             | 239-240.¶ Fourier Transforms                                       |
| 125.¶ Theory of Geometrical Constructions | 252-253.¶ Linear Spaces  |
| 126.¶ Calculus of Finite Differences      | 271-272-273.¶ Theory of Linear Differential and Integral Equations |
| 131.¶ Advanced Algebraic Theory           | 277-278-279.¶ Partial Differential Equations of the First Order    |
| 137.¶ Advanced Theory of Equations        | 287-288-289.¶ Banach Spaces and Functional Analysis                |
| 139.¶ Limits and Series                   |  |
| 140.¶ Projective Geometry                 |  |
| 160.¶ Numerical Methods in Computation    |  |

#### DRAWING AND DESCRIPTIVE GEOMETRY

- 111f-112w-113s.** § Advanced Descriptive Geometry. Prereq.: Draw. 3, M.&M. 25. 3 cred. per qtr. Ar.
- 115f-116w-117s.** § Curve Fitting. Prereq.: Draw. 3, M.&M. 25. 3 cred. per qtr. Eggers.
- 118f,w.s.** § Short Course in Curve Fitting. Prereq.: Draw. 3, M.&M. 25. 3 cred. Eggers.
- 152f,w.s-153w-154s.** § Nomography. Prereq.: Draw. 52, M.&M. 25. 3 cred. per qtr. Eggers.
- 157f-158w-159s.** § Graphical Mathematics. Prereq.: Draw. 3, M.&M. 26. 2 cred. per qtr. Eggers.

#### MECHANICAL ENGINEERING

Professors Richard C. Jordan, Axel B. Algren, Ernst R. G. Eckert, Newman A. Hall, Emory N. Kemler, James J. Ryan, Robert E. Summers, Lee S. Whitson, Dana Young; Associate Professors Fulton Holtby, Millard H. LaJoy, Thomas E. Murphy, Lloyd B. Ritchey; Assistant Professors John W. Andeen, Adolph O. Lee, John M. MacKenzie.

§ This course is given by the Department of Mathematics and Mechanics in the Institute of Technology.

¶ This course is given by the Department of Mathematics in the College of Science, Literature, and the Arts.

**Prerequisites**—For major work, adequate preparation in the sciences fundamental to mechanical engineering (chemistry, physics, mathematics and mechanics, technical subjects) and the general admission requirements. For minor work, the prerequisites to the courses to be pursued.

**Language Requirement**—For the M.S. degree none. For the Ph.D. degree reading knowledge of French and German. (Substitution of other languages such as Spanish or Russian or in special cases of a research technique may be permitted.)

**Master's Degree**—The M.S. degree is offered either under Plan A or Plan B. The major and the minor work may be taken in two separate divisions of the Mechanical Engineering Department under Plan A.

**Doctor's Degree**—The department offers work leading to the Ph.D. degree.

(Professional degrees in engineering—These degrees are administered by the Institute of Technology.)

## Courses

### MILLING ENGINEERING

- 100-101-102. Milling I, II, III.** Mechanical technology of wheat milling and related processing industries. Applications of thermodynamics, small particle dynamics, and aerodynamics. Prereq.: Hydr. 103 or equiv., 23, 132. 3 cred. per qtr. MacKenzie.
- 103-104. Milling Laboratory I and II.** I: Experimental milling procedures and laboratory exercises demonstrating the thermodynamics and other physical principles involved. II: Study of power requirements and operating characteristics of full scale milling equipment. Prereq.: 35, 100 or parallel. 2 cred. per qtr. MacKenzie.
- 105-106. Milling Design I and II.** Applications of fundamentals of thermodynamics, aerodynamics, and industrial engineering in the design of milling equipment and mill layout. Prereq.: 100, 121; for Milling Design II, 104, 105. 2 cred. per qtr. MacKenzie.

### INDUSTRIAL LABORATORIES

- 110. Foundry Control Methods.** X-ray analysis of castings. Laboratory practice in metals analysis, ferrous and nonferrous melting operations and control. Problems and reports. Prereq.: 12, Chem. 5, Phys. 9. 3 cred. Holtby.
- 111. Advanced Foundry Practice.** Prereq.: 110. 3 cred. Holtby.
- 112. Plastics Processing.** Materials, equipment, and processes for plastics fabrication. Design of plastics products and molds; testing of materials. Prereq.: 14. 3 cred. Holtby.
- 113. Advanced Machine Shop Practice.** Selection, tooling, and set-up of machine tools; specification of operations for production of complete units. Prereq.: 14. 3 cred. Crowder.
- 114. Advanced Welding.** Theory and applications of welding processes; factors affecting weldability. Fundamental considerations in the design of weldments. Prereq.: 13. 3 cred. Hughes.
- 115. Control of Manufacturing Standards.** Precision measurement techniques; design of special gauges and fixtures for rapid measurement of interchangeable parts. Operation of the standards laboratory for calibration of measuring instruments and inspection of tools, jigs, and fixtures. Prereq.: 14. 3 cred. Crowder.
- 118. Advanced Processing Technology.** Measurement and control of processing variables; effect on material properties and production costs. Processing considerations in product designs and specifications. Prereq.: 12, 13, 14, 24, M.&M. 141. 3 cred. Severson.
- 170. Tool Design.** Analysis of manufacturing requirements and design of special tools, jigs, and fixtures for mass production of interchangeable parts. Prereq.: 14, 24. 3 cred. Crowder.

## INSTRUMENTATION

- 198. Industrial Instrumentation and Automatic Control.** General characteristics of measuring, indicating, integrating, and recording mechanisms. The measuring means, type of controller mechanism, final control device, and the process. 3 cred. LaJoy.
- 199. Servomechanisms.** Discussion of elementary control systems and basic servomechanisms. Mechanical and electrical error indicators. Theory and analysis of servomechanisms with various types of damping. Methods of obtaining desired system characteristics. Prereq.: M.&M. 80, E.E. 37, or parallel. 3 cred. LaJoy.
- 298.\* Advanced Instrumentation and Automatic Control.** Controller characteristics under simulated process conditions; effect of process time constants; methods of controller calibration; analysis of single and multi-capacity systems. Prereq.: 198. 3 cred. LaJoy.

## MACHINE DESIGN

- 120. Advanced Engineering Design Drafting.** Design, layout, and development of a complete machine. Specifications, assembly and detail drafting; emphasis on design modifications and improvements. Prereq.: 20, 24. 2 cred. Palmer.
- 121. Machine Design.** Advanced machine elements. Force and shrink fits, brakes and clutches, lubrication theory and practice, gear design, flywheel. Design practice and machine layout. Prereq.: 24. 2 cred. Ryan.
- 122. Mechanical Engineering Design I.** Advanced statics, dynamics and stress analysis applied to machines. Mathematics of elevator design, statically indeterminate structures, theory and application of vibration in machines, study of gyroscopes. Special design problems. Prereq.: 121. 3 cred. Ryan.
- 123. Mechanical Engineering Design II.** Application of fundamentals of engineering design to individually selected machines. Conception, functional analysis, design calculations, layout drawings, and specifications. Prereq.: 121. 3 cred. Ryan.
- 124. Experimental Stress Analysis.** Experimental application and theoretical evaluation of the methods of stress analysis. Strain gauges, surface coatings, photoelasticity, dynamic stress measurements, penetration methods, and fracture methods. Prereq.: M.&M. 128. 3 cred. Ryan.
- 125. Machine Design Laboratory.** Experimental studies of fundamental vibration models, lateral and torsional vibrations of shafting, balancing machines, noise measurements on machinery. Use of vibration instruments, stroboscopes, sound meters and analyzers, photoelastic polariscope, 8-inch journal-bearing testing machine, electronic measuring devices. Prereq.: 24. 2 cred. Ryan.
- 127. Lubrication.** Fluid friction and viscosity, properties of lubricants, hydrodynamic theory of lubrication, dimensional analysis, full, partial and fitted bearings, oil thickness, pressure and velocity distributions, design and construction, laboratory tests on 8-inch journal bearings. Prereq.: 121. 3 cred. Ryan.
- 128. Photoelastic Stress Analysis.** Fundamentals of advanced stress analysis; equations of equilibrium, optics of polarized light, design and construction of polariscopes and models. Use of polariscope in solution of special design problems, photography and equipment. Prereq.: M.&M. 128. 3 cred. Ryan.
- 129. Vibration Engineering.** Fundamental analysis of vibrations, critical speeds, effects of damping, vibration absorption and isolation, measuring instruments. Prereq.: M.&M. 127. 3 cred. Kemler.
- 221.\* Advanced Mechanical Engineering Design.** Applications of the fundamentals of elasticity in the solution of design problems. Tension and compression; torsion; stresses and deflections in beams and shafts; statically indeterminate problems in bending of beams, shafts, frames. Prereq.: 121. 3 cred. Young.
- 222.\* Applications of Elasticity in Mechanical Design.** Applications of strain-energy methods in the analysis of design problems. Bending of bars on elastic foundations; reinforced tubes and cylinders. Stress concentration. Study of mechanical properties of materials, theories of failure and material testing. Prereq.: 121. 3 cred. Young.

- 223.\* Advanced Mathematical Theory in Mechanical Design.** Two-dimensional problems in theory of elasticity. Bending stresses and deflections in curved bars, thick cylinders, and rotating discs. Concentrated and distributed forces on beams, thin plates, and shells. Combined bending and twist. Stresses produced by dynamical causes. Prereq.: 121. 3 cred. Young.
- 224-225-226.\* Advanced Applied Dynamics.** Application of principles of dynamics to selected problems such as governors, reciprocating engine mechanisms, mechanical servo systems, gyroscopes, performance of trains, impact and dynamic stresses in machines. Prereq.: 129. 3 cred. per qtr. Young.
- 228. Photoelasticity.** Advanced studies in stress analysis by photoelasticity. Methods of determining principal stresses from measurements. Studies of stress patterns. Investigation of material constants and behavior. Frozen stresses. Solution of individual problems. Prereq.: 128. 3 cred. Ryan.
- 229.\* Advanced Vibration Engineering.** Advanced dynamics of vibration, Lagrange equations, vibration in mechanical, electrical, and equivalent systems. Model analysis, vibration of bars, rings, plates, etc. Vibration tests and analysis with instruments. Design problems. Prereq.: 129. 3 cred. Kemler.

## THERMODYNAMICS

- 131-132. Thermodynamics.** Thermodynamic properties of gases and vapors and the fundamental laws correlating energy with heat and work in systems such as air compressors, internal combustion engines, gas turbines, steam engines and steam turbines, refrigerators, heat pumps, etc. Prereq.: M.&M. 25, Phys. 8. 3 cred. per qtr. Hall.
- 133. Heat Transmission.** Introduction theory and principal empirical rules for problems in conduction, forced and free convection, and radiation. Emphasis on obtaining facility in the use of established empirical correlations. Prereq.: 132. 3 cred. Eckert.
- 134. Thermodynamics of Fluid Flow.** Fundamental thermodynamic procedures for the energy analysis of the flow of viscous and compressible fluids. Applications to flow systems such as ducts, diffusors, nozzles, ejectors, orifice plates, combustion chambers, heat exchangers, etc. Compressible flow phenomena occurring in mechanical engineering equipment. Flow of gases with suspended particles. Prereq.: 132 or Phys. 73. 3 cred. Hall.
- 135. Turbomachinery.** Principles of turbomachinery as derived from fluid dynamics and thermodynamics. Application of principles to gas turbines, steam turbines, axial and centrifugal compressors and pumps, fluid couplings and torque converters. Prereq.: 132. 3 cred. Lee.
- 231. Advanced Thermodynamics.** Review of basic concepts and laws. Equations of state and thermodynamic properties of gas, vapors, and mixtures. Thermodynamic functions and their differential relations. Analysis of thermodynamic cycles with critical examination of concepts of efficiency, availability, and other loss measurements. Thermodynamic equilibrium, supersaturation and supercooling, combustion. Prereq.: 132. 3 cred. Hall.
- 232. Advanced Fluid Thermodynamics.** Application of thermodynamics to non-equilibrium processes and systems with particular reference to energy transformations involving viscosity, thermal conductivity and diffusion under the influence of mechanical, thermal and chemical potentials. Interpretations for mechanical and process operations and equipment. Prereq.: 231, M.&M. 153, or permission. 3 cred. Hall. (Offered when demand warrants.)
- 233-234-235. Advanced Heat Transmission—Conduction, Convection, Radiation.** Conduction: Heat conductivity theory and measurement. Fourier's equation. Steady and unsteady state solutions without and with heat sources, including phase changes. Applications. Numerical methods and analogues. The regenerator. Convection: Review of fluid dynamics, concept of boundary layer and turbulence. Forced and free convection in laminar and turbulent flow. Condensation and evaporation. Mass transfer. Radiation: Black body radiation. Radiation of electric conductors and nonconductors, of gases and flames. Pyrometry. Heat exchange by radiation. Applications in engineering. Prereq.: 133, M.&M. 153, or permission. 3 cred. per qtr. Eckert.

## STEAM POWER

- 138. General Laboratory.** (For mining engineering students only.) (a) Calibration of pressure gauges. Steam calorimetry. Steam indicator practice, card calculation. Test of oils, engines, turbines, air compressors, and pumps. (b) The use of weirs, differential gauges, etc., in the tests of centrifugal pumps, hydraulic turbines, etc. Prereq.: Min.E. 122. 2 cred. Ar.
- 141. Heat Power Engineering.** Fuels and combustion. Heat transfer in engineering equipment. Thermodynamics and equipment of simple power plants. Industrial water treatment. Units of rating and efficiency in steam generators and prime movers. Problems from fundamental steam engineering. Prereq.: 132. 3 cred. Lee.
- 142. Advanced Heat Power Engineering.** Practice and economics relating to steam generators, prime movers, and plant auxiliaries. Specialized power plant cycles. Plant controls. Trends in power development. Prereq.: 141. 3 cred. Andeen.
- 146. Fuels and Combustion.** Fuels classification and analysis, stoichiometry, rates, combustion processes, combustion equipment and controls. Prereq.: 141. 3 cred. Andeen.
- 147. Design of Steam Machinery.** Steam generating station layout. General design of all component parts. Prereq.: 141. 3 cred. Andeen.
- 148. Design of Power Plant Units.** Steam generating station heat balance. Detail design of some component part—boiler, economizer, superheater, condenser, etc. Prereq.: 147. 3 cred. Andeen.
- 149. Advanced Steam Laboratory.** Tests of steam engines, steam turbines, evaporators, air compressors, and multiple turbo-generators units simulating actual power plant conditions. Prereq.: 141, 35. 2 cred. Andeen.
- 242.\* Power Plant Specification.** Estimating of initial installation, maintenance and depreciation costs of power plant components, and their effect on selection of units. Specification of units and components. Prereq.: 148. 2 cred. Ar.
- 243.\* Power Plant Layout.** Power plant layout and selection of most economical fuel components for location and type of service. Prereq.: 242. 2 cred. Ar.
- 244.\* Power Plant Management.** Maintenance and operating schedules. Records on performance. Operating problems. Load curves and efficient operation of plants. Prereq.: 142. 3 cred. Ar.

## INTERNAL COMBUSTION ENGINES

- 150. Internal Combustion Engines.** Thermodynamics and combustion processes of real gas and vapors in Otto, Diesel, and compression-ignition engines; volatile fuels, mixtures of real gases and vapors; cylinder pressures, flame temperature, combustion phenomena; heat losses, real cycle efficiencies. Prereq.: 132. 4 cred. Murphy.
- 150A. Internal Combustion Engines.** (Aero.E.) Thermodynamics and combustion processes of real gases and vapors—Otto, Diesel, and Brayton cycle engines; volatile fuels; mixtures of real gases and vapors; explosion pressures, flow temperatures, and combustion phenomena; heat losses, real cycle efficiencies. Prereq.: 132. 4 cred. Murphy.
- 151. Advanced Internal Combustion Engines.** Special reference to automobile, truck, and airplane engines. Theoretical consideration of fuels, combustion, detonation, lubrication, supercharging, carburetion, and fuel injection. Recent developments in automotive and airplane engines. Prereq.: 150. 3 cred. Murphy.
- 151A. Advanced Internal Combustion Engines.** (Aero.E.) Special reference to aircraft engines. Theoretical consideration of fuels, combustion, detonation, lubrication, superchargers, and induction systems. Recent developments in airplane engines. Prereq.: 150A or 150. 2 cred. Murphy.
- 152. Diesel Engines.** Advanced course in the theory, design, operation, and economics of the Diesel engine with emphasis on high-speed combustion and injection systems. Prereq.: 150. 3 cred. Staff.

- 153. Engine Service Management.** Instruments and methods used in servicing or reconditioning automobile and airplane engines. Causes of mechanical failure and wear. Permissible tolerance in worn parts. Lubrication and ignition service. Prereq.: 150. 3 cred. Staff.
- 154-155. Design of Internal Combustion Engines.** Detailed study of design of automotive and stationary engines. Problems, including calculation of bearing loads, stresses in moving parts, and valve mechanisms. Prereq.: 121, 150. 3 cred. per qtr. Murphy.
- 154A. Design of Airplane Engines.** Designs of radial and in-line aircraft engines. Drawing room problems, including graphical and analytical calculations of stresses in moving parts. Combined polar diagrams of bearing loads, etc. Prereq.: 150A. 2 cred. Murphy.
- 156. High Speed Engine Testing.** Advanced laboratory procedure and instrumentation. Effect of fuel mixture, distribution, etc., upon general engine performance. Prereq.: 158 or 159. 2 cred. Murphy.
- 157. Gas Turbine and Jet Propulsion Power Plants.** Gas turbine cycles and principles; calculations on reheaters, regenerators, intercoolers, closed and open systems, characteristics of compressors and turbines; power and efficiency calculations; combustion performance characteristics with propeller and jets. Prereq.: 150 or 150A. 3 cred. Murphy.
- 158. Aero Engine Testing.** Use of modern instruments for testing gasoline, Diesel, and aircraft engines. Use of dynamometers and torque stands in determining engine performance. Prereq.: 150A or parallel. 2 cred. Murphy.
- 159. Internal Combustion Engine Laboratory.** Tests of gasoline, aircraft, and Diesel engines. Power plant units, automotive engines, aircraft engines. Prereq.: 150 or parallel. 2 cred. Murphy.
- 250.\* Dynamics of High Speed Engines.** Advanced study of inertia forces; balancing high speed multi-cylinder engines; engine torque analysis; torsional vibration, etc. Conferences, assigned readings, and problems. Prereq.: 121, 150. 3 cred. Murphy.
- 252. Advanced Reciprocating Engines.** Reciprocating engines for aircraft and other power applications with regard to problems of performance at sea level and at altitude as affected by airflow, fuel-air ratio, mixture temperature, manifold pressure, spark timing and related factors. Prereq.: 151 or 151A. 3 cred. Murphy.
- 253. Advanced Gas Turbines.** Study of gas turbines for aircraft and other power applications with regard to problems of performance, control, basic design analysis of diffusers, nozzles, axial and centrifugal compressors and turbines; cooling, lubrication, and construction. Prereq.: 157. 3 cred. Hall, Murphy.
- 255. Thermal Jets and Rockets.** Particular regard to the problems of design and calculations of the performance of ram jets, pulse jets as affected by altitude, flight velocity, and combustion phenomena; problems of design and calculation of the performance of solid fuel and liquid fuel rockets as affected by the energy of combustion, required weights of fuel delivery, cooling of combustion chamber, etc. Prereq.: 157, 134. 3 cred. Hall, Eckert.
- 256.\* Engine Testing and Research.** Problems involving volumetric efficiency, manifolding, friction losses, oil deterioration, cylinder corrosion, and other engine performance factors of current interest. Prereq.: 158A or 159. Cred. ar. Murphy.
- 257.\* Combustion and Fuels for Internal Combustion Engines.** Characteristics of petroleum fuels and manufacturing processes. Combustion processes, tests, and specifications for several types of engines and propulsion systems. Heat of formation, heating valve, equilibrium in combustion, flame temperatures, and mechanism of combustion. Prereq.: 150, 157. 3 cred. Hall. (Offered when demand warrants.)

#### HEATING, VENTILATING, AND AIR CONDITIONING

- 160. Heating and Ventilation.** Principles of heating, ventilation, and air conditioning. Warm air, steam, hot water, vapor, vacuum, and fan systems of heating; pipe systems, heat regulation. Ventilation and air conditioning, central station heating. Prereq.: 132, M.&M. 127, 129. 3 cred. Algren.

- 161-162. Heating, Ventilation, and Air Conditioning Design.** Calculation of heating and cooling loads; selection and arrangement of equipment; design of complete heating, ventilation, and air conditioning systems for various types of buildings. Prereq.: 160. 3 cred. per qtr. Algren.
- 165. Advanced Heating, Ventilation, and Air Conditioning.** Requirements for comfort, health, and industrial processes. Thermodynamics of air vapor mixtures. Heating, cooling, humidification, dehumidification. Atmospheric impurities, sources, classifications, methods of elimination. Air supply and distribution. Methods of control and application. Prereq.: 160. 3 cred. Algren.
- 169. Heating and Ventilation Laboratory.** Tests of heating, ventilation, and air conditioning equipment. The determination of air qualities as required for comfort and for specific industries. Tests and studies of complete installation. Prereq.: 35, 160 or 160 parallel. 2 cred. Algren.
- 265.\* Advanced Air Conditioning.** Advanced study of the thermodynamics of air and water vapor mixtures, objective of heating or cooling and the physiological principles involved, solar transmission, solar radiation, cooling loads, humidification, and dehumidification. Prereq.: 160. 3 cred. Algren.
- 266.\* Advanced Ventilation and Air Distribution.** Physiological principles as applied to ventilation, ventilation systems, exhausting and conveying systems, mechanics of air distribution, air duct design; a study of fans, their classification, performance, and characteristic curves; sound control, air pollution and air cleaning devices. Prereq.: 160, 265 or permission. 3 cred. Algren.
- 267.\* Applied Heating, Ventilation, and Air Conditioning.** Practical problems of radiant heating from a physiological standpoint, fundamental computation and application methods, district heating, heating equipment, automatic fuel-burning equipment, and assigned field studies. Prereq.: 160 or permission. 3 cred. Algren.

## REFRIGERATION

- 180. Refrigeration.** Refrigeration cycles; thermodynamics of refrigeration; refrigerants; load calculations; compression, steam jet, and absorption refrigeration; refrigeration equipment. Prereq.: 132, 160 or 160 parallel. 3 cred. Algren.
- 181. Advanced Refrigeration.** Fluid flow and heat transmission applied to refrigeration; condensers and evaporators; refrigeration piping; refrigeration controls; low temperature refrigeration; refrigeration applications. Prereq.: 180. 3 cred. Algren.
- 182. Refrigeration Design.** Calculation of refrigeration loads; selection of compressors, evaporators, condensers, piping sizes, and control; design of refrigeration systems for various types of building. Prereq.: 180. 3 cred. Algren.
- 189. Refrigeration Laboratory.** Tests of reciprocating, rotary, absorption, and steam jet refrigeration equipment. Study of refrigeration controls, dry and flooded evaporators, operating characteristics of condensing units. Prereq.: 180 or parallel. 2 cred. Algren.
- 280.\* Theoretical Refrigeration.** Advanced study dealing with problems involving the theory and design of refrigeration systems. Lect., assigned reading, and reports. Prereq.: 180. 3 cred. Jordan.
- 281.\* Applied Refrigeration.** Advanced study involving the applications of refrigeration systems to commercial and industrial equipment and processing. Lect., assigned reading, reports. Prereq.: 180. 3 cred. Jordan.
- 282.\* Reverse Applications of Refrigeration—the Heat Pump.** Industrial, commercial, and residential applications of refrigeration systems as heat pumps. Lect., assigned reading, reports. Prereq.: 180. 3 cred. Jordan.

## GENERAL

- 190-191-192. Seminar.** Reading of assigned articles in current technical press. Classroom presentation of principal features of assigned articles. 1 cred. per qtr. Staff.

- 196. Inventions and Patents.** Problems associated with inventions, their patenting, development, evaluation, and exploitation. Prereq.: 121 or permission. 3 cred. Kemler.
- 290-291-292.\* Mechanical Engineering Research.** Investigations in connection with lubrication, fuels, furnaces, boilers, steam engines, turbines, gas engines, heating and ventilation, industrial, and other engineering problems. Prereq.: permission of the division chief in charge of work. Cred. ar. Staff.
- 293. Graduate Seminar.** Colloquy for graduate students and staff. Reports and discussion by members on research or specific problems to be assigned. Recommended for graduate students and junior staff members. No cred. Staff.

#### INDUSTRIAL ENGINEERING

Advanced degrees with a specialization in industrial engineering are available to students with the Bachelor's degree in this field and to graduates of other engineering curricula 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 head of the division regarding their individual programs and requirements.

#### Courses

- I.E.150. Elements of Industrial Engineering and Management.** Background of modern industry; management and administrative functions; industrial organization. Production engineering; industrial plants; planning and control of manufacturing operations; cost relationships. Prereq.: M.E. 14 or permission. 3 cred. Block.
- I.E.153. Methods Engineering and Work Measurement.** Analysis and development of effective production processes and methods; motion study principles and applications. Job standardization, work measurement, production standards, wage incentives. Prereq.: 150. 3 cred. MacKenzie.
- I.E.154. Advanced Methods Engineering and Work Measurement.** Advanced process and methods analysis; group and multiple-machine operations, line production, mechanization. Advanced work measurement techniques and cost control applications. Prereq.: 153. 3 cred. MacKenzie.
- I.E.165. Industrial Plants.** Analysis of the over-all manufacturing process and materials flow; determination of equipment and space requirements; layout of production and service departments. Design and specification of plant buildings, service facilities, and materials handling equipment. Economic considerations. Prereq.: 153. 3 cred. Whitson.
- I.E.167. Materials Handling and Packaging.** Technical and economic considerations in the selection and application of materials handling equipment; development of integrated handling and storage systems. Industrial packaging techniques and equipment. Prereq.: 165 or M.E. 105. 3 cred. MacKenzie.
- I.E.170. Production Planning and Control.** Coordination of production and sales; determination of plant equipment, personnel, and materials requirements. Long-range and immediate planning; routing, scheduling, and follow-up of production. Standardization, economic lot sizes, inventory policies and control. Prereq.: 153. 3 cred. Whitson.
- I.E.171. Quality Control.** Quality requirements and their effect on production and costs. Quality standards, inspection, interpretation of results, and corrective action. Application of statistical methods and sampling theory. Prereq.: 150, M.&M. 90 or equiv. 3 cred. Block.
- I.E.172. Elements of Quality Control.** Similar to 171, except no previous course in statistics is required. Prereq.: 150. 3 cred. Block.

- I.E.173. Engineering Economic Analysis.** Analysis of capital expenditures and annual operating costs as the basis for management decisions on equipment installations, plant expansions, and plant locations. Prereq.: 165, B.A. 66. 3 cred. Whitson.
- I.E.180. Elements of Supervision.** Supervisory functions and relations with employees, other supervisors, staff departments, and management. Work assignments, motivation, discipline, grievances. Interpretation and application of company policies. Prereq.: 150. 3 cred. MacKenzie.
- I.E.181. Industrial Relations.** Labor-management relations and their effect on plant operations and industrial engineering functions; collective bargaining; labor laws. Employee selection and training, job evaluation, wage and salary administration, employee attitudes. Prereq.: 150. 3 cred. Block.
- I.E.182. Industrial Safety and Hygiene.** Major industrial hazards; preventive and remedial measures. Safety requirements for production processes, equipment, and plants. Management, technical, and legal aspects; organization and administration of safety and hygiene programs. Prereq.: 150. 3 cred. Block.
- I.E.190-191-192. Industrial Engineering Seminar.** Current developments in industrial engineering and management. Reading of assigned articles, classroom presentation and discussion. 1 cred. per qtr. Staff.
- I.E.194-195-196. Applied Production Engineering and Management.** Cost reduction surveys and reports; analysis and correction of manufacturing difficulties; major revisions of existing operations and plants. Establishment of new manufacturing plants or departments; getting new products into production. Problems from local industrial plants. Prereq.: 18 cred. in I.E. or permission. 3 cred. per qtr. Whitson.
- I.E.251-252-253.\* Advanced Industrial Engineering and Management.** Advanced studies in selected fields of industrial engineering and management. Problems in manufacturing policy, production engineering, and plant operation. Management engineering surveys and reports; long-range industrial planning and development. Industrial engineering organization and administration. Prereq.: permission. 3 cred. per qtr. Whitson.
- I.E.261-262-263.\* Production Engineering Problems.** Application of industrial engineering principles to the solution of industrial problems. Development of manufacturing processes and methods, special production equipment, and plant layouts. Establishment of suitable controls over production, costs, quality, and other factors. Prereq.: permission. 3 to 5 cred. per qtr. Whitson.
- I.E.271-272-273.\* Industrial Engineering Research.** Special investigations and research studies in selected areas of industrial engineering, production, and management. Work of thesis quality but lesser scope. Prereq.: permission. 3 to 5 cred. per qtr. Whitson.

## MEDICAL SOCIAL WORK

For statement of prerequisites and of graduate courses and staff, see Social Work and Sociology, pages 187 and 191.

## MEDICINE

(Including Divisions of Internal Medicine, Dermatology and Syphilology, and Clinical Laboratory Medicine)

The graduate work in the Department of Medicine is designed to offer opportunities for gifted men and women to prepare themselves for the practice of internal medicine or any of its subdivisions as a specialty, and aims to guide its fellows in research in these fields and to give them a start in university teaching. Prospective fellows who have had no special orientation in addition to that of the ordinary undergraduate courses will profit greatly from some special work. While any of the

preclinical subjects might be of value, physiology, biochemistry, pharmacology, bacteriology, and pathology at the present are of the greatest importance. Work in any of these subjects might be further continued during the major studies in medicine to meet the requirements for a minor subject. In dermatology, first-year fellows are residents at the Minneapolis General Hospital; the last two years are outlined by arrangement.

For staff and courses of study offered, see the *Graduate Medical Bulletin*.

## METALLOGRAPHY

Professor Ralph L. Dowdell; Associate Professor Henry S. Jerabek; Instructor William B. F. Mackay.

**Prerequisites**—For major work, adequate preparation in the sciences and general engineering subjects fundamental to metallography.

**Language Requirement**—For the Master's degree either German or French. Exemption from this requirement may be made in exceptional cases by petition. For the Ph.D. degree either (a) two foreign languages (German, French, or Russian) or (b) one of these languages and the option of a special research technique.

**Master's Degree**—Offered only under Plan A.

**Doctor's degree**—The division offers work leading to the Ph.D. degree.

### Courses

- 153f-154w-155s. Metallography.** (Long course for metallurgical engineers.) Theory and properties of metals and alloys. Lab. Prereq.: 12 or equiv. 4 cred. per qtr. Jerabek.
- 156f. Metallography for Mechanical, Mining, and Petroleum Engineers.** Survey course of theory and practice of metals and alloys. 3 cred. Dowdell.
- 157w. Advanced Metallography for Mechanical, Mining, and Petroleum Engineers.** Metallography of alloy steels and important nonferrous alloys. Lab. Prereq.: 156 or 160. 3 cred. Mackay.
- 160f.w.s. Metallography (Ch.E.).** Survey course of theory and practice of metals and alloys. Lab. 3 cred. Jerabek.
- 161w. Advanced Metallography (Ch.E.).** Metallography and heat treatment of iron and steel, including alloy steel. Two lect., three lab. hours per week. Prereq.: 156 or 160. 2 or 3 cred. depending on lab. Jerabek.
- 162s. Advanced Metallography (Ch.E.).** Metallography of the nonferrous metals with a study of the constitution diagrams, properties, and uses of important commercial alloys. Two lect., three lab. hours per week. Prereq.: 156 or 160. 2 or 3 cred. depending on lab. Jerabek.
- 163f. Advanced Metallography.** Recent advances in metallography. Lect., rec., reading, and reports. Prereq.: 6 cred. in metallography. 3 cred. Dowdell.
- 164w. Advanced Metallography.** Advanced consideration of the structures, properties, and uses of metals and alloys. Prereq.: 6 cred. in metallography. 3 cred. Dowdell.
- 165s. Advanced Metallography.** Technical metallography as applied to industry. Lect., reports. Prereq.: 6 cred. in metallography. 3 cred. Dowdell.
- 166f-167w-168s. Laboratory.** Problems in ferrous, nonferrous, and X-ray metallography. Prereq.: 155. 1 to 3 cred. per qtr. Dowdell, Jerabek.
- 170f-171w-172s. Special Problems in Metallography.** 1 to 3 cred. Dowdell, Jerabek.
- 201f-202w-203s. Advanced Metallography.** Research work. Cred. ar. Dowdell, Jerabek, Mackay.

- 204f-205w-206s. Metallographic Research.** Research problems and seminar. Cred. ar. Dowdell, Jerabek, Mackay.  
**210f-211w-212s. Thesis Courses.** Research work. Cred. and hours ar. Dowdell, Jerabek, Mackay.

## METALLURGY

Professors Thomas L. Joseph, Strathmore R. B. Cooke, Edward W. Davis; Assistant Professors Allan E. Martin, Gust Bitsianes.

**Prerequisites**—Elements of physics and chemistry.

**Language Requirement**—For the Master's degree either German or French. Exemption may be made in exceptional cases by petition. For the Ph.D. degree either (a) two foreign languages (German, French, or Russian) or (b) one of these languages and the option of a special research technique.

**Master's Degree**—Offered only under Plan A.

**Doctor's Degree**—The division offers work leading to the Ph.D. degree.

### Courses

- 106f. Nonferrous Metallurgy.** Principles involved in the metallurgy of copper including roasting, smelting, and refining. 3 lect. hours per week. Prereq.: general inorg. chem. 3 cred. Bitsianes.
- 107w. Nonferrous Metallurgy.** Principles underlying the recovery and refining of lead and zinc. 3 lect. hours per week. Prereq.: 106. 3 cred. Bitsianes.
- 108s. Nonferrous Metallurgy.** Principles underlying the metallurgy of the lighter metals, the ferroalloy metals, and the precious metals. 3 lect. hours per week. Prereq.: 107. 3 cred. Bitsianes.
- 110f. Mineral Dressing.** Comminution and sizing. 2 lect., 3 lab. hours per week. Prereq.: Geol. 24. 3 cred. Cooke.
- 111w. Mineral Dressing.** Classification and gravity concentration. 2 lect., 3 lab. hours per week. Prereq.: 110. 3 cred. Cooke.
- 112s. Mineral Dressing.** Principles and practice of mineral flotation. Miscellaneous processes. 2 lect., 3 lab. hours per week. Prereq.: 111. 3 cred. Cooke.
- 121f. Ore Testing (Iron Ores).** Methods of beneficiation, principles, methods and machines, concentration, formulas, metallurgical and economic considerations. 1 lect., 3 lab. hours per week. Prereq.: 110. 2 cred. Davis.
- 122w. Advanced Mineral Dressing.** Application of mineral dressing techniques to specific problems. 2 lect., 1 rec. hour per week. Prereq.: 112. 3 cred. Cooke.
- 123s. Advanced Mineral Dressing.** Consideration of factors affecting extraction. 2 lect., 1 rec. hour per week. Prereq.: 122. 3 cred. Cooke.
- 124f-125w-126s. Problems in Mineral Dressing.** Detailed study of mineral dressing problems. Prereq.: 112. Cred., hours ar. Cooke.
- 130f-131w-132s. Problems in Nonferrous Metallurgy.** Seminar work on metallurgical problems. Prereq.: 108. Cred., hours ar. Joseph, Martin, Bitsianes.
- 133w. Electrometallurgy.** Arc, induction, and resistance furnaces used in the metallurgical industry. 3 lect. hours per week. Prereq.: 12. 3 cred. Martin.
- 134f. Advanced Metallurgy.** Refractories. Manufacture, properties and use. 3 lect. per week. Prereq.: 12. 3 cred. Martin.
- 135w. Advanced Metallurgy.** Chemistry of the blast furnace process. Slag-metal and gas-solid reactions. Economics and size preparation of raw materials. 3 lect. per week. Prereq.: 134. 3 cred. Joseph.
- 136s. Advanced Metallurgy.** Detailed study of the physical chemistry of basic open hearth steelmaking. 3 lect. per week. Prereq.: 135. 3 cred. Martin.
- 140f. Advanced Ore Testing (Iron Ores).** Metallurgical calculations and report writing. Prereq.: 121. 2 cred. Davis.

- 141f-142w-143s. **Research Problems in the Production of Iron and Steel.** Cred., hours ar. Joseph, Martin, Bitsianes.
- 213f-214w-215s. **Thesis Course for Graduate Students.** Research work. Cred., hours ar. Joseph, Cooke, Martin, Bitsianes.
- 219f-220w-221s. **Research Problems in Advanced Metallurgy.** Cred., hours ar. Joseph, Martin, Bitsianes.

### MINING AND PETROLEUM ENGINEERING

Professor Louis S. Heilig; Associate Professor Eugene P. Pfeider; Assistant Professors Washington D. Lacabanne, Donald H. Yardley.

**Prerequisites**—For major work, the Bachelor's degree in mining or petroleum engineering, or its equivalent. If the student cannot meet this requirement, he may become eligible by taking courses prescribed by his adviser.

**Language Requirement**—Exemption from the requirement may be made in individual cases by petition.

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

#### Courses

##### MINING

(For complete course description see *Bulletin of the Institute of Technology.*)

- 111f-112w-113s. **Elements of Mining.** Fundamentals of mining, embracing the exploration, development, and exploitation of mineral deposits. Prereq.: Geol. 25. 3 cred. per qtr. Pfeider, Yardley.
- 121w-122s-123f. **Mine Plant.** Application of basic mathematics and physics to mining and petroleum plant. Principles and design of equipment. Prereq.: M.&M. 129, M.E. 131. 3 cred. per qtr. Hartman.
139. **Mining Field Trip.** Study of mining operation, mine plant and metallurgical plants in several mining camps. Three weeks beginning about September 1. 6 cred. Pfeider, Yardley.
- 141f. **Examination and Valuation.** Mine examinations and reports; mining economics, taxation, capitalization, and amortization. Organization and administration. Prereq.: 113. 3 cred. Pfeider.
- 142w. **Surface Mining.** Excavation by shovels and draglines, handling materials by railroad, trucks, and conveyors. Quarry and placer operations. Prereq.: 113. 3 cred. Pfeider.
- 143s. **Coal Mining.** Coal mining methods, mechanization, coal preparation, mine gases; safety work, and organization. Prereq.: 113. 3 cred. Yardley.
- 144w-145s. **Advanced Mining.** Preparation of a report on a mining property or some phase of the mineral industry. Prereq.: 141. 144, 2 cred.; 145, 4 cred. Pfeider.
- 151-152-153.\* **Special Problems in Mining.** Seminar work on mining problems. Prereq.: 141, 142, 143. Cred. ar. Heilig, Pfeider, Yardley.
- 160w. **Industrial Minerals and Rocks.** 2 cred. Heilig.
- 201-202-203.\* **Special Problems in Mining.** Seminar work on mining problems. Cred. ar. Pfeider, staff.
- 210.\* **Field Course in Mining.** Detailed study and report of the actual operations of a mine. Term and cred. ar. Heilig, Pfeider.
- 212-213-214.\* **Special Problems in Mining.** Intended primarily for research. Cred. ar. Pfeider, staff.

##### PETROLEUM ENGINEERING

(For complete course description see *Bulletin of the Institute of Technology.*)

- 111f. Oil Field Development.** Drilling and completion of oil wells. Logging techniques, well surveying, and hydrology. Prereq.: Geol. 25. 3 cred. Lacabanne.
- 112w. Oil Field Production.** Principles and methods of producing oil. Characteristics of oil reservoirs, and of oil and gas. Secondary methods of oil recovery. Prereq.: 111. 3 cred. Lacabanne.
- 131s. Petroleum Refining.** Distillation and fractionation processes used in making commercial products from crude petroleum. General physical and chemical properties of petroleum. Prereq.: Inorg. Chem. 12, Phys. 9. 2 cred. Lacabanne.
- 134w. Natural Gas Engineering.** Natural gas characteristics, critical and retrograde phenomena, metering, gas reserves, well potentials, hydrates. Prereq.: 112. 2 cred. Lacabanne.
- 135s. Petroleum Field Trip.** Oil well drilling and production methods and refining practice in several oil fields. Two-week field trip to be arranged. Prereq.: 112. 3 cred. Lacabanne.
- 138s. Oil Field Mapping.** Methods and practices of graphically displaying, studying, and interpreting oil field data. Oil and gas well logs, etc. Prereq.: 112. 2 cred. Lacabanne.
- 144w-145s. Advanced Petroleum Engineering.** Preparation of a report on the exploration and development of an oil property or some phase of the industry. Prereq.: Min. 141, 144, 3 cred.; 145, 5 cred. Pfeider.
- 152f-153w-154s. Petroleum Production Technology.** Problems in oil and gas production, such as mud fluids, core analysis, permeability and porosity, electrical and mechanical coring, etc. Prereq.: 112. 3 cred. per qtr. Lacabanne.
- 155-156-157.\* Problems in Petroleum Engineering.** Seminar in petroleum problems. Prereq.: 144-145 parallel. Cred. ar. Lacabanne.
- 201-202-203. Seminar on Petroleum Problems.** Cred. ar. Lacabanne.
- 206.\* Field Course in Petroleum Engineering.** A detailed study and report of the actual operations of an oil field. Term and cred. ar. Lacabanne, Pfeider.
- 207-208-209.\* Problems in Petroleum Engineering.** Intended primarily for research. Cred. ar. Lacabanne, Pfeider.

## MUSIC

Professor Paul M. Oberg; Associate Professor James Aliferis; Assistant Professors Paul S. Ivory, Edward O. Downes; Instructors Edward Berryman, Paul Fetler, Earl George, James W. McConkie.

**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: (1) History and Literature, (2) Theory and Composition, (3) Normal Piano, or (4) Music Education. Placement tests in Music Theory and Applied Music are required of all entering students.

**Language Requirement**—For the Master's degree, a reading knowledge of French or German. Substitution may be made by petition when a different language is needed for an individual research problem.

**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 fields. An original composition may be offered in place of the usual research thesis under Plan A. Under Plan B, courses from the fields 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 nine credits outside the various music fields.

## Courses

- 104f-105w-106s. American Music.** Study of the history of music in America from early colonial times to the present through reading and record listening. Prereq.: 36 or 9 cred. in Am. hist. or Am. stud. 2 cred. per qtr. Oberg.
- 121f-122w-123s. Advanced Harmony.** Designed to develop the creative approach and application of harmonic materials enabling student to write in various musical styles. Prereq.: 6T. 2 cred. per qtr. George.
- 124f-125w-126s. History of Opera.** Survey of opera as music and drama, including production, styles, and cultural background, from the late sixteenth century to the present day with emphasis on modern repertoire which is to be broadcast during the year by the Metropolitan Opera Company. Prereq.: 9 cred. in either hist. of mus., hist. of art, hist. of the theater, Eur. hist. from 1600, or permission. 3 cred. per qtr. Downes. (Offered 1953-54 and alternate years.)
- 127f-128w-129s. Composition.** Original work in various forms. Prereq.: 97-98-99, 121-122-123. Cred. ar. Ar.
- 134f-135w-136s. History of Church Music.** Contemporary trends including relationship of old and new liturgies together with their music. Prereq.: 34-35-36 or permission. 2 cred. per qtr. Berryman.
- 141f-142w-143s. Orchestration.** A detailed study of the instruments of the orchestra together with a practical study of art of symphonic scoring. Prereq.: 6T. 2 cred. per qtr. Aliferis.
- 144f-145w-146s. Bach through Beethoven.** Forms, techniques, and styles of the late Baroque and Classical periods with particular attention to the following masters: Bach, Handel, Gluck, Mozart, Haydn, and Beethoven. Prereq.: 36. 3 cred. per qtr. Downes.
- 154f-155w-156s. Music in the Middle Ages and Renaissance.** An intensive study of monophonic music from the period of Gregorian Chant to that of the English Madrigal School. Prereq.: 34-35-36. 2 cred. per qtr. (Offered 1952-53 and alternate years.)
- 164f-165w-166s. Music in the Baroque Era.** An intensive study of the music of the early, middle, and late Baroque periods in Italy, The Netherlands, Germany, Austria, France, and Spain. Prereq.: 34-35-36. 2 cred per qtr. McConkie.
- 197f-198w-199s. Advanced Counterpoint.** Practice in the technique of writing three and four voice fugue, double fugue, and the analysis of contrapuntal writing of various periods. Prereq.: 97-98-99. 2 cred. per qtr. Fetler.
- 200f-201w-202s. Basis of Musical Expression.** Prereq.: 56-57-58. 3 cred. per qtr. Ar.
- 204f.w.s. Graduate Applied Music.** Prereq.: placement test by Music Dept. staff; minimum of 12 hours practice per week. 3 cred. per qtr.; maximum 9 cred. Staff.
- 209f-210w-211s. Advanced Topics in Musical Analysis.** Prereq.: 76. 3 cred. per qtr. Oberg.
- 212f.w.s. Special Problems in Music.** Prereq.: 202 or 211. 1 to 3 cred. per qtr. Oberg.
- 227f-228w-229s. Seminar in Composition and Orchestration.** Open only to graduates who have completed an undergraduate major sequence in music theory and composition, including the following: 97-98-99, 121-122-123, 127-128-129, 141-142-143, 197-198-199. 3 cred. per qtr. Aliferis.

## OBSTETRICS AND GYNECOLOGY

For staff and courses of study offered, see the *Graduate Medical Bulletin*.

## OPHTHALMOLOGY AND OTOLARYNGOLOGY

For staff and courses of study offered, see the *Graduate Medical Bulletin*.

## PATHOLOGY

Professors James R. Dawson, Jr., M.D., Head, A. B. Baker, M.D., Ph.D., Robert Hebbel, M.D., Ph.D., James McCartney, M.D.; Professors Emeriti E. T. Bell, M.D., Benjamin J. Clawson, M.D., Ph.D.; Associate Professors Kano Ikeda, M.D., Nathaniel H. Lufkin, M.D., John F. Noble, M.D.

**Prerequisites**—Graduate students who desire to take their major work in pathology must present credits for the equivalent of the first two 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.

**Master's Degree**—Offered only under Plan A.

**Master's Degree with Designation in Pathology**—Given only after three years of work.

**Doctor's Degree**—The Ph.D. degree with designation in pathology may be awarded after completion of three or more years in graduate work and presentation of a thesis of high quality.

**Note**—For information on work in Cancer Biology, see page 62.

## Courses

101. **Pathology. General Pathology.** Prereq.: completion of first year in Medical School or equiv. 143 hours, 8 cred. Dawson, Hebbel, McCartney, and staff.
102. **Pathology. Special Pathology.** Prereq.: 101. 143 hours, 8 cred. Dawson, Hebbel, McCartney, and staff.
104. **Autopsies.** Prereq.: 102. Cred. ar. Staff.
105. **Diseases of the Kidney.** Prereq.: 102. 3 cred. Hebbel.
106. **Diseases of the Heart.** Prereq.: 102. 3 cred. McCartney.
110. **Seminar in Pathology.** Prereq.: 102. 1 cred. per qtr. Staff.
111. **Conference on Autopsies.** Prereq.: 102. 1 cred. per qtr. Staff.
112. **Diagnosis of Tumors.** Prereq.: 102. 2 to 5 cred. per qtr. Hebbel, McCartney.
113. **Surgical Pathology.** Prereq.: 102. 2 to 5 cred. per qtr. Hebbel, McCartney.
114. **Diseases of the Liver.** Prereq.: 102. 1 cred. McCartney.
115. **Advanced Neuropathology.** (See Neur. 150, 210) Hours and cred. ar. Baker.
116. **Problems in Neuropathology.** (See Psychiatry 146) Hours and cred. ar. Baker.
117. **Neuropathology.** (See Neur. 143) Hours and cred. ar. Baker.
118. **Intracranial Neoplasms.** (See Neur. 211) Hours and cred. ar. Baker.
119. **Survey of Neuropathology.** (See Neur. 151) Examination of specimens from current autopsies. Baker.
201. **Research.** Graduate students with necessary preliminary training may elect research, either as majors or minors in pathology. Hours and cred. ar. Staff.

## PEDIATRICS

For staff and courses of study offered, see the *Graduate Medical Bulletin*.

## PHARMACEUTICAL CHEMISTRY

Professors Charles H. Rogers, Sc.D., Dean, Ole Gisvold, Ph.D., Willard J. Hadley, Ph.D., Charles V. Netz, Ph.D., Taito Soine, Ph.D.; Associate Professor Frank E. DiGangi, Ph.D.

**Prerequisites**—Graduate work leading to the M.S. and Ph.D. degrees with a major in pharmaceutical chemistry or pharmacognosy 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 implement them to do graduate work successfully with a major in pharmaceutical chemistry.

**Language Requirement**—For the Master's degree one foreign language. For the Ph.D. degree either (a) two foreign languages or (b) one foreign language and the option of a special research technique.

**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.

### Courses

**161f-162w-163s. Organic Pharmaceutical Products.** Sources, methods of production, properties, reactions, relationships of structures to activity, and uses of natural and synthetic organic compounds used as therapeutic agents. 161: Hydrocarbons, halogenated hydrocarbons, alcohols, aldehydes, ketones, acids, phenols, ethers, and esters. 162: Analgesics, organometallics—mercurials, silver compounds, arsenicals, and bismuth compounds—dyes, surface active agents, miscellaneous antiseptic agents, sulfonamides, and antibiotics. 163: Pressor principles, myotics, mydriatics, antispasmodics, local anesthetics, barbiturates and related compounds, alkaloids, tannins, cardiac glycosides, sex hormones, and structurally related compounds and vitamins. Prereq.: Org.Chem. 2. 161, 3 cred.; 162, 3 cred.; 163, 4 cred. Gisvold.

**164w-165s. Special Analytical Methods.** The Food, Drug, and Cosmetic Act and official analytical methods of the United States Pharmacopoeia, National Formulary, and Association of Official Agricultural Chemists. Laboratory work: special analytical methods, physical and chemical, used in analyses of some drugs and foods. Student uses the viscosimeter, Abbé and Zeiss refractometers, polariscope, Duboscq colorimeter, photoelectric colorimeter, cryoscope, and other instruments for quantitative measurements. Professional elective. (Students planning to do graduate work with a major in pharmaceutical chemistry and a minor in organic chemistry should elect 164 for their winter professional elective and Org.Chem. 63 and 64 for their spring professional electives.) Prereq.: 3, 54, Org.Chem. 62. 3 cred. per qtr. Soine or DiGangi and staff.

**201f,w,s.\* Pharmaceutical Chemistry Seminar.** Required of majors in pharmaceutical chemistry and pharmacognosy. 1 cred. per qtr. Gisvold.

**202f-203w-204s.\* Advanced Analytical Methods.** Analyses of complex food, drug, and cosmetic products. Identification of colors, perfumes, flavoring agents, digestants, adulterants, etc. Precision instruments. Prereq.: 165. 3 to 5 cred. per qtr. Rogers, Netz.

**205f-206w-207s.\* Chemistry of Medicinal Products.** Chemistry and relationships between constitution and physiologic action of organic compounds. Isolation of active principles and syntheses of medicinal compounds. 205: Proteins, enzymes, co-enzymes, respiratory enzymes, biological oxidation and reductions, vitamins, some hormones, and the cardiac glycosides. Gisvold. 206: Organometallics (i.e., mercurials, arsenicals, and bismuth compounds), certain dyes, acridines, sulfones, sulfonamides, amidines, and the complex ureas. Gisvold. 207: Central nervous system depressants, central nervous system stimulants, local anesthetics, parasympathomimetics, sympathomimetics, and spasmolytics. Soine. Prereq.: Org.Chem. 2 and 163 or permission. 3 to 6 cred. per qtr.

- 208f. Carbohydrates and Glycosides.** Origin, isolation, characterization, and chemistry of the carbohydrates and glycosides. Prereq.: 163 or permission. 3 to 5 cred. Gisvold.
- 209s.\* Alkaloids.** Chemistry and experiments on methods used to isolate, purify, and characterize alkaloids. Prereq.: 163 or permission. 3 to 5 cred. Soine.
- 210f.\* History of Pharmaceutical Chemistry.** 3 cred. Netz.
- 211s.\* Terpenes, Carotinoids, Tannins, and Anthocyanins.** Discussion of their chemistry and experimental investigation of methods of isolation and characterization of the volatile oils and their constituents. Prereq.: 163 or permission. 3 to 5 cred. DiGangi.
- 212w.\* Fats, Waxes, Sterols, and Related Compounds.** Origin, isolation, characterization, and chemistry of the fats, waxes, sterols, and related compounds. Prereq.: 163 or permission. 3 to 5 cred. Gisvold.
- 213f,w,s,su. Research Problems.** Study and experimental investigation of one or more topics, e.g., complex drug and cosmetic products, carotinoids, enzymes, fats, oleoresins, pigments, proteins, resins, vitamins, waxes, etc. Prereq.: 163 or permission. Cred. ar. Staff.
- 214f,w,s,su. Research in Pharmaceutical Chemistry.** Cred. ar. Staff.

## PHARMACOGNOSY

Professor Earl B. Fischer, Ph.D.; Associate Professor Wallace F. White, Ph.D.

For prerequisites and statements on Master's and Doctor's degrees, see Pharmaceutical Chemistry.

**Language Requirement**—For the Master's degree one foreign language. For the Ph.D. degree two foreign languages, one of which must be German.

## Courses

- 162w. Biological Assay of Drugs.** Didactic and laboratory considerations of biological assays of vegetable and animal drugs of the United States Pharmacopoeia and National Formulary. Important nonofficial assay methods are also studied. Registration limited to available instructional facilities. Prereq.: 57 and Pharm.Chem. 56. 3 cred. White.
- 201f,202w,203s.\* Advanced Pharmacognosy.** Lecture and laboratory courses dealing with a systematic study of the pharmacognosy and pharmacohistology of the official, and a few important nonofficial, vegetable, and animal drugs. Information concerning the microscopic and microchemical properties of cell contents and cell forms such as alkaloids, glycosides, calcium oxalate, carbohydrates, parenchyma cells, stone cells, conducting cells, etc., and their appearance and arrangement in vegetable drug tissue, is applied to the identification, determination of purity, evaluation and detection of adulteration of vegetable and animal drugs. Important microscopical accessories such as the micropolariscope, microphotographic camera, staining reagents, etc. are used. Prereq.: 55, 56, 57. 3 to 5 cred. Fischer.
- 204f,w,s,su. Research in Pharmacognosy.** Cred. ar. Fischer, White.
- 205f. Microscopy of Foods.** Identification of food products of vegetable origin, by means of the microscopic structure and microchemical reactions of their tissues and cell contents, together with the determination of purity and the detection of adulteration. Prereq.: 55, 56, 57. 3 to 5 cred. Fischer.
- 206w. Technical Microscopy.** Study of microscopic characteristics and identification of technical products such as vegetable and animal fibers, woods, barks, cellulose, textiles, seeds, etc. Prereq.: 55, 56, 57. 3 to 5 cred. Fischer.
- 207f,208w. Pharmacodynamic Methods.** Practical application and evaluation of special techniques used in testing qualitative and especially quantitative drug action on experimental animals. Emphasis on evaluation of drugs

obtained from plants grown in the Medicinal Plant Garden, in light of modern pharmacological techniques. Drug types studied include anthelmintics, diuretics, bactericidal and bacteriostatic agents, analgesics, cardiac drugs, local anesthetics, and antispasmodics. 3 to 5 cred. per qtr. White.

**209f.210w.211s. Advanced Experimental Drug Testing Techniques.** Projects will be assigned including library and laboratory work to duplicate techniques of selected original investigations reported in the literature in order to prepare the student to carry on original investigations in drug testing. Students may enter this course at the beginning of any quarter. Cred. ar. White.

## PHARMACOLOGY

Professor Raymond N. Bieter, M.D., Ph.D., Head; Associate Professor Harold N. G. Wright, Ph.D.; Assistant Professor Elizabeth M. Cranston, Ph.D.

The laboratories of the Department of Pharmacology are excellently equipped for study of both the chemical properties of drugs and their actions upon functions of living organs and tissues, for studies on detection, isolation, and estimation of poisons, and for experimental chemotherapy. By cooperation of the clinical departments, special studies may be made of the action of drugs, old and new, upon patients in the University Hospitals and allied hospitals.

**Prerequisites**—In addition to fulfilling requirements for admission to the Graduate School students should satisfy the requirements for entrance to the Medical School.

**Language Requirement**—For the Master's degree one foreign language. For the Ph.D., either (a) two foreign languages or (b) one foreign language and the option of a collateral field of knowledge.

**Minor**—This department offers work for a minor to students in allied sciences.

**Master's Degree**—Offered under Plan A.

**Doctor's Degree**—Work toward the Ph.D. degree is offered in this department.

### Courses

**101f.w.s. Introduction to Pharmacology.** The first course in a sequence in which drugs and related chemical compounds are presented for study from the standpoints of chemical structure, beneficial pharmacological actions or effects upon the living body and on living organisms, toxic or harmful effects, and their applications to the treatment of disease. Prereq.: Physiol. 106, 107 or equiv. 2 cred. Bieter, Wright, Cranston.

**102s. General and Experimental Pharmacology.** Continuation of 101 with laboratory experiments and demonstrations. Prereq.: 101. 9 cred. This course runs as a single unit through the spring quarter and the first term of Summer Session. Bieter, Wright, Cranston.

**105f.w. General and Experimental Pharmacology.** Continuation of 101 with laboratory experiments and demonstrations. Prereq.: 101. 6 cred. (See 108 below.) Bieter, Wright, Cranston.

**106w.s. General Pharmacology.** A lecture continuation of 105. 2 cred. (See 108 below.) Bieter, Wright, Cranston.

**108w.s. Prescription Writing.** Prereq.: 101, 105, 106. 101 and 102 are equiv. to 101, 105, 106, and 108. 1 cred. Wright.

**109f.w.s.su. Pharmacological Problems.** Prereq.: 101 and 102 or equiv. Cred. and hours ar. Bieter, Wright, Cranston.

- 110f.w.s.su. Toxicology.** Lect. and lab. Lect. only may be taken if desired. Prereq.: 101 and 102 or equiv. Cred. and hours ar. Wright.
- 111f.w.s.su. Advanced Toxicology.** Laboratory study of quantitative toxicological analysis. Prereq.: 110 or parallel. Cred. and hours ar. Wright.
- 124f.w.s. Pharmacology of Special Systems.** Conferences on the more detailed pharmacology of special organ systems and the clinical applications thereof. 3 cred. Bieter, Wright, or Cranston.
- 203f.w.s.su. Research in Pharmacology.** Prereq.: 101 and 102 or equiv., permission. Cred. and hours ar. Bieter, Wright, or Cranston.
- 204f.w.s. Advanced Pharmacology.** Prereq.: 101 and 102 or equiv., permission. 1 cred. Bieter, Wright, Cranston.
- 205f.w.s. General Discussions in Pharmacology.** A seminar. Prereq.: 101 and 102 or equiv., permission. 1 cred. Bieter, Wright, or Cranston.

## PHILOSOPHY

Professors Wilfrid Sellars, Herbert Feigl; Associate Professors Paul L. Holmer, Mary Shaw; Assistant Professors May Brodbeck, John Hospers.

### I. THE GRADUATE MAJOR IN PHILOSOPHY

**Prerequisites**—To be accepted as a graduate major in philosophy, the applicant must have completed 18 Senior College credit hours in philosophy with a grade average of B or above. In special cases provisional registration may be arranged.

**Fields of Specialization**—The following broad classification of philosophical studies is adopted for the purpose of these regulations: (A) History of Philosophy; (B) Logic and Epistemology; (C) Metaphysics; (D) Philosophy of Science; (E) Ethics and Social Philosophy; (F) Philosophy of Religion; (G) Esthetics. In addition to the requirements listed below, candidates for advanced degrees in philosophy are expected to be familiar with the basic concepts and problems of each of these fields.

**Language Requirement**—For the Master's degree one foreign language. For the Ph.D. degree two foreign languages, one of which must be German.

**Master's Degree**—Offered only under Plan A. The candidate shall, with the approval of his adviser, choose three fields of specialization from the above list, including the History of Philosophy—one of these three fields shall be designated as his thesis field. The written examination required by the Graduate School shall consist of a written examination in each of the three selected fields of specialization.

**Doctor's Degree**—The candidate shall, with the approval of his adviser, choose four fields of specialization, including fields A and B, from the above list. One of the four fields shall be designated as his thesis field. The candidate is responsible for preparing himself in these fields and must pass a written examination in each field prior to the preliminary oral examinations.

### II. THE 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 of the fields of specialization listed in section I of these regulations.

**Note**—Students interested in major work in American Studies will find a description of this work on pages 20 and 46. For credit in Humanities Seminar, see page 119.

### Courses§

- 101f-102w. Principles of Philosophy.** 101: Knowledge, meaning, truth, reality, mind, and nature; 102: Human values and action. Open only to seniors and graduates who have not had 1 (Problems of Philosophy). 4 cred. per qtr. Feigl.
- 106f-107w. Philosophy of Plato.** Prereq.: 50 or permission. 3 cred. per qtr. Sellars.
- 108s. Philosophy of Aristotle.** Prereq.: 50 or permission. 3 cred. Sellars, Shaw.
- 111Aw. Eighteenth-Century Philosophy.** The philosophy of the enlightenment in France, England, and Germany. Prereq.: permission. 3 cred. Shaw.
- 112s. Kant.** Prereq.: 52 or permission. 3 cred. Sellars.
- 113w. Kierkegaard and Scandinavian Philosophy.** Prereq.: 2 courses from 50-51-52 or permission. 3 cred. Holmer.
- 114f. Introduction to American Philosophy: from Puritanism to Pragmatism.** Jonathan Edwards, deism, transcendentalism, evolutionism. Especially for students of American history and literature. 3 cred. Brodbeck.
- 114Aw. American Philosophy from William James.** Prereq.: 114 or permission. 3 cred. Brodbeck.
- 115s. Contemporary Philosophy.** Current systematic and critical philosophies, especially idealism, naturalism, realism, pragmatism, and positivism, as represented by their principle exponents. Prereq.: 52 or permission. 3 cred. Terrell.
- 115As. Nineteenth-Century Thought.** Main currents in British and European philosophy; the ideological background; interaction between Continental and British thinkers; realism and positivism; German and British idealism; Romanticism; philosophical psychology; materialism; evolutionism and its philosophical consequences. Prereq.: 52 or permission. 3 cred. Brodbeck.
- 116s. Philosophy of John Dewey.** Prereq.: 52 or permission. 3 cred. Ar.
- 117f-118w-119s. Readings in Recent Philosophy.** Intensive study of works by Russell, Whitehead, and Collingwood; in other years, works by other authors. Prereq.: 52 or permission. 3 cred. per qtr. Holmer.
- 123w. Comparative Philosophy.** Prereq.: 1 course from 50-51-52. 3 cred. Ar.
- 125f. Rationalism: Descartes.** Analysis of the philosophical works of Descartes. Prereq.: 1 course from 50-51-52 or permission. 2 cred. Sellars.
- 126w. Rationalism: Spinoza.** Study of the philosophy of Spinoza based primarily on the analysis of his "Ethics." Prereq.: 125 or permission. 2 cred. Sellars.
- 127w. Rationalism: Leibnitz.** Study of the philosophy of Leibnitz based on the analysis of selected philosophical writings. Prereq.: 125 or permission. 2 cred. (Not offered 1952-53.)
- 130f. Readings in Medieval Philosophy.** Analysis of selected works of the principal medieval philosophers. Prereq.: 50, 51 or permission. 3 cred. Shaw.
- 133f. Empiricism: Locke and Berkeley.** Analysis of the principal epistemological works of Locke and Berkeley with emphasis on their sources and influence. Prereq.: 52 or permission. 3 cred. Shaw.
- 134w. Empiricism: Hume.** Detailed study of Hume's "Treatise" and "Inquiry." Prereq.: 52, 133. 3 cred. Shaw.

§ Check with Philosophy Department to ascertain which of the following courses are offered in 1952-53, which in 1953-54, which in both years.

- 135w. Philosophy in Modern Literature.** Literature in an age of science. Deals with the impact of science and the scientific outlook on ideas of man and man's relation to nature. Uses prose, fiction, and drama. 3 cred. Terrell.
- 143w. Theory of Knowledge.** Analysis of the logical structure and the experiential roots of knowledge. Meaning, validity, truth, reason and experience, induction, criteria of objectivity and reality. Prereq.: 2 or permission. 4 cred. Sellars, Feigl.
- 147f. Elements of Symbolic Logic and Semantics.** Systematic introduction to modern mathematical logic and the logical analysis of language. Dimensions of language; calculus of propositions, classes, and the relations; applications to foundations of mathematics. Prereq.: 2 or permission. 4 cred. Brodbeck.
- 148f. Epicureanism and Stoicism.** Greek philosophy after Aristotle. Modern elements in Stoic logic. Prereq.: 50. 3 cred. Shaw.
- 149w. Scepticism.** Development of Greek and Roman scepticism; revival of scepticism in the French Renaissance and its influences in the 17th and 18th centuries. Prereq.: 50. 3 cred. Shaw.
- 153s. Philosophy of Science.** An attempt to provide a clear understanding of the meaning, methods, and implications of modern science through the examination of basic concepts, presuppositions, and procedures. Description, explanation, prediction, experimentation; space, time, number, matter, energy; causality, probability, statistics; organic life, evolution, mind. Prereq.: 2 or permission. 4 cred. Feigl.
- 155s. Metaphysics.** Prereq.: 2 courses from 50-51-52 or permission. 4 cred. Terrell.
- 159f-160w. Principles of Esthetics.** Nature of the esthetic experience; standards of esthetic evaluation; relation of art to 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 esthetics to ethics. 3 cred. per qtr. Hospers.
- 164s. Ethical Theory.** Prereq.: 2 courses from 50-51-52 or permission. 3 cred. Sellars, Hospers.
- 165w. Political and Social Ethics.** Prereq.: permission. 3 cred. (Not offered 1952-53.)
- 170f. Philosophy of History.** Prereq.: 6 cred. in philos. or 10 cred. in hist. 3 cred. Holmer.
- 180f. History of Religions.** Prereq.: 6 cred. or permission. 3 cred. Holmer.
- 181w. Psychology of Religion.** Prereq.: 6 cred. or permission. 3 cred. Holmer.
- 182s. Philosophy of Religion.** Prereq.: 6 cred. or permission. 3 cred. Holmer.
- 191f-192w-193s. Seminar in Philosophy.** Individual investigation, with topics to be determined after consultation with the department. Prereq.: 9 cred. in philos., permission. 3 cred. per qtr. Sellars, Feigl, Holmer, Shaw, and others.
- 210f-211w-212s. Seminar in Moral Philosophy.** Systematic study of concepts and problems relating to the moral universe of discourse. Prereq.: 164 or permission. 3 cred. per qtr. Sellars.
- 220f-221w-222s. Seminar in Philosophical Analysis.** Systematic study of the basic concepts and problems of epistemology. Prereq.: 143 or permission. 3 cred per qtr. Sellars.
- 223f-224w-225s. Seminar in Philosophy of Language.** Systematic study of concepts and problems relating to the structure, meaning, and use of language. Prereq.: 143 or 147, permission. 3 cred. per qtr. Sellars.
- 230f-231w-232s. History of Philosophy, Advanced.** Primarily for graduate students in other departments who have had no previous courses in philosophy. Philosophy majors who have taken 50-51-52 may enroll with permission. 3 cred. per qtr. Hospers.
- 233f-234w-235s. Seminar in Philosophy of Religion.** Systematic study of the conceptual structure of religion. Prereq.: 182 or permission. 3 cred. per qtr. Holmer.

- 236f-237w-238s. Seminar in the History of the Philosophy of Religion.** Historical study seeking to isolate the origins, the nature, the scope of philosophy of religion in Western culture from the Greeks through the 18th century. Prereq.: 182, knowledge of the hist. of philos., permission. 3 cred. per qtr. Holmer.
- 241f-242w-243s. Seminar: Philosophy of the Physical Sciences.** Prereq.: permission. 3 cred. per qtr. Feigl.
- 244f-245w-246s. Seminar: Philosophical Problems of Psychology.** Open to advanced graduate students in philosophy or psychology with written permission. 3 cred. per qtr. Feigl. (1952-53: Feigl, Meehl.)
- 247f-248w-249s. Seminar: Logic of the Exact Sciences.** Prereq.: permission. 3 cred. per qtr. Feigl.
- 250f-251w-252s. Seminar: Philosophy of the Social Sciences.** Prereq.: permission. 3 cred. per qtr. Feigl.
- 350f-351w-352s. Research in History of Philosophy.** Prereq.: permission. Cred. ar. Sellars, Shaw, and others.
- 360f-361w-362s. Research in Philosophy of Science.** Prereq.: permission. Cred. ar. Feigl and others.
- 370f-371w-372s. Research in Philosophy of Culture.** Prereq.: permission. Cred. ar. Ar.

### PHYSICS

Professors J. William Buchta, Charles L. Critchfield, Edward L. Hill, Alfred O. C. Nier, Otto H. Schmitt, Joseph Valasek, Clifford N. Wall, John H. Williams; Associate Professor Edward P. Ney; Assistant Professors J. Morris Blair, Thomas E. Collins, George D. Freier, John E. Nafe, John R. Winckler.

**Prerequisites**—For major work, differential and integral calculus and two years of college physics. For minor work, differential and integral calculus and one year of college physics.

**Language Requirement**—For the Master's degree reading knowledge of French or German. It is desirable that the language requirement be fulfilled before graduate work is begun. For the Ph.D. degree German and either French, Russian, or Italian. Other languages may be considered on petition.

**Master's Degree**—Offered under either Plan A or Plan B. Courses 181-183-185 and 191-192-193 are required. Alterations of this requirement may be made only after consultation with the chairman of the department.

**Doctor's Degree**—Candidates for the Ph.D. degree will be expected to pass qualifying examinations as determined by the chairman of the department before admission to the preliminary examination.

**Note**—For courses in Biophysics, see pages 57-58. For courses in Geophysics, see page 124.

### Courses

- 101f-103w-105s. Theoretical Physics.** Analytical survey of the fundamental principles of classical physics. Five lect. per week. Prereq.: 15 cred. in phys., Math. 106 or M.&M. 80 or one of them parallel. 5 cred. per qtr. Nier.
- 107f\*-109w\*-111s.\* Modern Physics.** Survey of the newer developments in physics. Students may, with permission, enter any quarter. Prereq.: Math. 51 or M.&M. 25, 15 cred. in phys. 3 cred. per qtr. Collins.
- 110w.s\*-112w.s.\* Modern Experimental Physics.** Advanced laboratory projects in which the student develops necessary apparatus and works out selected problems in modern physics. Prereq.: 120-121 or permission. 3 cred. Ar.

- 113w. Intermediate Acoustics.** Mechanics of vibrating systems and wave motion. Production, propagation, analysis, and reception of sound. Prereq.: Math. 51 or M.&M. 25, 15 cred. in phys. 3 cred. Buchta.
- 114f.w.s\*-116f.w.s\*-118f.w.s.\*\$ Elementary Physical Investigation.** Problems, either experimental or theoretical, in which the student may have special interest. A written report on the work accomplished is required. Prereq.: permission of department chairman. 3 cred. per qtr. Staff.
- 120f.\* Atomic Physics.** A laboratory course to introduce techniques and methods used in physics research laboratories. Vacuum gauges and systems, properties of charged particles, X-ray diffraction, ionization of gases, mass spectroscopy, photoelectricity, secondary electron emission. Prereq.: 7-8-9, Math. 51 or M.&M. 25. 3 cred. Blair.
- 121w.\* Experimental Nuclear Physics I.** A laboratory course not requiring extensive knowledge of electronic circuits. Natural radioactivity, cloud chambers, ionization chambers, properties of nuclear radiations, alpha, beta, and gamma rays, neutrons; shielding artificial radioactivity, photographic techniques, health protection. Prereq.: 7-8-9, Math. 51 or M.&M. 25. 3 cred. Blair.
- 122s.\* Experimental Nuclear Physics II.** A laboratory course in techniques requiring knowledge of electronic circuits. Geiger, proportional, scintillation, and coincidence counters. Cosmic rays. Nuclear resonance phenomena. Health monitoring instruments. Prereq.: 121, 146 or permission. 3 cred. Blair.
- 131f.\* Geometrical Optics.** Theory of mirrors, prisms, and lenses. Optical instruments. Prereq.: 15 cred. in phys., Math. 51 or M.&M.25. 3 cred. Valasek.
- 133w.\* Physical Optics.** Theory of interference and interferometers. Theory of diffraction, resolving power, and diffraction gratings. Polarized light, crystal optics, and applications. Prereq.: 15 cred. in phys., Math. 51 or M.&M.25. 3 cred. Valasek.
- 134f.w.\* Experimental Optics.** Laboratory work in spectrometry, optics of compound lenses, photometry, absorption, interferometry, polarized light. 2 three-hour lab. periods a week. Prereq.: 15 cred. in phys. 3 cred. Valasek.
- 135s.\* Spectroscopy.** Light sources, instruments and methods used in spectroscopy of the X-ray, ultraviolet, visible, and infrared regions of the spectrum. Prereq.: 15 cred. in phys., Math. 51 or M.&M.25. 3 cred. Valasek.
- 136w.s.\* Spectrum Analysis.** Laboratory work on measurement of wave lengths, intensities, and absorption coefficients in the infrared, visible, and ultraviolet regions of the spectrum. 2 three-hour lab. periods per week. Prereq.: 15 cred. in phys. 3 cred. Valasek.
- 144f. Electrical Measurements.** An experimental course covering ballistic and current galvanometers, magnetic flux measurements, potentiometer methods, D.C. bridges, and audiofrequency A.C. bridges. Prereq.: 15 cred. in phys., Math. 51 or M.&M.25. 4 cred. Blair.
- 146w.\* Electronics.** Physics of vacuum tubes and associated circuits, thermionics. Prereq.: 144, permission. 3 cred. Blair.
- 148s.\* Application of Electronic Circuits.** Application of various electronic circuits which are useful in physics research. Lecture and laboratory work involving amplifiers, computing circuits, servomechanisms, regulating circuits, and others especially adapted to work in physics. Prereq.: 146 or permission for those who have a basic knowledge of electronics. 3 cred. Ar.
- 181f\*-183w\*-185s.\* Atomistics and Elementary Quantum Mechanics.** An introduction to wave mechanics, atomic structure, and nuclear physics. Prereq.: 101-103-105 or permission. 3 cred. per qtr. Williams.
- 191f\*-192w\*-193s.\* Introduction to Mathematical Physics.** Intensive treatment of the equations of mathematical physics using material drawn from the fields of mechanics, small vibrations of continuous media, acoustics, electromagnetic theory, and heat conduction. Prereq.: 101-103-105, Math. 106-107-108 or M.&M. 150, 152, 153 or equiv. 3 cred. per qtr. Hill.

Prerequisites for all courses listed below are Mathematical Physics 191-192-193 or permission, and advanced calculus. A reading knowledge of German is highly desirable and will be presumed in certain phases of the work.

**201f-202w-203s. Dynamics of Fluid Motion.** 3 cred. per qtr. Hill.

**204f-205w-206s. Statistical Thermodynamics.** 3 cred. per qtr. Wall,

§ Students may enter any quarter.

- 207f-208w-209s. **Electrodynamics, Theoretical Optics, and the Theory of Relativity.** 3 cred. per qtr. Ar.
- 210f-211w-212s. **Analytical Dynamics and Quantum Mechanics.** 3 cred. per qtr. (Offered 1953-54.)
- 213f\*-214w\*-215s.\* **Seminar in Contemporary Experimental Physics.** 3 cred. per qtr. Staff.
- 216f\*-217w\*-218s.\* **Seminar in Contemporary Theoretical Physics.** 3 cred. per qtr. Staff.
- 225f-226w-227s. **Advanced Quantum Theory.** 3 cred. per qtr. Ar.
- 228f-229w-230s. **Nuclear Theory.** 3 cred. per qtr. Critchfield.
- 231f-232w-233s. **Theory of Atomic and Molecular Structure.** 3 cred. per qtr. Hill. (Offered 1952-53.)
- 246f-247w-248s. **Cosmic Rays.** 3 cred. per qtr. Ar.
- 249f-250w-251s. **Theory of the Solid State of Matter.** 3 cred. per qtr. Ar.
- 252f-253w-254s. **Seminar in Nuclear Physics.** Cred ar. Williams and staff.
- 255f-256w-257s. **Seminar in Mass Spectroscopy.** Cred. ar. Nier and staff.
- 258f-259w-260s. **Seminar in Cosmic Rays.** Cred ar. Ney, Winckler, and staff.

The following courses will be offered when demand warrants.

- 222f-223w-224s. **The General Theory of Relativity.**
- 234f-235w-236s. **Advanced Theory of Optics and Optical Instruments.**
- 237f-238w-239s. **Advanced Hydrodynamics and Aerodynamics.**
- 240f-241w-242s. **The Theory of Electric Circuits and Radiation.**
- 243f-244w-245s. **Advanced Thermodynamics and Statistical Mechanics.**

## PHYSIOLOGICAL CHEMISTRY

Professors Wallace D. Armstrong, M.D., Ph.D., Head, David Glick, Ph.D., Karl Sollner, Ph.D.; Associate Professors Cyrus P. Barnum, Jr., Ph.D., Saul L. Cohen, Ph.D., Ralph Holman, Ph.D.; Assistant Professors Elizabeth Frame, Ph.D., Leon Singer, Ph.D.

**Prerequisites**—A Bachelor's degree with a major in chemistry or physics and a minor in some other science. Prerequisites for admittance as a candidate for the Ph.D. degree with either a major or minor in this department, or for the M.S. degree with a major in this department, are: Analytical Chemistry 1-2 or 101-102 or equivalent; Organic Chemistry 63-64 or equivalent; Physical Chemistry 107-108 or equivalent; and 6 credits of a biological science.

**Language Requirement**—One foreign language for the Master's degree. For the Ph.D. degree two foreign languages. In general these languages will be French and German, but at the discretion of the major adviser other foreign languages may be substituted for either or both French and German.

**Master's Degree**—Offered under Plan A. The following are required of all candidates for the Master's degree with a major in this department: 3 credits of advanced analytical chemistry, 3 credits of advanced organic chemistry, 6 credits of biological sciences, and Physiological Chemistry 100-101.

**Doctor's Degree**—The following are required of all candidates for the Doctor's degree with a major in this department: 6 credits of advanced analytical chemistry, 6 credits of advanced organic chemistry, 6 credits of advanced physical chemistry or physics, 10 credits of Physiology 106-107, Physiological Chemistry 100-101, and 4 of the 5 physiological chemistry courses numbered 206, 207, 208, 209, or 211. These are not intended to be interpreted as minimum requirements, however, and each graduate student is expected to work out his full program in consulta-

tion with an adviser, with the understanding that needs may differ in individual cases.

If Physiological Chemistry 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.

### Courses

- 100f.su-101w.su. Physiological Chemistry.** Prereq.: phys., org. chem. 100, 7 cred.; 101, 6 cred. Armstrong, Barnum, Glick, Cohen, Carr.
- 153f.w.s.su. Problems in Physiological Chemistry.** Special work arranged with qualified students. May be taken one or more quarters. Prereq.: 100-101. Hours and cred. ar. Armstrong, Barnum, Glick, Cohen, Frame.
- 155f.w.s. Seminar and Conference on Dental and Oral Biochemistry.** Prereq.: 100-101 or 56-57. Hours and cred. ar. Armstrong.
- 200f.w.s. Seminar in Physiological Chemistry.** 1 cred. Staff.
- 205f.w.s.su. Research in Physiological Chemistry.** Hours and cred. ar. Armstrong, Barnum, Glick, Sollner, Cohen, Frame.
- 206f.§ Advanced Endocrinology and Steroid Chemistry.** Prereq.: 100-101. 3 cred. Cohen (Offered in sessions which begin with an odd-numbered year.)
- 207w.§ Radiotracers and Mineral Metabolism.** Prereq.: 100-101. 3 cred. Armstrong. (Offered in sessions which begin with an odd-numbered year.)
- 208s. Advanced Laboratory Technique.** Limited to 10 students. Prereq.: 100-101. 3 cred. Staff. (Offered in sessions which begin with an odd-numbered year.)
- 209f.§ Histochemistry.** Prereq.: 100-101 and histology, or permission. 3 cred. Glick. (Offered in sessions which begin with an even-numbered year.)
- 211s.§ Intermediary Metabolism.** Prereq.: 100-101. 3 cred. Barnum. (Offered in sessions which begin with an even-numbered year.)
- 212f.w.s.su. Histochemistry Laboratory.** Problems in the field of histochemistry selected to meet individual interests. Prereq.: 100-101 and permission. Hours and cred. ar. Glick.
- 213f.w.s. Clinical Physiological Chemistry.** Hours and cred. ar. Staff.
- 236f.w.s. Radioisotope Seminar.** 1 cred. Stenstrom, Moore, Armstrong, and staff.

### PHYSIOLOGICAL HYGIENE

Professor Ancel Keys, Ph.D., Director; Associate Professors Josef M. Brozek, Ph.D., Ernst Simonson, M.D., Henry L. Taylor, Ph.D.; Assistant Professor Joseph T. Anderson, Ph.D.

**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.

**Master's Degree**—Offered under Plan A.

**Doctor's Degree**—Work is offered in physiological hygiene leading toward the Ph.D. degree.

### Courses

- P.H.191w. Science of Human Nutrition.** Evaluation of nutritional status, surveys, special dietetics. Prereq.: 8 cred. in biochem., 91, 92 or permission. 3 cred. Keys.
- P.H.192w. Physiology of Exercise.** Acute and chronic effects of exercise. Prereq.: 92 or Physiol. 103 or equiv., permission. 4 cred. Keys, Taylor.
- P.H.194f. Human Factors in Industry.** Job requirements, physiological cost of work, industrial fatigue, industrial hazards, environment, accidents, absenteeism. Prereq.: permission. 3 cred. Brozek.

§ Offered only when 8 or more students are registered.

- P.H.202f.w.s. Seminar in Physiological Hygiene.** Nutrition; human physical fitness; gerontology; human adaptation in health and disease; geographical physiology; and related topics. 1 cred. Staff.
- P.H.220f.w.s. Readings in Problems of Physiological Hygiene.** Prereq.: permission. Cred. ar. Staff.
- P.H.290f.w.s. Research in Physiological Hygiene and Related Areas.** Cred. ar. Staff.

## PHYSIOLOGY

Professors Maurice B. Visscher, M.D., Ph.D., Head, John J. Bittner, Ph.D., Ernst Gellhorn, M.D., Ph.D., Nathan Lifson, M.D., Ph.D., Herbert S. Wells, M.D.; Associate Professor Joseph T. King, M.D., Ph.D.; Assistant Professors Ernest B. Brown, Ph.D., Marthella Frantz, Ph.D., Robert A. Huseby, M.D., Ph.D., Carlos Martinez, 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.

**Language Requirement**—For the Master's degree German, French, Russian, or Spanish. For the Doctor's degree either (a) two foreign languages or (b) one foreign language and the option of a collateral field of knowledge.

**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.

**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 department.

**Note**—For information on work in Cancer Biology, see page 62.

## Courses

- 106s-107su.† Human Physiology.** (Formerly 103, 104.) Registration for 106 or 107 singly is not permitted, but students may register for lecture without laboratory. Prereq.: org. chem., zool., and neuroanat. 15 cred. Visscher, Gellhorn, and others.
- 113f.w.s.su. Problems in Physiology.** Arranged with qualified students. Each student will be assigned a topic for special laboratory study. Conferences and reading. May be taken one or more quarters. Prereq.: 106-107 or equiv. 3 cred. per qtr. or ar. Visscher, Gellhorn, Lifson, King, Brown, and others.
- 114f.w.s. Seminar in Physiology.** One or more seminars in various major fields of physiology will be offered each quarter. Interested students should obtain information concerning proposed offerings from the department office. Prereq.: satisfactory completion of a course equiv. to 106-107. Hours and cred. ar. Staff.
- 124f. Seminar in Neurophysiology.** Prereq.: 106-107 with grade of B or better, or special examination. 2 cred. Gellhorn.
- 124w.\* Selected Topics in Advanced Neurophysiology.** Prereq.: 106-107 with grade of B or better, or special examination. 1 cred., or 2 cred. by special arrangement for students preparing term paper. Gellhorn.
- 201f.w.s.su.\* Seminar in Physiology.** For advanced students. Cred. ar. Visscher and staff.
- 202.\* Readings in Physiology.** Topics will be selected for each student, and written reviews will be prepared and discussed. 1 to 3 cred. Visscher, Gellhorn, King, and others.

- 203f.w.s.su.\* **Research in Physiology.** Hours and cred. ar. Visscher, Gellhorn, King, Lifson, and others.  
 206s.\* **Seminar in History of Physiology and Related Sciences.** 1 cred. Visscher.

### PLANT PATHOLOGY AND BOTANY

Professors Elvin C. Stakman, Clyde M. Christensen, Jonas J. Christensen, Carl J. Eide, Helen Hart; Associate Professors Milton F. Kernkamp, Thomas H. King; Assistant Professors Louise Dossdall, Raymond H. Landon, Alvin H. Larson; Instructors Harold G. Heggeness, Matthew B. Moore.

#### Prerequisites—

Plant Pathology major: The minimum requirement is (a) three years (27 credits) in the basic plant sciences; (b) one year (9 credits) in plant pathology—preferably two years (18 credits).

Plant Pathology minor: The minimum requirement is (a) three years (27 credits) in the basic biological sciences; (b) 5 credits in plant pathology.

Applied Plant Physiology and Agricultural Botany major: The minimum requirement is (a) three years (27 credits) in the basic plant sciences; (b) one year (9 credits) in plant physiology.

Applied Plant Physiology and Agricultural Botany minor: The minimum requirement is (a) three years (27 credits) in the basic plant sciences; (b) 5 credits in plant physiology.

**Language Requirement—**For the Master's degree Plan A, one foreign language; for the Master's degree Plan B, a foreign language strongly advised but not required. For the Doctor's degree two foreign languages.

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

**Doctor's Degree—**Work for the Ph.D. degree is offered by this division.

### Courses

#### PLANT PATHOLOGY

- 104w. **Industrial Mycology.** Fungi in relation to industrial processes and products. Prereq.: 1, 10, or 56. 3 cred. C. M. Christensen.  
 105f-106w-107s. **Mycology.** Morphology and taxonomy of fungi. Lect., lab., and field work. Prereq.: 1, 10, 56, or equiv. 3 or 5 cred. per qtr. Dossdall.  
 111w. **Diseases of Field Crops.** Symptomatology, etiology, and practical methods of control. Lab., lect., and greenhouse work. Prereq.: 1 or 10. 4 cred. J. J. Christensen, Kernkamp.  
 114w. **Advanced Forest Pathology.** Wood rots, including a study of the deterioration of wood products caused by fungi. Lect. and lab. Prereq.: 1 or 10. 3 cred. C. M. Christensen.  
 115s. **Diseases of Vegetable Crops.** Detailed study of vegetable diseases, especially those important in Minnesota. Lect., lab., field, greenhouse work. Prereq.: 1, 10, or 120. 3 cred. Eide. (Offered 1953-54 and alternate years.)  
 116s. **Diseases of Fruit Crops.** Detailed study of fruit diseases, especially those important in Minnesota. Lect., lab., field, greenhouse work. Prereq.: 1, 10, or 120. 3 cred. King. (Offered 1952-53 and alternate years.)  
 117f. **Virus Diseases of Plants.** Nature of plant viruses and types of diseases they cause; emphasis on methods for studying virus diseases. Prereq.: 1 or 10. 3 cred. Eide. (Offered 1953-54 and alternate years.)  
 118f. **Bacterial Diseases of Plants.** Bacteria as plant pathogens; representative types with particular reference to the technique used in studying bacterial diseases of plants. Prereq.: 1 or 10. 3 cred. Eide. (Offered 1952-53 and alternate years.)

- 119s. Principles of Plant Disease Control.** General consideration of principles and practices in controlling plant diseases. Prereq.: 1 or 10. 3 cred. King, Moore.
- 120f,w,s. Advanced Plant Pathology.** General plant pathology. Lect., lab., greenhouse work, and special problems. Prereq.: 14 cred. in plant sciences or permission; not open to students who have taken 1 or 10. 3 cred. C. M. Christensen, Moore.
- 141f-142w. Insects in Relation to Plant Diseases.** The principal insect vectors and their habits; types of insect injuries affecting health of plants; modes of insect transmission and dissemination of plant disease; methods of rearing and handling insect vectors. Prereq.: 8 cred. in entomol. or pl. path. 3 cred. per qtr. J. J. Christensen, Granovsky.
- 143f. Methods.** Theoretical and practical consideration of methods used in mycological and pathological research. Prereq.: 1 or 10. 3 cred. Hart, Moore.
- 156f. Advanced Study of Fungi.** General characteristics of fungi; especially those used in identification; cultural and taxonomic procedures and practices. Prereq.: 9 cred. in bot. or permission. Not open to students who have taken 56, 105, 106, 107. 3 cred. C. M. Christensen.
- 203f-204w-205s-206su.\* Research in Plant Pathology.** Special assignment of work in laboratory and field problems in pathological research. Cred. ar. Stakman and staff.
- 207f-208w-209s-210su.\* Problems in Mycology.** Research work along such lines as taxonomy of natural groups, fungus flora of particular regions, localities, or habitats; investigation of fungi involved in special industrial or natural processes; morphology or physiology of special forms. Prereq.: 105-106-107. For minor or major. Cred. ar. Stakman, C. M. Christensen, Dossdall.
- 211w. History of Plant Pathology.** The development of plant pathology as a science. 2 cred. Stakman. (Offered 1952-53 and alternate years.)
- 213f,w,s.\* Seminar.** Critical review of progress and problems in plant pathology. 2 cred. Stakman and staff.
- 215f.§ Genetics of Plant Pathogens.** Physiologic specialization, sexuality, hybridization, mutation, and similar phenomena in plant pathogens, with emphasis on practical implications. Prereq.: 1 or 10 and Agron. and Pl.Gen. 131. 5 cred. Stakman, J. J. Christensen. (Offered 1952-53 and alternate years.)
- 216f. Physiology of Plant Pathogens.** Physical and chemical requirements and effects of plant pathogens in relation to their parasitism. 3 or 5 cred. Landon.
- 217s. Ecology of Plant Pathogens.** The effect of environmental factors on the development of plant pathogens and plant disease epidemics. 3 cred. Kernkamp.
- 218w. Principles of Plant Pathology.** Systematic consideration of the basic factors governing the development of plant diseases. Prereq.: 1 or 10, Bact. 53, and 6 additional cred. in pl. path. 5 cred. Stakman, Eide.

#### APPLIED PLANT PHYSIOLOGY AND AGRICULTURAL BOTANY

- 101f. Special Agricultural Botany.** Botanical characters, environmental relations, and utilization of important groups of plants, especially those of the tropics and subtropics. Prereq.: 9 cred. in bot. or equiv. 3 or 5 cred. Kernkamp, Larson.
- 102w. Physiology of Seeds.** Physiology of development, ripening, storage, dormancy, viability, and germination; processing and seed treatment in relation to viability. Prereq.: 15 cred. in plant sciences or permission. 3 cred. Heggeness.
- 103f. Physiology of Crop Plants.** Physiological factors affecting the growth and development of crop plants. Lect. and lab. Prereq.: 15 cred. in plant sciences or permission. 3 or 5 cred. Heggeness.
- 135f. Weed Control.** Cultural and chemical methods of weed control; weed and seed laws pertaining to dissemination and control. Lect., lab., and field work. Prereq.: Agron. 1, Pl.Path. 3. 3 cred. Heggeness, Dunham.

§ If there is sufficient demand for courses offered in alternate years, they will be given out of turn.

- 160s. Plant Histochemistry.** The composition and function of the tissues of economic plants, including changes produced by chemical and biological agents. Lect. and lab. Prereq.: 15 cred. in plant sciences or permission. 3 cred. Landon. (Offered 1952-53 and alternate years.)
- 161s. Technology of Fruits and Vegetables.** Methods used in transporting, storing, and ripening fruits and vegetables. Lect. and lab. Prereq.: 15 cred. in plant sciences or permission. 3 cred. Landon. (Offered 1953-54 and alternate years.)
- 162w. Temperature Relations of Crop Plants.** General temperature effects, with emphasis on low temperatures and prevention of low temperature injury. Lect. and lab. Prereq.: 15 cred. in plant sciences or permission. 3 cred. Landon.
- 163f. Applied Plant Physiology.** A study of the applications of plant physiological principles to agriculture, horticulture, and forestry. Lect. and lab. Prereq.: 15 cred. in plant sciences or permission. 3 cred. Landon.
- 251f,252w,253s.\* Seminar in Applied Plant Physiology.** 1 cred. per qtr. Landon.
- 254f,255w,256s,257su.\* Research Problems in Applied Plant Physiology.** Special assignment of work in applied plant physiology. Cred. ar. Landon.
- 260f,261w,262s,263su. Research Problems in Agricultural Botany.** Special assignment of problems in agric. bot. 3 or 5 cred. per qtr. Stakman, Larson.

## POLITICAL SCIENCE

Professors Lloyd M. Short, William Anderson, Asher N. Christensen, Werner Levi, Benjamin E. Lippincott, Clarence C. Ludwig, Lennox A. Mills, Harold S. Quigley; Associate Professors Herbert McClosky, Charles H. McLaughlin, Arthur E. Naftalin, Mulford Q. Sibley, George A. Warp.

**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 fields 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.

**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.

**Fields of Specialization**—When a candidate selects one of the listed fields as part of the requirements for a degree, he is not necessarily required to take all the courses offered in that field. He is, however, required to prepare for examination in some extensive part of the field that is dealt with in courses and seminars offered by the department. The recognized fields are:

1. American Government and Politics, comprising four subfields: (a) national and state government; (b) local government; (c) public administration; (d) public law.

2. Comparative Government and Politics, comprising four subfields: (a) Europe; (b) the Far East; (c) British Empire and Commonwealth of Nations; (d) Latin America.

§ A more detailed explanatory statement of prerequisites, fields and subfields, and requirements for the M.A. and Ph.D. degrees may be obtained from advisers or the office of the department.

3. Theory, comprising two subfields: (a) history of political ideas; (b) political theory.

4. International Affairs, comprising four subfields: (a) international law and diplomacy; (b) international relations and organization; (c) regional international relations (Far Eastern, European, or Latin American); (d) colonial politics and administration.

5. Political Behavior. This field is not at present available as a field of concentration.

**General Requirement**—All candidates for the Ph.D. degree or master of arts under Plan A are required to complete 229 (Scope and Methods of Political Science), or to present evidence of satisfactory completion of a similar course at another approved institution. Candidates for the Master's degree who are not in residence at a time when this course is offered are excused from the requirement.

#### REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS

**Plan A with Major in Political Science**—The work leading to the Master's degree consists of at least three quarters of graduate study, estimated as follows: (1) at least 18 credits in political science in addition to 229; (2) at least 9 credits in the minor department; (3) satisfactory completion of a substantial thesis based upon independent research. Courses taken in the major should be grouped in two subfields of specialization, lying in either one or two fields, and those taken in the minor should consist of a single 9-credit course, or a three-quarter sequence of related courses totaling 9 credits. \*

**Plan A with Minor in Political Science**—Candidates with political science as the minor must take at least one 9-credit course or a three-quarter sequence of related courses lying in either one or two subfields and totaling 9 credits.

**Plan B with Political Science as the Field of Concentration**—Candidates for the Master's degree without thesis must take 21 to 27 credits in political science, of which at least six must be in courses numbered 200 or above. These courses should be a logical grouping selected from not more than four subfields in at least two, and not more than three fields of specialization. Candidates must also take 18 to 24 credits in at least two related departments, a total program of 45 credits. Courses elected in political science along with those in the related fields should constitute an integrated plan of study. Normally at least 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 three fields of specialization, one of which shall be designated as his thesis field or field of concentration. He must prepare for examination in one subfield in each of two fields, and in two subfields in the field of concentration, pursuing a program of courses and seminars in political science that will vary in content and amount according to his individual needs and the extent of his undergraduate work in political science and related fields. He will also satisfy requirements of

the minor department. Work leading to the Ph.D. degree consists of at least three full years of graduate study. Course work requirements will be decreased for those who enter the Graduate School with advanced standing. The preliminary examination covers the entire major and minor; the final oral examination is devoted to the thesis and to relevant aspects of the field in which it is written.

**Minor in Political Science**—A candidate for the Ph.D. degree who elects political science as his minor shall prepare himself in two subfields in either one or two fields.

**Note**—For information on work in Public Administration, see page 26; for International Relations and Area Studies, see page 23.

### Courses

- 101f.\* Principles of the American Constitution I.** Nature of constitutions, judicial review, separation of powers, national-state and interstate relations. Prereq.: 1-2 or equiv. 3 cred. Anderson.
- 102w.\* Principles of the American Constitution II.** Powers of the national government, restrictions on the states. Prereq.: 101 or equiv. 3 cred. Anderson.
- 103s.\* Principles of the American Constitution III.** Civil liberties and rights, due process and equal protection. Prereq.: 101 or 102 or equiv. 3 cred. Anderson.
- 104-105-106.\* American Constitutional Development.** Prereq.: 9 cred. or Hist. 20-21-22. 3 cred. per qtr. (Not offered.)
- 108w.\* Legislative Organization and Procedure.** The structure and functioning of legislative bodies. Prereq.: 6 cred. 3 cred. Short.
- 116w-117s.\* Local Government.** Nature of local government, areas, organization, major functions, state supervision, administration, finance. Prereq.: 9 cred. or permission. 3 cred. per qtr. Anderson.
- 118s.\* Local Government: Legal Status, Powers, and Responsibilities.** Prereq.: 116. 3 cred. Anderson. (Not offered 1952-53.)
- 120f. Municipal Functions.** A general survey of "line" functions: safety, health, welfare, works, utilities, etc. Prereq.: 6 cred. 3 cred. Ludwig.
- 121w. Municipal Administration.** A general survey of overhead administration, with special emphasis on fiscal phases. Prereq.: 120 or permission. 3 cred. Ludwig.
- 122s.\* Municipal Problems.** Intensive individual research and preparation of term reports on selected topics. (Individual conferences—no regular class.) Prereq.: 121 or permission. 3 cred. Ludwig.
- 123f.\* City Planning.** (Same as Arch. 104.) General survey of the economic, governmental, social, and technical phases of city planning and group housing. 3 cred. Jones, Anderson, Caplow, Filipetti, Vaile.
- 124f.\* Recent Social Legislation.** Federal, state, and local programs in public assistance and social security with emphasis on major programs of the Social Security Act, health insurance, and housing. Prereq.: 6 cred. 3 cred. Christensen.
- 126w-127s.\* Government and the Economic Order.** Powers of national, state, and local governments to regulate business enterprise. Policies with reference to trusts, public utilities, communication agencies, food and drug legislation, etc. Emphasis on legislative background, administrative problems, judicial interpretation of the statutes. Prereq.: 9 cred. 3 cred. per qtr. Warp.
- 129w. Social Legislation and Social Institutions in the Scandinavian Countries.** Prereq.: Soc. 1 or permission. 3 cred. Ar.
- 131f.\* Public Administration: Organization and Areas; Administrative Responsibility.** Prereq.: 6 cred. 3 cred. Short.
- 132w.\* Public Administration: Personnel Administration.** Prereq.: 131 or permission. 3 cred. Short.

- 133s.\* Public Administration: Financial Administration.** Prereq.: 131 or permission. 3 cred. Short.
- 135.\* Problems of Public Planning.** Survey of the history, nature, objectives, and theory of public planning; planning organization and research; city and regional planning, natural resources, and social planning. 3 cred. Warp. (Not offered.)
- 137f.\* American Political Parties.** Role and functions of parties in American government; composition and organization; process of nomination and policy formulation; regulation of organization and activities. Prereq.: 6 cred. or 12 cred. in soc. sci. 3 cred. Christensen.
- 138. American Political Campaigns and Elections.** Prereq.: 6 cred. 3 cred. (Not offered.)
- 141f-142w.\*† European Governments: Theory and Practice.** Prereq.: 6 cred. or 12 cred. in soc. sci. 6 cred. Turner.
- 143s.\* Government of the U.S.S.R. and Adjacent States.** Prereq.: 6 cred. 3 cred. Turner.
- 145f. Government and Politics of the Scandinavian Countries.** Prereq.: Course C or equiv. or permission. 3 cred. Ar.
- Psy.147s. Political Psychology.** Prereq.: Psy. 140. 3 cred. Bird.
- 149f.\* Government and Politics of the British Empire—India and the Tropical Colonies.** Prereq.: 6 cred. or permission. 3 cred. Mills.
- 150w.\* Government and Politics of the British Empire—Development of Dominion Status.** Prereq.: 6 cred. or permission. 3 cred. Mills.
- 151.\* British Problems of Closer Union.** Problems of unity within the British Dominions; regional unions with adjacent states. Prereq.: 149, 150 with grade of C plus or better or permission. 3 cred. Mills. (Not offered 1952-53.)
- 153f.\* Japanese Government and Politics.** Constitutional and political development in Japan; political ideas, government, political parties, and problems. Prereq.: 6 cred. or permission. 3 cred. Quigley.
- 154w.\* Chinese Government and Politics.** Constitutional and political development in China; political ideas, government, political parties, and problems. Prereq.: 6 cred. or permission. 3 cred. Quigley.
- 155w-156s.\* Government and International Relations in Latin America.** Analysis of factors that have conditioned constitutional and political organization of principal Latin-American states; their relations with other American nations; development and nature of the inter-American political system. Prereq.: 6 cred. or permission. 3 cred. per qtr. Christensen.
- 160f.\* American Political Thought.** Appraisal of the more significant political ideas of American statesmen, writers, and movements from colonial times to the present. Prereq.: 6 cred. or 12 cred. in soc. sci. or permission. 3 cred. Sibley.
- 161w.\* Problems of Democracy.** Postulates and implications of democracy; principal criticisms: intellectualist, scientific, psychological and biological, Marxist, fascist. Prereq.: 6 cred. or 12 cred. in soc. sci. or permission. 3 cred. Sibley.
- 162s.\* Recent Political Thought.** Comparison and evaluation of the main ideas in the political philosophy of democracy, socialism, communism, and fascism. Prereq.: 6 cred. or 12 cred. in soc. sci. or permission. 3 cred. Sibley.
- 164f.\* Development of Political Thought: Greece and Rome.** Prereq.: 6 cred. or 12 cred. in soc. sci. or permission. 3 cred. Sibley.
- 165w.\* Development of Political Thought: The Middle Ages.** Prereq.: 6 cred. or 12 cred. in soc. sci. or permission. 3 cred. Sibley.
- 166s.\* Development of Political Thought: Early Modern.** Prereq.: 6 cred. or 12 cred. in soc. sci. or permission. 3 cred. Sibley.
- 167-168-169w.s.\* Political Behavior.** Role of personality and leadership; functions of myth, ideology, and interests; group behavior and public opinion; factors in voting and elections; consequences of organization; attitudes and the psychology of political preference; quantitative techniques in measurement of political behavior. Prereq.: permission. 4½ cred. per qtr. McClosky.

- 171w. **Scandinavian Foreign Policy.** Prereq.: 6 cred. in hist. or pol. sci. or permission. 3 cred. Ar. (Not offered 1952-53.)
- 175f-176w†-177s.\* **Conduct of U.S. Foreign Relations.** 175-176: Control of foreign relations; treaties, executive agreements; State Department; Foreign Service; other agencies. 177: Formation and control of foreign policy. Prereq.: 9 cred. or Hist. 93-94-95 or permission. 3 cred. per qtr. McLaughlin.
- 180f-181w†-182s.\* **International Law.** 180-181: Nature and sources of international law; international legal personality; nationality; territory; jurisdiction; diplomatic and consular agents; treaties. 182: Pacific settlement, war, neutrality. Prereq.: 9 cred. or permission. 3 cred. per qtr. McLaughlin.
- 184f.\* **International Organization I.** Development and conditions of success. Prereq.: 6 cred. or permission. 3 cred. Levi.
- 185w.\* **International Organization II.** International organs for the promotion of international cooperation. Prereq.: 6 cred. or permission. 3 cred. Levi.
- 186s.\* **International Organization III.** International administration; planning for international order. Prereq.: 6 cred. or permission. 3 cred. Levi.
- 187f.\* **Problems of European Reconstruction.** Political, economic, and social conditions of Europe since 1945. Prereq.: 6 cred. or permission. 3 cred. Levi.
- 191.\* **East Asia in International Relations. I.** The period of separatism. Prereq.: 6 cred. or permission. 3 cred. Quigley. (Not offered 1952-53.)
- 192.\* **East Asia in International Relations. II.** The period of inequality. Prereq.: 6 cred. or permission. 3 cred. Quigley. (Not offered 1952-53.)
- 193.\* **East Asia in International Relations. III.** Contemporary developments and problems. Prereq.: 6 cred. or permission. 3 cred. Quigley. (Not offered 1952-53.)
- 195.\* **Colonial Government and the Problems of Imperialism.** Motives of American, British, Dutch, French, and Spanish colonization; ancient and modern imperialism. Prereq.: 6 cred. or permission. 3 cred. (Not offered 1952-53.)
- 196.\* **Colonial Government and the Problems of Imperialism.** Varieties of colonial rule in contemporary empires. Prereq.: 195 or permission. 3 cred. (Not offered 1952-53.)
- 197.\* **The Mediterranean Area in World Affairs.** Economic, political, and strategic conditions; postwar policies of the Western and Asiatic states. Prereq.: 25 or Hist. 125a-126a-127a. 3 cred. Mills. (Probably not offered 1952-53.)
- 201w-202s.\* **Readings in American Government.** Prereq.: permission. 3 cred. per qtr. (Not offered.)
- 204w-205s.\*† **Seminar in Public Law.** Prereq.: 18 cred. or permission. 3 cred. per qtr. Warp.
- 207-208-209.\* **Seminar in Theories of Law and Politics.** Prereq.: 18 cred. or permission. 3 cred. per qtr. (Not offered.)
- 210f-211w-212s.\*† **Special Seminar in Public Administration.** (Registration only with permission of staff.) 3 cred. per qtr. Warp, Ludwig, Short.
- 214w.\* **Seminar in Political Parties.** Prereq.: 12 cred. or permission. 3 cred. Christensen.
- 217w-218s.\* **Seminar in Comparative European Government.** Prereq.: 12 cred. or permission. 3 cred. per qtr. Levi.
- 219-220-221.\* **Seminar in Political Power in the Modern World.** Prereq.: 12 cred. or permission. 3 cred. per qtr. McClosky. (Not offered.)
- 222-223-224.\* **Seminar in Recent Political Thought, American and Foreign.** Special reference to the problems of democracy. Prereq.: 12 cred. or permission. 3 cred. per qtr. (Not offered 1952-53.)
- 225f-226w-227s.\* **Readings in the Classics of Politics.** Plato, Aristotle, Machiavelli, Hobbes, Locke, Rousseau, Mill, Marx, Lenin, Hitler. Prereq.: 164-165, which may be parallel, or permission. 3 cred. per qtr. Lippincott.
- 228.\* **Seminar in Political Theory.** Freedom and control in the democratic state. Prereq.: 12 cred. or permission. 3 cred. Lippincott. (Not offered 1952-53.)
- 229f.\* **Scope and Methods of Political Science.** The field of political science; relation to other studies; types of approach; research methods and techniques; bibliography. Prereq.: permission. 3 cred. Anderson.

- 238f.\* Topics in International Law and Diplomacy I.** Historical development of the law of nations and international judicial agencies. Prereq.: 180-181 or 184 or permission. 3 cred. McLaughlin.
- 239w.\* Topics in International Law and Diplomacy II.** Legal problems in the structure and functioning of international organizations. Prereq.: 180-181 or permission. 3 cred. McLaughlin.
- 240s.\* Topics in International Law and Diplomacy III.** The law of foreign trade and exchange transactions; international commercial conventions. Prereq.: 180-181 or permission. 3 cred. McLaughlin.
- 241s.\* Interdepartmental Seminar on East and South Asia.** The topic, to be announced each year, will serve as a focus for approaches of several departmental disciplines to problems of the area. Prereq.: major in East and South Asian Area Study; others with permission. 2 or 3 cred. Interdepartmental staff; consult Quigley, Mills, Levi.
- 242f-243w-244s.\* Topics in Colonization.** Comparative study of the twentieth-century political and economic problems of American, British, Dutch, and French colonies. Prereq.: 195 or permission. 3 cred. per qtr. Mills.
- 245f-246w-247s.\* Seminar in East Asian Government and International Relations.** Prereq.: 153-154 or equiv. 3 cred. per qtr. Quigley.
- 248w-249s.\* Seminar in International Organization.** Prereq.: 12 cred. or permission. 3 cred. per qtr. Levi.

The following seminars, with credits arranged, offer opportunities for research and directed individual study:

- 251f-252w-253s.\* Public Law.** Anderson, Warp.
- 254f-255w-256s.\* American Government, Politics, and Administration.** Anderson, Short, Christensen, Naftalin, Warp.
- 257f-258w-259s.\* American Constitutional Development.** Ar.
- 261f-262w-263s.\* Local Government.** Anderson, Naftalin.
- 264f-265w-266s.\* Municipal Administration.** Ludwig.
- 271f-272w-273s.\* Comparative European Government and Politics.** Levi.
- 281f-282w-283s.\* Political Theory.** Lippincott, Sibley.
- 291f-292w-293s.\* Far Eastern Government and International Relations.** Quigley.
- 294f-295w-296s.\* Colonization and Imperialism.** Mills.
- 297f-298w-299s.\* International Law and Relations.** McLaughlin, Levi.

### POULTRY HUSBANDRY

Professor Hubert J. Sloan; Associate Professors Thomas H. Canfield, Robert N. Shoffner.

**Prerequisites**—For major and 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**—Candidates for the Master's degree may, upon the approval of the Graduate School, be exempted from the language requirement. 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.

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

**Doctor's Degree**—The division offers work leading to the Ph.D. degree.

### Courses

- 102w. Poultry Breeding.** The principles of genetics and physiology of reproduction as applied to the breeding of poultry. Prereq.: 1, Agron. 31. 4 cred. Shoffner.
- 153s. Poultry Nutrition and Feeding.** A study of the nutrient requirements of poultry and practical feeding systems. Prereq.: 1, Agr.Biochem. 1. 3 cred. Sloan.

- 154f. **Poultry Products.** A study of grades and classes of market poultry and eggs and methods of processing and storage. Prereq.: 1. 3 cred. Ar.
- 214f.w.s.\* **Research in Poultry Husbandry.** Problems assigned to fit the needs of the student. Prereq.: permission. Cred. ar. Sloan, Canfield.
- 215f.w.s.\* **Research in Poultry Nutrition.** Prereq.: 9 cred. in agr. biochem. or equiv. Cred. ar. Sloan.
- 216f.w.s.\* **Research in Poultry Breeding.** Prereq.: 9 cred. in genetics or equiv. Cred. ar. Shoffner.
- 217f.w.s.\* **Poultry Husbandry Seminar.** Special assignments. 1 cred. per qtr. Sloan.

## PSYCHOLOGY

Professors Paul E. Meehl, Ralph F. Berdie, Charles Bird, John G. Darley, Richard M. Elliott, Starke R. Hathaway, William T. Heron, Howard P. Longstaff, Donald G. Paterson, Miles A. Tinker, Edmund G. Williamson; Associate Professors Kenneth E. Clark, Leon Festinger, Kenneth MacCorquodale, William Schofield; Assistant Professors James J. Jenkins, Ephraim Rosen, Wallace A. Russell, Stanley A. Schachter.

**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 fields of proposed specialization. In certain cases completion of preparatory courses in the fundamental sciences may be accepted as part of the prerequisites.

**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.

**Major and Minor**—All candidates should consult advisers in both the major and minor departments.

In general it is expected that all graduate students in psychology, either major or minor, shall have 15 credits of prerequisite work in psychology.

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

**Doctor's Degree**—Work leading to the Ph.D. degree is offered in this department.

### Courses

- 101f-102wf-103s.\* **Experimental Psychology.** An advanced treatment of emotions, psycho-physical methods, association, reaction time, sensation, and perception. After several experiments involving the use of standard equipment, the student completes a minor research project. One lect., four lab. hours per week. Prereq.: 1-2, 4-5 or equiv. in another science. 3 cred. per qtr. Tinker.
- 108f.\* **Systems of Psychology.** A reading course on the chief systems or schools of theoretical psychology. A term paper is required. Prereq.: preparation for advanced work in psy., permission. 3 cred. Elliott.
- 114w. **Human Behavior.** An integrative approach, examining the background, development, and organization of human behavior. Consciousness and purpose are treated as properties of the living body. Prereq.: 1-2, 4-5 or Zool. 1-2-3, or a course in philos. 3 cred. Elliott.

- 125f-126w.\* Psychology of Individual Differences.** Experimental and statistical study. Influence of sex, race, immediate ancestry, environment, and maturity in the causation of individual differences. Investigation of definite problems and analysis of results. Prereq.: 1-2, 4-5, or 5 cred. in statistics. 3 cred. per qtr. Paterson, Jenkins.
- 127f.w.s.\* Projects in the Psychology of Individual Differences.** (Primarily for majors in Sequence C.) Prereq.: 125-126. 3 cred. Paterson, Longstaff, Jenkins.
- 128f-129w.\* Psychology of Learning.** Psychological theory: its characteristics and function. Critical analysis of all learning theories and their application to problems of normal and abnormal behavior. Prereq.: 9 cred. in psy. 3 cred. per qtr. Heron.
- 130f.w.s. Vocational and Occupational Psychology.** Psychology of individual differences in intelligence, aptitudes, interests, and training, with special reference to vocational guidance and problems of vocational adjustment. Lect. and lab. work. Prereq.: 9 cred. in psy. 3 cred. per qtr. Paterson.
- 132f-133w. 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. Particular reference to motivation in complex situations involving set, level of aspiration, the Zeigarnik effect, frustration, etc. Prereq.: 9 cred. in psy. 3 cred. per qtr. Russell. (Offered 1953-54 and alternate years.)
- 135f-136w-137s. Occupational Counseling.** Occupational information as used in counseling; study of educational and occupational training opportunities and requirements. Psychological technique in case analysis, interviewing, and remedial work. Types of vocational problems. Illustrative case histories. Prereq.: for 135-136, 9 cred. or permission; for 137, 130. 2 cred. per qtr. Ar.
- 140w. Social Psychology.** Experimental investigations of group behavior. Emphasis on the place of emotions, drives, and personality traits in the adjustment of individuals to the demands of modern societies. Prereq.: 1-2, 4-5, 9 cred. in soc. sci. 3 cred. Bird.
- 144f-145w.† Abnormal Psychology.** Normal and abnormal behavior contrasted. Emphasis on the dynamics, and particularly the social determinants, of personality maladjustments. Prereq.: 9 cred. in psy.; or 6 cred. in psy. and either Zool. 1-2-3 or 12 cred. in a soc. sci. 3 cred. per qtr. Bird, Rosen.
- 147s. Political Psychology.** Problems and points of view falling within the area of both political science and psychology. Importance of deriving techniques for identification of political attitudes. The part played by psychological factors in the determination of belief, propaganda, and public opinion. Prereq.: 1-2, 4-5, 9 cred. in a soc. sci. 3 cred. Bird.
- 148w. Physiological Psychology.** Elements of neural anatomy and physiology, tonus, neuromuscular set, integration, and the neural basis of learning. The treatment of these topics will stress their importance for psychology. Prereq.: 1-2, 4-5 or Zool. 1-2-3 or permission, 3 cred. Hathaway.
- 151f. Animal Psychology.** Historical, philosophical, and biological foundations: consciousness; motivation; learning; reasoning; judgment; abnormal behavior; social influences. Prereq.: 1-2, 4-5 or equiv. in other sciences. 3 cred. Heron.
- 152w,\*153s.\* Individual Investigations in Animal Psychology.** Prereq.: 151. 3 cred. per qtr. Heron.
- 155s. Industrial Psychology.** Psychological problems in industrial production with special reference to biomechanics (the adaptation of the machine to the capacities and limitations of the operator), work and effort, and the role of communication in an industrial organization. Prereq.: 1-2, Math. 15-16 or equiv. or 10 cred. in statistics. 3 cred. Russell, Jenkins.
- 156w.\* Psychology of Advertising.** Psychological analysis of basic principles underlying advertising and selling. Consumer research is stressed. Research techniques for investigating advertising problems and the analysis of consumer wants considered in detail. 3 cred. Longstaff.
- 160f.w. Psychology in Personnel Work.** Psychology as applied to selection and retention of a stabilized personnel. The standardized interview; principles

- and technique of employment tests; methods of judging character qualities; the rating scale; personnel classification methods. Prereq.: 1-2, 4-5 or 3 cred. in statistics, and principles of econ. or permission. 3 cred. Longstaff.
- 165f. Advanced General Psychology.** Reconsideration of the topics of general psychology with emphasis on behavior theory and the methods of science. Historical backgrounds, learning, motivation, emotion, and language. Prereq.: 1-2 and one course in psy. above 50. 3 cred. MacCorquodale.
- 167w. Techniques and Problems of Public Opinion Analysis.** Emphasis on the determinants of opinion, formulation of questions, methods of sampling, social implications of polling, and applications of polling to elections, morale, and national and international issues. Prereq.: a course in statistics. 3 cred. Clark.
- 168s.\* Research Project in Public Opinion Analysis.** Students in journalism will be assigned to problems in cooperation with technical advisers in journalism. Prereq.: 167. 3 cred. Clark.
- 171f-172w.† Clinical Psychology.** A survey of the methods of clinical psychology emphasizing basic concepts and research problems, especially in a psychiatric setting. Theory of diagnosis, the history and mental status, structured tests, major diagnostic groups, psychological deficit, prediction, psychotherapy, and interprofessional relations. Prereq.: 144, either 125 or Ed.Psy. 120, or 5 cred. in statistics and 6 additional cred. in psy., child welfare, or ed. psy. 3 cred. per qtr. Meehl.
- 200f-201w-202s.† History of Psychology I: European.** Origin and development of scientific psychology. Men, schools, and methods. Emphasis on the experimental period, 1860 to the present. Prereq.: permission. 1 cred. per qtr. Tinker. (Offered 1953-54 and alternate years.)
- 203f-204w-205s.† History of Psychology II: American.** Development of laboratories, departments, apparatus, texts, and journals. Present status. Prereq.: permission. 1 cred. per qtr. Tinker. (Offered 1952-53 and alternate years.)
- 207f-208w-209s. Group Dynamics.** Structure and functioning of social groups. Problems of social change, leadership, productivity, communication, social influence, etc. Prereq.: permission. 2 cred. per qtr. Schachter. (Offered 1952-53 and alternate years.)
- 210f-211w-212s. Research Problems.** Laboratory investigations. Cred ar. Graduate staff.
- 215f,216w,217s. Seminar in Special Areas of Psychology and Related Sciences.** Program based on a syllabus of required and optional reading. Offered irregularly according to announcements in Official Daily Bulletin. Cred. ar. Ar.
- 219s. Psychology of Personality.** A survey of some major methods, problems, and concepts in the field of personality. Introduction to some major theoretical approaches to personality, e.g., Murphy, Murray, Freud, Kardiner, factor-analytic studies of personality, etc. Prereq.: abnormal psy. and undergraduate major in psy. or permission. 3 cred. Rosen.
- 220f-221w-222s.† Personality, Its Structure and Dynamics.** The problem of units, traits, and levels in the description of personality; logical analysis of such concepts as motivation, habit and conflicts; dynamics of motivation; the factor-analytic approach; derived needs and functional autonomy; the problem of anxiety. Prereq.: 246; either 219 or 286; either 129 or 165; and written permission. (Class restricted to 3rd and 4th-year Ph.D. candidates in clin. psy.) 2 cred. per qtr. Meehl. (Offered 1953-54 and alternate years.)
- 225f.w.s. Seminar in Contemporary Research.** Discussion of the problems of psychology and related sciences and reports of research projects. Monthly meetings attended by the department staff and graduate students majoring in psychology. Open for credit to Ph.D. candidates with a major in psychology who have completed one year of graduate study. Other graduate students are urged to attend. Offered only when specially announced in Official Daily Bulletin. 2 cred. Staff.
- 230f-231w-232s. Field Work in Psychometrics and Applied Psychology.** For qualified students. Prereq.: written permission. Cred. ar. Paterson, Darley, Longstaff, and others.

- 235f-236w-237s. Clinical Practice in the Student Counseling Bureau.** Gives qualified students experience in use of psychological and related methods in dealing with individuals. Prereq.: permission of instructor and adviser. 1 to 3 cred. per qtr. Berdie.
- 240f,241w,242s. Seminar in Student Personnel Work.** Topics and problems relating to content, development, and coordination of comprehensive student personnel programs. Critical review of current research being made by university personnel workers. Prereq.: permission. 1 cred. per qtr. Williamson.
- 243f-244w.\* Experimental Psychodynamics.** The application of experimental methods to problems emphasized by the rise of clinical psychology. The relation of certain clinical concepts to learning and motivational theory. Prereq.: 128, 144-145, permission. 3 cred. per qtr. Russell. (Offered 1952-53 and alternate years.)
- Phil.244f-245w-246s. Philosophical Problems of Psychology.** Prereq.: open to advanced graduate students in philos. and psych. with written permission of either instructor. 3 cred. per qtr. Feigl. (1952-53; Feigl, Meehl.)
- 246s. Advanced Abnormal Psychology.** Emphasis on psychoanalytic interpretations of the neuroses. Prereq.: 144-145, 171. 3 cred. Bird.
- 250f\*-251w\*-252s.\* Topics in Psychology.** Independent reading, tutorial conferences, and reports in any field of psychology, such as the psychology of sensation, reaction time, perception of space, Gestalt psychology, differential psychology, social and political behavior, personnel psychology, esthetics, human and animal learning, etc., which meets the approval of one of the listed instructors. The chairman of the department will, if requested, assist the student in selecting the most appropriate instructor to guide reading in a particular field. Cred. ar. Graduate staff.
- 253f-254w. Clinical Use of Projective Techniques.** Restricted to physicians enrolled in graduate work in psychiatry or neurology. Prereq.: M.D. degree, permission. 1 cred. per qtr. Hales. (Not offered 1953-54.)
- 257f-258w-259s.† Methods of Research in Group Behavior.** Methodology of laboratory and field research applied to small groups. Practice and participation in field studies and laboratory experiments. Techniques of observation, sociometry, interviewing, etc. Prereq.: permission. 3 cred. per qtr. Schachter. (Offered 1952-53 and alternate years.)
- 260f\*-261w\*-262s.\* Seminar in Application of Psychological Methods to the Study of Psychiatry.** Recent experimental literature and interpretations in terms of clinical practice. Discussion and experimentation in the field of personality evaluation. Prereq.: permission. 1 cred. per qtr. Hathaway.
- 265-266-267. Seminar in Advanced Clinical Psychology.** A practicum in diagnosis and evaluation of personality traits and structure in relation to occupational and social roles. Prereq.: advanced statistics, Course 171-172, permission. 1 cred. per qtr. Hathaway. (Not offered.)
- 270f.s. Advanced Psychological Measurement.** Lecture and basic text material the same as 70, but graduate students must satisfy additional requirements either by analysis and interpretation of a set of research data, or by writing reports on advanced psychometric topics. 3 cred. Clark.
- 271f-272w-273s. Seminar in the Recent Literature of Psychology.** Acquaints students with a variety of contemporary topics by survey and critical discussions. Prereq.: open to graduate students majoring in psychology who receive permission. 1 cred. per qtr. MacCorquodale.
- 274s. Preclinical Practicum in Clinical Psychology.** A practicum course in the integration of clinical data to precede the psychometric clerkship. Representative case materials presented and discussed, emphasizing the organization of data from the life history, diagnostic interview, physician's findings, and psychometric tests into a meaningful personality description, aiming to develop the student's skills in diagnosis, prediction, and therapy. Training in the use of special tests and techniques will also be included. Open only to graduate majors in clin. psy. Prereq.: 171-172, 291 (or 291 parallel). 2 cred. Schofield and staff.
- 280-281-282. Psychology for Fellows in Psychiatry or Neurology.** Open only to physicians enrolled in the Graduate School. Prereq.: M.D. degree, permission. 1 cred. per qtr. Meehl and staff. (Not offered 1953-54.)

- 286s.\* Advanced Biographical Psychology.** Lecture and basic text material the same as in 86 but graduate students must prepare under tutorial guidance a report based on recent literature in this field. 3 cred. Elliott.
- 290f. Introduction to Projective Techniques.** Survey of the field of projective techniques, emphasizing theory, methodological considerations, and published studies of reliability and validity. Instruction in administration and scoring of some currently used devices, especially the Rorschach. Prereq.: 144-145, 171-172. 3 cred. Rosen.
- 291w. Practicum in Interpretation of Projective Techniques.** Prereq.: 290, written permission. 3 cred. Rosen.
- 292w-293s. Seminar in Theoretical Problems of Group Functioning.** Intensive consideration of theoretical problems in social psychology and the behavior of groups in connection with recent or current research. Prereq.: permission. 2 cred. per qtr. Festinger.
- 295f-296w-297s. Seminar in Individual Differences and Applied Psychology.** Advanced students meet for reports and discussion of contemporary trends in the psychology of individual differences and applied psychology. Prereq.: written permission. 1 cred. per qtr. Paterson.
- 299w. Tabulating Equipment Laboratory.** Gives qualified students an opportunity to become acquainted with use of electric tabulating machines in the treatment of research data. Prereq.: P.H. 110, 111, or equiv. 1 cred. Clark.

### PUBLIC HEALTH

Professors Gaylord W. Anderson, M.D., Dr.P.H., Director, Herbert M. Bosch, M.P.H., Ruth E. Boynton, M.D., M.S., Harold S. Diehl, M.A., M.D., D.Sc., J. Arthur Myers, M.D., Ph.D., Alan E. Treloar, Ph.D.; Associate Professors Ruth E. Grout, Ph.D., C.P.H., Theodore A. Olson, M.A., George O. Pierce, M.S., C.P.H., Stewart C. Thomson, M.P.H., M.D.; Assistant Professors Richard G. Bond, M.S., M.P.H., Ruth von Bergen, M.P.H.; Lecturers Harold S. Adams, B.S., Henry Bauer, Ph.D., Leslie W. Foker, M.D., M.P.H., William A. Jordan, D.D.S., M.P.H.

**Master's Degree**—Offered under both Plan A and Plan B. All candidates for a Master's degree must take basic courses in (1) public health administration, (2) epidemiology, (3) statistics, (4) sanitation, (5) public health nursing, and (6) health education, unless specifically excused by the department.

(Inquiries concerning other work in public health, including courses of study leading to the degrees of master of public health and master of hospital administration, should be addressed to the Director of the School of Public Health, Millard Hall, University of Minnesota, Minneapolis 14, Minnesota.)

### Courses

- 100f.s.† Elements of Preventive Medicine and Public Health.** Occurrence and prevention of communicable, degenerative, and industrial diseases; protection of food, water, and milk; maternal and child health. Prereq.: 3 or 50 or equiv. and a course in bacteriology. 5 cred.; 6 cred. for medical students. Anderson, Thomson.
- 102f. Environmental Sanitation I.** Methods for promoting man's health and comfort by controlling his environment. Prereq.: 50 or 51 or 100 or concurrently with any of these. 3 cred. Pierce, Olson.
- 103f.w.s.\* Public Health Bacteriology.** Bacteriologic and serologic diagnosis, public health laboratory administration and methods. Prereq.: Bact. 101-102, 116, permission. Cred. ar. Bauer.

- 104w\*-105s. Epidemiology.** Factors underlying the spread of infectious diseases, with detailed discussion of selected diseases; simple statistical and epidemiologic methods. Lect., lab., and seminars. Prereq.: 100, permission. 140 or 110-111 must be taken concurrently or previously. 3 cred. per qtr. Ar.
- 106w.\* Public Health Administration.** Structure, basic functions, and activities of public health agencies. Prereq.: 100. 3 cred. Anderson.
- 107f. Child and Adult Hygiene.** Maternal, child and adult hygiene in public health programs. Lect., field trips. (Physicians; others by permission.) Prereq.: 100. 3 cred. Boynton and associates.
- 109s. Institutional Sanitation.** Sanitation practices in hospitals and other institutions. (For hospital administrators; others by permission). 3 cred. Prereq.: 100, 106. Bosch, Pierce, Olson, Bond.
- 112. Public Health Engineering—Plan Examinations.** (For engineers). Prereq.: 102 or permission. 112af: Water Supplies. 1 cred. Bosch, Pierce. 112bw: Waste Disposal Systems. 1 cred. Bosch. 112cw: Swimming Pools and Plumbing. 1 cred. Pierce.
- 113. Public Health Engineering—Field Investigations.** (For engineers; others by permission). Prereq.: 102. 113aw: Water Supplies. 2 cred. Bosch, Pierce. 113bs: Waste Disposal. 2 cred. Bosch. 113cs: Swimming Pools and Plumbing. 2 cred. Pierce.
- 114f.¶ Environmental Sanitation II.** Public health supervision of activities in field of sanitation. Prereq.: 102. 2 cred. Bosch, Pierce, Olson.
- 115w. Food Sanitation.** Sanitary problems in production, processing, and distribution of milk, meat, shellfish, and other foods; methods of public health supervision. Prereq.: 102, and either 100 or 104. 3 cred. Olson.
- 116s.\*¶ Public Health Engineering Administration.** Administrative organization of environmental sanitation activities. Prereq.: 102, 100 or 104, 106. 2 cred. Bosch.
- 117f-118w. Sanitary Biology.** Survey of plant and animal forms important in environmental sanitation, with special reference to disease vectors. Prereq.: permission. 3 cred. per qtr. Olson.
- 119f,w,s,su. Field Practice in Environmental Sanitation.** Prereq.: permission. Cred. ar. Ar.
- 122s.\* Public Health Administration Problems.** Budgeting, program planning and appraisal of public health procedures. Prereq.: 106. 3 cred. Anderson.
- 123f,w,s. Topics in Public Health.** Selected readings and problems. Prereq.: permission. Cred. ar. Staff.
- 125s. Community Health Education Programs.** Group procedures, community organization, public relations, and development and use of media. Prereq.: 100, or 104 and 106. 3 cred. Grout.
- 126f. Industrial Health Problems.** Industrial hazards and their control. Prereq.: 100, Chem. 1-2 or equiv., or permission of department. 3 cred. Foker.
- 127f. Industrial Health Problems—Nursing Aspects.** Organization and administration of nursing service in industrial health programs. Prereq.: 126 parallel. 1 cred. Ar.
- 129f,w,s. Field Work in Industrial Nursing.** Visits to industrial health services to demonstrate range of industrial health problems; supervised experience in industrial medical unit. Prereq.: 67. Cred. ar. Ar.
- 133w,s. Mental Hygiene.** Emotional factors underlying wholesome family relations; problems which interfere with successful adjustment in family and community life. Prereq.: 62 or experience in public health nursing. 3 cred. Wood.
- 135s. Conservation of Hearing.** Detection, prevention, and amelioration of hearing impairments. Prereq.: 100 and 62 or parallel. 1 cred. Boies and associates.
- 136s. Sight Conservation.** Conditions that impair human vision; community programs of vision testing and correction of defects; sight conservation. Prereq.: 100 and 62 or parallel. 1 cred. Hansen and associates.

¶ Students who have taken 112, 113, or 116 will not be given credit for 114.

- 137s. Dental Health.** Conditions resulting in tooth decay and loss; preventive and corrective measures; mouth hygiene; community programs for dental health. Prereq.: 100 and 62 or parallel. 1 cred. Jordan.
- 138f.w.s. Field Work in Child Hygiene.** Field practice, conferences, and seminars in child care. Prereq.: permission. Cred. ar. Ar.
- 139f.w.s. Special Field Work for Students in Mental Hygiene Program.** Experience in gaining further insight into handling problems of human dynamics in all age groups. Prereq.: permission. Cred. ar. von Bergen and associates.
- 141s. 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. Prereq.: permission. 3 cred. Mickey.
- 152f.w.s. Industrial Hygiene Engineering.** Field and laboratory methods used by industrial hygiene engineers in study and control of occupational health hazards. Prereq.: permission. 3 cred. Pierce.
- 170w.\* Supervision in Public Health Nursing.** Supervision as guidance; methods of supervision; administrative functions; preparation and selection of supervisors. Prereq.: 100, 62, 63, and experience in public health nursing, or permission. 3 cred. Ar.
- 171f.w.s.\* Problems in Public Health Nursing.** For advanced students; includes methods used in studies and doing one study. Prereq.: 170 or permission. Cred. ar. Ar.
- 173f.w.s. Field Work in Supervision of Public Health Nursing.** For public health nurses only. Prereq.: 170 or permission. Cred. ar. Ar.
- 174f.w.s. Supervision Laboratory.** Critical analysis of supervisory problems, procedures, and methods. Prereq.: 170 or parallel; public health nurses only. 2 cred. Ar.
- 181f.w.s. Principles and Methods in Community Health Education.** Seminars, field trips, and laboratory in group procedures, community organization, public relations, and development and use of media. Prereq.: permission. Cred. ar. Grout and associates.
- 190f.w.s. Field Work in Community Health Education.** Three months of approved field experience. Prereq.: 125, 181, 227. Cred. ar. Grout and associates.
- 200f.w.s.\* Research.** Opportunities will be offered by the University and by the various collaborating organizations for qualified students to pursue research work. Cred. ar. Staff.
- 210f.w.s.\* Seminar in Public Health.** Cred. ar. Staff.
- 212f.w.s. Seminar in Public Health Engineering and Sanitation.** Cred. ar. Bosch, Pierce, Olson.
- 215f.w.s. Maternal and Child Health.** Study of administration and active participation in well-child and antepartum conferences; psychosomatic problems of children. (Physicians only; permission.) Cred. ar. Boynton.
- 227f.w.s. Problems in the Community Health Education Programs.** Independent study and experimentation in health education. Prereq.: permission. Cred. ar. Grout and associates.

**Note**—See also courses in Biostatistics and Physiological Hygiene, pages 58 and 167.

(For courses leading to the professional degree of master of hospital administration, see **School of Public Health Announcement**.)

## RADIOLOGY

For staff and courses of study offered, see the *Graduate Medical Bulletin*.

## ROMANCE LANGUAGES

Professors Francis B. Barton, Raymond L. Grismer, Walter T. Pattison; Associate Professors Emmert M. Brackney, Herbert E. Clefton, Elizabeth Nissen; Assistant Professors Rodolfo O. Floripe, Thomas B. Irving.

**Prerequisites**—For major work, 27 Senior College credits or equivalent; for minor work, 18 Senior College credits or equivalent.

**Language Requirement**—A candidate for the Master's degree must have a reading knowledge of at least one modern language other than the language of his major field. Candidates for the Doctor's degree must have a knowledge of Latin equivalent to at least two 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 a second foreign language.

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

**Doctor's Degree**—Offered in both French and Spanish.

**Note**—For information on work in Comparative Literature, see page 21.

## Courses

## FRENCH

- 100s. Practical French Phonetics.** Prereq.: 20 or 53-54 or permission. 3 cred. Ar.
- 103f-104w-105s.† French Syntax and Composition.** Special studies in characteristic problems of French syntax. Prereq.: 63 or parallel. 3 cred. Barton.
- 107s. Cours de Style.** Prereq.: 63-64 or permission. 3 cred. Ar.
- 110f\*-111w\*-112s.\*‡ French Literature: Nineteenth Century.** 100: Chateaubriand and Romantic prose; 111: Drama; 112: Poetry. Prereq.: 70-71-72 or 73-74. 3 cred. per qtr. Barton, Clefton.
- 113. Ste. Beuve and the Modern French Critics.** Prereq.: 70-71-72 or 73-74 or permission. 3 cred. Ar. (Not offered 1952-53.)
- 115f\*-116w\*-117s.\*‡ French Literature: Seventeenth Century.** 115: Formation of the classic ideal; 116: Corneille, Molière, Racine; 117: Moral and didactic literature. Prereq.: 70-71-72 or 73-74. 3 cred. per qtr. Ar.
- 118f-119w-120s.\*‡ French Literature: Eighteenth Century.** 118: Beginnings of the philosophic movement, Bayle, Montesquieu, Diderot; 119: Voltaire; 120: Rousseau. Prereq.: 70-71-72 or 73-74. 3 cred. per qtr. Clefton.
- 121-122-123.\* French Literature: Sixteenth Century.** 121: The Rhétoriciens, Marot, Rabelais; 122: The *Pléiade*; 123: Montaigne, Amyot. Prereq.: 9 cred. in lit. above 74 or permission. 3 cred. per qtr. (Not offered 1952-53.)
- 130. French Romantic Poetry: Victor Hugo.** Prereq.: 70-71-72 or 73-74. 3 cred. Clefton. (Not offered 1952-53.)
- 131. Parnassian Poetry.** Prereq.: 70-71-72 or 73-74. 3 cred. Clefton. (Not offered 1952-53.)
- 132f. Baudelaire.** Prereq.: 70-71-72 or 73-74. 3 cred. Clefton. (Offered 1952-53.)
- 146w.\* Contemporary French Dramatic Literature.** Prereq.: 70-71-72 or 73-74. 3 cred. Barton. (Offered 1953-54 and alternate years.)
- 156s. French Realistic Novel.** Prereq.: 70-71-72 or 73-74. 3 cred. Barton. (Offered 1952-53 and alternate years.)
- 157. French Novel: France, Loti, and Bourget.** Prereq.: 70-71-72 or 73-74. 3 cred. Brackney. (Not offered 1952-53.)
- 158. Contemporary French Novel I.** Course conducted in French. Prereq.: 70-71-72 or 73-74. 3 cred. (Alternates with 159. Not offered 1952-53.)
- 159w. Contemporary French Novel II.** Continuation of Course 158. Social problems. Prereq.: 70-71-72 or 73-74. 3 cred. Ar.

† Students may enter any quarter with permission of instructor.

- 171f-172w-173s.\*† **History of French Language.** Lectures and illustrative texts giving the development of the French language from its origins to the nineteenth century. Especially intended for prospective teachers. Prereq.: one year of Latin or permission. 1 cred. per qtr. Brackney.
- 181-182-183.\*†¶ **Movement of Ideas in French Literature.** 181: Sixteenth and seventeenth centuries; 182: Nineteenth century; 183: Contemporary period. 3 cred. per qtr. Desgranges. (Not offered 1952-53.)
- 201f-202w-203s. **Old French Phonology and Morphology.** Lectures on the origin and development of the French language, with practical exercises and reports on assigned topics. 2 cred. per qtr. Brackney.
- 204f-205w-206s. **Reading in Old French Literature.** Introductory course in reading of Old French. Different types of literature read and their origin and development discussed. Collateral reading required. 2 cred. per qtr. Brackney.
- 207f-208w-209s. **Old Provençal.** Reading in early Provençal literature with special attention to the poetry of the troubadours. 2 cred. per qtr. Brackney.
- 222f-223w-224s.\* **French Seminar. Classical Period.** 2 cred. per qtr. (Not offered 1952-53.)
- 225f-226w-227s.\* **French Seminar. Romanticism.** 2 cred. per qtr. (Offered 1952-53.)
- 230f-231w-232s. **Research Methods and Material.** 1 cred. per qtr. Ar.
- 259f-260w-261s.\* **Directed Readings in Romance Languages.** Cred. depends upon amount of work accomplished. Staff.

## ITALIAN

- 159f-160w.¶ **Dante.** The "Divina Commedia." (Alternates with 161-162.) Prereq.: one course above 50. 3 cred. per qtr. Nissen. (Offered 1952-53.)
- 161f-162w. **The Sixteenth Century.** Reading of texts and study of literary influences. Prereq.: one course above 50. 3 cred. per qtr. Nissen. (Not offered 1952-53.)
164. **Dante (in English).** Lectures, reading, and discussion of the "New Life" and the "Divine Comedy." Prereq.: permission. 3 cred. Nissen. (Not offered 1952-53.)

## SPANISH

- 103f-104w-105s. **Spanish Syntax and Composition.** Prereq.: 60 or parallel. 1 cred. per qtr. Irving.
- 110f\*-111w\*-112s.\* **Spanish Literature: Nineteenth Century.** Prereq.: 65-66-67 or 68-69. 3 cred. per qtr. Pattison.
- 115f-116w-117s.\*¶ **Spanish Literature: Seventeenth Century.** 115: The drama; 116: The novel; 117: Lyric and epic poetry. Prereq.: 65-66-67 or 68-69. 3 cred. per qtr. Grismer. (Alternates with 155-156-157. Offered 1953-54.)
120. **The Ballad.** Prereq.: 65-66-67 or 68-69. 3 cred. (Not offered 1952-53.)
130. **Cervantes: Don Quijote.** Prereq.: 65-66-67 or 68-69. 3 cred. Grismer. (Not offered 1952-53.)
131. **The Picaresque Novel.** Prereq.: 65-66-67 or 68-69. 3 cred. Grismer. (Not offered 1952-53.)
- 140f-141w-142s. **Contemporary Latin-American Literature.** Prereq.: 65-66-67 or 68-69 or 74-75-76. 3 cred. per qtr. Ar.
- 143\*-144\*-145.\* **Colonial and Nineteenth-Century Latin-American Literature.** Prereq.: a survey of the literature of Spain or Latin America. 3 cred. per qtr. (Not offered 1952-53.)
- 155f-156w-157s.\*¶ **Spanish Literature: Sixteenth Century.** 155: The drama; 156: Cervantes and the novel; 157: Poetry, the mystics. Prereq.: 65-66-67 or 68-69. 3 cred. per qtr. Grismer. (Alternates with 115-116-117. Offered 1952-53.)
- 174-175-176. **Contemporary Spanish Literature.** 174: The drama; 175: The novel; 176: Poetry. Prereq.: 65-66-67 or 68-69. 3 cred. per qtr. Pattison. (Alternates with 110-111-112. Not offered 1952-53.)
- 230f-231w-232s. **Research Methods and Materials.** 1 cred. per qtr. Grismer.
- 241f-242w-243s.\* **Old Spanish Philology.** 2 cred. per qtr. Grismer.

† Students may enter any quarter with permission of instructor.

- 244-245-246.\* Old Spanish Literature.** Every year a different genre is studied, such as the epic. Subject to be decided by arrangement with students. 2 cred. per qtr. (Not offered 1952-53.)
- 247f-248w-249s. Spanish Seminar: Hispano-Arabic Culture.** 2 cred. per qtr. Irving.
- 250f-251w-252s.\* Spanish Seminar: Contemporary Poetry.** 2 cred. per qtr. Floripe.
- 253f-254w-255s. Seminar in Spanish-American Literature.** 2 cred. per qtr. Ar.

## SCANDINAVIAN

Professor Alrik Gustafson; Associate Professor Lynwood G. Downs; Visiting Lecturers.

**Prerequisites**—In the Department of Scandinavian Languages and Literatures: for major work, 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 Studies: see special bulletin, *University of Minnesota Program in Scandinavian Area Studies*. This program is subject to change subsequent to the publication of the present *Graduate School Bulletin*.

**Language Requirement**—Candidates for the Master's degree must have reading knowledge of one foreign language in addition to one of the Scandinavian languages.

**Master's Degree**—In the Department of Scandinavian, offered under both Plan A and Plan B; and in Scandinavian Studies, only under Plan B.

**Note**—For information on work in Comparative Literature, see page 21.

### Courses§

- Geog.106w. Geography of Scandinavia.** 3 cred. Ar.
- Germ.113f-114w. Gothic.** 113: Gothic. An introduction to Germanic linguistics and to a comparative study of Indo-European languages. 3 cred. Downs; 114: Gothic Texts. 3 cred. Downs. (Not offered 1952-53.) Prereq.: 80 and 11 cred. above 59 or equiv.
- Soc.117s. Scandinavian Folk Movements: Their Social and Political Significance.** Prereq.: Soc. 1 or permission. 3 cred. Ar.
- Hist.122f-123w-124s. History of the Scandinavian Countries.** 3 cred. per qtr. Lindberg.
- Pol.Sci.129w.\* Social Legislation and Social Institutions in the Scandinavian Countries.** Prereq.: Soc. 1 or permission. 3 cred. Kolehmainen.
- Pol.Sci.145f. Government and Politics of the Scandinavian Countries.** Prereq.: Pol.Sci. 7 or equiv. or permission. 3 cred. Kolehmainen.
- Scand.161f.\* Scandinavian Novel of the Late Nineteenth Century.** "The great tradition" in the modern Scandinavian novel, and the circumstances, intellectual and political, social and economic, out of which it grew. Prereq.: 4-5-6 or 10-11-12 or 8 cred. in lit. 3 cred. Gustafson.
- Scand.162w.\* Contemporary Scandinavian Novel.** Characteristic trends in Scandinavian life and thought in the twentieth century as expressed in the between-the-wars novel. Prereq.: 4-5-6 or 10-11-12 or 8 cred. in lit. 3 cred. Gustafson.
- Scand.171f.\* Ibsen and the Beginnings of the Modern Drama.** Intensive examination of the plays of Ibsen, especially with reference to the role he has played as "the founder" of the modern European drama. Prereq.: 4-5-6 or 10-11-12 or 8 cred. in lit. 3 cred. Gustafson.

§ A knowledge of one of the Scandinavian languages is not required of those enrolled in these courses who are not pursuing major work in Scandinavian.

- Scand.172w.\* Strindberg and the Drama in Revolt and Transition.** Strindberg as master of the naturalistic drama and as "the father of modernity" in the European and American theater since his day. Prereq.: 4-5-6 or 10-11-12 or 8 cred. in lit. 3 cred. Gustafson.
- Scand.173s.\* Contemporary Scandinavian Theater.** The Scandinavian theater today, particularly with reference to its "experimental" trends both in dramatic composition and staging. Prereq.: 4-5-6 or 10-11-12 or 8 cred. in lit. 3 cred. Gustafson.
- Germ.176-177-178. Problems and Research Trends in Germanic Philology.** 176: The Germanic languages. 3 cred.; 177: The Germanic literary tradition. A comparative discussion of native and foreign records of the Old Germanic Period. 3 cred.; 178: Linguistic geography. 3 cred. Prereq.: two Germanic dialects. (Not offered 1952-53.)
- Hist.176bf-177bw-178bs.\* Selected Readings in Scandinavian History.** 3 cred. per qtr. Lindberg.
- Scand.191f-192w-193s. Readings in the Scandinavian Literatures.** Intensive readings in representative texts—Danish, Norwegian, or Swedish. Prereq.: 4-5-6 or 10-11-12. 3 cred. per qtr. Gustafson.
- Scand.215-216-217.\* Studies in Scandinavian Romanticism.** 3 cred. per qtr. Gustafson. (Not offered in 1952-53.)
- Scand.218f-219w-220s.\* Studies in Late Nineteenth-Century Scandinavian Literature.** 3 cred. per qtr. Gustafson.
- Scand.221f-222w-223s.\* Dramatic Interpretative Problems in Strindberg.** 3 cred. per qtr. Gustafson.

## SOCIAL WORK

Professors John C. Kidneigh, F. Stuart Chapin, Elio D. Monachesi; Associate Professors Werner W. Boehm, Richard G. Guilford, Gisela Konopka, Verval J. Mueller, Malcolm B. Stinson; Assistant Professors Maurice F. Connerly, Genevieve F. Miner, Ruby B. Pernell, Dorothy A. Whitmore, Helen J. Yesner; Lecturers Hyman S. Lippman, Kenneth Murase, Marvin Sukov.

**Prerequisites**—An applicant of satisfactory scholastic record 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, 400 Ford Hall, University of Minnesota, Minneapolis 14, Minnesota.

Applications and transcripts in duplicate must be filed in advance of the registration date. 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 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 when available, 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 below.

**Language Requirement**—For the Master's degree a foreign language is not required, but is strongly recommended. 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.

**Master's Degree**—The degree of master of social work requiring two years of graduate study will be awarded to students who fulfill the following requirements:

1. Ninety credits including a 9-quarter credit degree project (as indicated below) must be presented with an average grade of B or better.
2. One or more courses from each of the basic eight areas in Social Work which are:

Case work Psychiatric and psychological information Medical information Public welfare	Social administration Community organization Group work Social research
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3. A project of 9 quarter credits consisting of seminar research papers or a single research report requiring independent work under faculty supervision which shows capacity for critical evaluation and analysis must be presented. Preferably all 9 credits should be earned under the supervision of 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 above 100, (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 seven 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 end of the quarter preceding the quarter in which the degree is to be conferred, the student shall apply for admission to candidacy for the degree, using the appropriate application form. The application for candidacy will be reviewed by the faculty of the School of Social Work and recommended to the Graduate School dean, through the appropriate graduate group committee, for acceptance or rejection.
10. Not later than the beginning of the final quarter's work and after admission to candidacy, the student shall submit, through his major adviser, a program of all credits presented for the degree upon the appropriate degree program form.

Students who began their work prior to fall quarter, 1948, may complete a program already started for the master of arts degree in social work under either Plan A or Plan B. Such students may, in lieu of completing requirements for the master of arts degree in social work, become candidates for the degree of master of social work provided they fully meet all standards indicated above.

**Doctor's Degree**—Students who have the Master's degree in social work from this school, or the comparable Master's degree from a member school of the American Association of Schools of Social Work, may, if their records are distinctly superior, become candidates for the Ph.D. degree in social work (requiring at least two years of post-Master's graduate work).

(**Note**—Students may be awarded a certificate in social work on the completion of 45 quarter credits. For detailed information consult the *Bulletin of the School of Social Work.*)

## Courses

### A. GENERAL SOCIAL WORK

- 200f. The Field of Social Work.** Fields of specialization, functions of agencies, and contributions made by outstanding leaders. 3 cred. Ar.  
**201s. The History and Theory of Social Work.** 3 cred. Ar.  
**205f, 206w, 207s. Special Topics in Social Work.** Cred. ar. Staff.  
**209f, w.s. Seminar in Social Agencies and Institutions.** Cred. ar. Staff.

### B. FIELD WORK

- 210f-211w-212s. Initial Field Training in Social Work.** Field practice under direct supervision. Prereq.: 220 or 282A, parallel, or equiv. Cred. ar. Staff.  
**215f, w.s-216f, w.s-217f, w.s. Advanced Field Training in Social Work.** Field practice under direct supervision. Prereq.: 221 or 282B. Cred. ar. Staff.  
**219f, w.s. Seminar for Field Training Supervisors.** Limited to persons engaged in supervising students in field work. Cred. ar. Staff.

### C. CASE WORK

- 220f. Case Work I.** A study of the generic processes in social case work practice and an approach to understanding the individual in the social situation with some exercise in the process of case analysis. Prereq.: 210 parallel, or equiv. 3 cred. Whitmore.  
**221w-s. Case Work II.** A continuation of Case Work I, emphasizing critical analysis of the case work process and development of skills in case work method. Prereq.: 220 plus 211, 236, both of which may be parallel or equiv. 4 cred. Whitmore.  
**222f-w. Advanced Case Work.** Case discussions focused primarily on treatment processes. Prereq.: 221 or equiv. 4 cred. Boehm, Mueller.  
**224f, w.s. Seminar in Case Work in the Public Agency.** Prereq.: Course 221 or permission. Cred. ar. Scott. (Not offered 1952-53.)  
**225w.s. Seminar in Family Case Work.** Prereq.: 221 or permission. Cred. ar. Boehm.  
**226w. Seminar in Case Work in Health Problems.** Prereq.: 221 or permission. Cred. ar. Mueller.  
**227f, w.s. Seminar in Case Work in the Psychiatric Setting.** Prereq.: 221, 215-216-217, parallel. Cred. ar. Ar.  
**228f. Seminar in Social Case Recording.** Cred. ar. Ar.  
**229s. Seminar in Case Work Supervision.** Prereq.: 222 or 230 or 251 or 261. Cred. ar. Ar.

## D. PSYCHIATRIC AND PSYCHOLOGICAL COURSES

- 235s. Introductory Psychiatry.** A lecture course: mental hygiene, mental mechanisms, psychiatric history taking, review of schools of psychiatry, classification of mental diseases. 3 cred. Ar.
- 236f-w. Personality Development as It Affects Social Work.** Factors involved in personality development and how these factors aid social work practice. Prereq.: 220, which may be parallel. 4 cred. Winer.
- 239s. Seminar in Psychiatric Social Work.** Prereq.: 230, 235, 236. 2 cred. Lippman.
- 240w. Dynamics of Human Behavior Based on Psychoanalytic Theory.** Prereq.: 235. 2 cred. Lippman.

## E. MEDICAL SOCIAL WORK

- 250w. Medical Information for Social Workers.** A discussion of diseases most often encountered in social work, with a consideration of their social implications. Prereq.: P.H. 50 or 51 or equiv. 3 cred. Mueller.
- 259f,w,s. Seminar in Medical Social Work.** Prereq.: 222, which may be parallel. Cred. ar. Mueller.

## F. CHILD WELFARE

- 260s. The Child and the State.** Development of the rights of the child in relation to parental rights as evidenced in child labor laws, the juvenile courts, adoption, aid to dependent children, the changing status of the illegitimate child, and public organization for more effective administration of laws relating to child dependency, delinquency, and neglect. 3 cred. Guilford.
- 262s. Principles of School Social Work.** Case work function of social worker in public school programs with discussion of problems met by the visiting teacher. Prereq.: 221. 2 cred. Laabs.
- 266f,w,s. Seminar in Child Welfare.** Cred. ar. Guilford.

## G. PUBLIC WELFARE

- 267f. Public Welfare I.** Historical development and existing functions of present-day public welfare services. 3 cred. Guilford.
- 268w. Public Welfare II.** Continuation of Public Welfare I. Prereq.: 267. 2 cred. Guilford.
- 269f,w,s. Seminar in Public Welfare Administration.** Prereq.: 268. Cred. ar. Stinson.

## H. SOCIAL ADMINISTRATION AND COMMUNITY ORGANIZATION

- 275s. Principles of Administration Applied to Social Work.** A technical study of the process of translating social policy into social services. 3 cred. Kidneigh.
- 276f. Legal Aspects of Social Work.** Legal information for social workers to furnish background for understanding social problems having legal implications. Not designed to teach technical law. 3 cred. Ar.
- 279f. Seminar in Administration and Community Organization.** Prereq.: 275, 280. Cred. ar. Kidneigh.
- 280s. Community Organization.** Analysis of the process by which groups and individuals in a community work together toward a social goal and the professional worker's role in this process. Prereq.: 220, 282, or permission. 2 cred. Kidneigh.

## I. GROUP WORK

- 282Afs. Principles of Group Work I.** A general introduction to the group work process and its use in various fields. 3 cred. Konopka, Saloshin.
- 282Bw. Principles of Group Work II.** Understanding of the group process, formation of groups, the role of the group worker in relation to different kinds of groups, and the effect of social forces in the community on group behavior. Prereq.: 282A plus 211 and 236, which may be parallel. 2 cred. Konopka.

- 283w. Use of Program in Groups I.** Understanding of program as a tool in meeting the needs of the individual in the group and of the community. Prereq.: 282A. 2 cred. Saloshin.
- 284f. Use of Program in Groups II.** Continuation of 283. Emphasis on the teaching of principles and practice of the discussion method. Prereq.: 282A. 1 cred. Pernell.
- 285s. Group Work III.** Intensified understanding of the individual in the group. Analysis of record material taken from normal and therapeutic groups including referral process. Prereq.: 282B. 2 cred. Konopka.
- 286w. Group Work IV: Therapeutic Group Work.** Group work in a psychiatric setting. Work with individuals in a group for therapeutic purposes. Prereq.: 282A, 230, 251, or 261. 2 cred. Konopka.
- 287f. Supervision and Administration in Group Work I.** Principles and practice of administrative supervision, departmental planning, financing, budgeting work with board, staff, and volunteers. Supervision of staff and volunteers. Use of supervisory records. Prereq.: 284, 286. 2 cred. Konopka. Pernell.
- 288w. Supervision and Administration in Group Work II.** Principles of relationship and responsibility of the professional group worker toward the field of social work, related fields, and the wider community. Prereq.: 287. 2 cred. Pernell.
- 289f.w.s. Seminar in Group Work.** Cred. ar. Konopka.

#### J. RESEARCH

- 293f.w.s.\* Special Studies in Social Work.** (Fulfills 9 cred. requirement for degree project.) Cred. ar. Staff.
- 299w.s. Seminar in Recent Research in Social Work.** Cred. ar. Stinson.
- 300f.w.s. General Seminar in Social Work.** Prereq.: Master's degree in social work. Cred. ar. Staff.
- Soc.180w. Methods of Social Research.** Prereq.: Soc. 45 or 182 or equiv. 3 cred. Monachesi.
- Soc.182f. Statistical Methods.** Prereq.: Soc. 1 and 15 cred. in soc. sci., child welfare, ed., philos., or psy., or permission. 3 cred. Chapin.
- Soc.183s. Problems in Social Measurement.** Prereq.: Soc. 45 or 182 or equiv. 3 cred. Monachesi.

#### SOCIOLOGY

Professors Elio D. Monachesi, F. Stuart Chapin, Lowry Nelson, Arnold Rose, George B. Vold, Malcolm M. Willey; Associate Professors Theodore Caplow, Don Martindale.

**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.

**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.

**Note**—For information on work in Statistics, see pages 27-28.

#### Courses

##### I. SOCIAL PROBLEMS AND SOCIAL POLICY

- 100s. Contemporary Penology.** Analysis of some of the more important developments in recent attempts at the treatment of criminals and the prevention of crime. Prereq.: 1, 53, 15 cred. in soc. sci., child welfare, ed., philos., or psy., or permission. 3 cred. Vold.

- 101f. Criminological Theories—Historical and Contemporary.** Consideration and evaluation of major historical and contemporary theories of criminal behavior. Prereq.: same as 100. 3 cred. Vold.
- 102w. Adult Parole and Probation.** Critical examination of problems and practices in the supervision of adult criminals. Prereq.: Same as 100. 3 cred. Vold. (Not offered 1952-53.)
- 103f. Juvenile Courts and Probation.** Historical, legal, and social aspects of juvenile courts and probation. A critical survey of juvenile courts and probation work based upon a consideration of the nature of delinquent behavior. Prereq.: 53. 3 cred. Monachesi.
- 104w. Police Problems and Practices in the United States.** Personnel, organization, and public relations of police forces. Special attention to successful techniques of intergrading police work with other community agencies. Prereq.: Same as 100. 3 cred. Vold.
- 106f. City Planning.** General survey of economic, governmental, social, and technical phases of city planning and group housing. (Same as Arch. 104 and Pol. Sci. 123.) 3 cred. Jones, Anderson, Caplow, Filipetti, Vaile.
- 111w. Population Trends.** Cultural and social phases of population change as related to the institutional aspects of both rural and urban life. Population policy considered with particular reference to the U. S. Prereq.: 1, 15 cred. in soc. sci., child welfare, ed., philos., or psy., or permission. 3 cred. Ar.
- 112s. World Population Problems.** Population policy, both historical and present-day, in Europe, Asia, and other selected areas but with emphasis on the U. S. Some discussion of the field of population and power politics. Prereq.: Same as 111. 3 cred. Ar.
- 115w. 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. Prereq.: same as 111. 3 cred. Caplow.
- 116s. Population Theory in the Scandinavian Countries.** Prereq.: 1 or permission. 3 cred. Ar.
- 117s. Scandinavian Folk Movements: Their Social and Political Significance.** Prereq.: 1 or permission. 3 cred. Ar.

## II. SOCIAL PSYCHOLOGY AND SOCIAL PROCESSES

- 120f.w. Social Psychology.** Summary of research and theory regarding the relation of the individual to social groups. Emphasis on the socialization process; effects of social interaction and isolation; individual behavior under conditions of social organization and disorganization; collective behavior in the crowd, the mass, the public, and the institution. Prereq.: same as 111. 3 cred. Rose.
- 122w. 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. Prereq.: same as 111. 3 cred. Vold.
- 123f.s. Intergroup Relations.** Interaction of racial and cultural groups in America. Processes leading to group contact; characteristics and contributions of ethnic groups in the U. S.; 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. Prereq.: same as 111. 3 cred. Rose.
- 124s. Social Mobility.** Relationship of social mobility to a system of social stratification. Analysis of vertical and horizontal mobility. Relationship of social mobility to social organization. Social mobility in contemporary societies with special reference to the U. S. Prereq.: Same as 111. 3 cred. Ar.

## III. SOCIAL ORGANIZATION AND SOCIAL INSTITUTIONS

- 140w.s. 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. Prereq.: same as 111. 3 cred. Chapin.

- 141f.w.s. The Family.** Evolution of the family: development of family unity or disunity, the roles of the several members of the family, methods of investigation of the family. Prereq.: same as 111. 3 cred. Johnson.
- 142. Religion as a Social Institution.** Prereq.: same as 111. 3 cred. Ar. (Not offered 1952-53.)
- 143. The Newspaper as a Social Institution.** Prereq.: same as 111. 3 cred. Ar. (Not offered 1952-53.)
- 144w. Social Stratification.** Social stratification as a phase of social organization. Analysis of caste; estates and social classes. Analysis of social stratification in contemporary societies with special reference to the U. S. Prereq.: 140, 15 cred. in soc. sci., child welfare, ed., philos., or psy., or permission. 3 cred. Ar.
- 145s. Urban Sociology.** Introduction to study of the city as a social organization. Emphasis on analysis of urbanism as a way of life, and on relationship between spatial and social configurations. A brief research project under supervision, using material drawn from the Twin Cities, is required. Prereq.: same as 111. 3 cred. Caplow.
- 146f. Industrial and Occupational Sociology.** Analysis of the occupational group, the factory, and the business enterprise as social institutions, with attention to contrasting functions of formal and informal organization, and to the significance of cooperation, authority, communication, status, and group norms in the working situation. Prereq.: 1, 15 cred. in soc., psy., pol. sci., or econ. 3 cred. Caplow.

#### IV. RURAL LIFE AND WELFARE

- 160f. Rural Community Organization.** Historical evolution, ecological characteristics, and demography of the rural community; the social processes, stratification, assimilation, conflict, and cooperation as manifested in rural society. Prereq.: same as 111. 3 cred. Nelson.
- 161s. Rural Community Analysis.** Primarily for prospective rural teachers and extension workers. Emphasis on methods of making field studies of communities. Prereq.: 1, 15 cred. in soc. sci., or permission. 3 cred. Ar.
- 162w. Rural Social Institutions.** Factors in rural environment that condition the functioning of rural social institutions, including the family, school, church, local government, health, and welfare. Prereq.: same as 111. 3 cred. Nelson.

#### V. THEORIES OF SOCIAL CHANGE AND SOCIAL ORDER

- 170f. Analytical Social Theory.** Examination of major problems of sociological theory; survey of main types of sociological theory (positivistic, rationalistic, idealistic); study of major theoretical concepts. Prereq.: same as 111. 3 cred. Martindale.
- 171w. Social Life and Cultural Change.** Examination of theories of social change with attention to their methodological problems. Materials drawn from the comparative social thought and structure of antiquity utilized as basic data for analysis. Prereq.: same as 111. 3 cred. Martindale.
- 172s. Backgrounds of Modern Social Thought.** Major trends of social thought from the Renaissance to the nineteenth century with attention to those factors contributing to the origin of sociology. Prereq.: same as 111. 3 cred. Martindale.

#### VI. RESEARCH METHODS AND TECHNIQUES

- 180w. Methods of Social Research.** Major methods employed in social research including consideration of their advantages and limitations when applied to specific types of research problems. Prereq.: 45 or equiv. 3 cred. Monachesi.
- 181s. Problems in Rural Social Research.** Methods currently used by students in investigating rural society; class reports on recent samples of rural research. Prereq.: same as 111. 2 cred. Nelson.
- 182f. Statistical Methods.** Selected problems of social relationship described, analyzed and interpreted by means of the common statistical methods. Prereq.: same as 111. 3 cred. Chapin.

- 183s. Problems in Social Measurement.** Theoretical analysis of problems involved in measuring social variables, including consideration of problems of reliability, validity, and standardization in construction of new measuring instruments. Prereq.: 45 or 182 or equiv. 3 cred. Monachesi.
- 184f-185w-186s. 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 some supervision. Prereq.: 45 or 182, which may be parallel. 2 cred. per qtr. Ar.

## VII. SEMINARS

- 200f.w.\* Seminar: Research Problems in Criminology.** Cred. ar. Vold.
- 200As.\* Seminar: Research Problems in Social Conflict.** Cred. ar. Vold.
- 201f.w.s.\* Seminar: Social Psychology.** Cred. ar. Rose.
- 202f.w.s.\* Seminar: Research in Urban Sociology.** Cred. ar. Caplow.
- 203f-204w-205s.\* Seminar in Social Theory.** Cred. ar. Martindale.
- 206f-207w-208s.\* Seminar: Statistical Theory in Relation to Social Theory and Practice.** Cred. ar. Chapin.
- 209f.\* Research Methods in Rural Sociology.** Cred. ar. Ar.
- 210w-211s.\* Seminar: Problems in Population Research.** Cred. ar. Ar.
- 215f.\* Research Seminar in Rural Social Policy.** Cred. ar. Nelson.
- 216w.\* Research Seminar in the Rural Community.** Cred. ar. Nelson.
- 217s.\* Research Seminar in Rural Social Theory.** Cred. ar. Nelson.
- 218f.w.s.\* Seminar in Methodological Problems in Sociological Research.** Cred. ar. Ar.
- 219f.w.s. Seminar: Research in Problems of Modern Mass Society.** Cred. ar. Rose. (Not offered 1952-53.)
- 234f.w.s.\* Research Seminar in Juvenile Delinquency and Treatment.** Cred. ar. Monachesi.
- 238f-239w.\*† Principles of Sociology.** 3 cred. per qtr. Monachesi.
- 240f.w.s. General Seminar.** Cred. ar. Ar.

## SOILS

Professors Clayton O. Rost, Paul M. Burson, Paul R. McMiller; Associate Professors Alfred C. Caldwell, John M. MacGregor; Assistant Professor Harold F. Arneman.

**Prerequisites**—For major work at least two years of work in chemistry, including both quantitative analysis and organic chemistry, and one year of work in general physics are essential. With approval of the adviser, courses in physical and plant sciences may be accepted as part of the major work.

**Language Requirement**—For the Master's degree German or French. Where other languages are needed for development of the thesis, Spanish, Russian, or the Scandinavian languages may be substituted by petition. Foreign students to whom English is an acquired language may be exempted from the requirement on recommendation of the major adviser by petition. In no case where English is the native language will the requirement be waived.

For the Ph.D. either (a) two foreign languages or (b) one foreign language and the option of a special research technique or a collateral field of knowledge.

**Master's Degree**—Offered preferably under Plan A. In exceptional cases Plan B may be followed by petition approved by members of the graduate faculty of the division.

**Doctor's Degree**—Work for the Ph.D. degree is offered under the general requirements of the Graduate School.

### Courses

- 103f. Principles of Soil Erosion.** Causes and forms of erosion; relation of erosion to climate, vegetation, slope, soil type, and soil management. Practices used in controlling soil erosion. Organizations dealing with soil conservation. Prereq.: 4. 3 cred. MacGregor.
- 104s. Soil Mapping.** Practice in identification and mapping of soil types in the field; preparation of soil maps and gathering of field data. Prereq.: 108, 109. 3 cred. Arneman. (Offered in odd-numbered years.)
- 108w. Physical Properties of Soils.** Determination of physical constants of soils, including mechanical composition. Lect. and lab. Prereq.: 4. 3 cred. McMiller, Arneman.
- 109s.\* Soil Genesis and Classification.** Genesis, nature, and distribution of the soil types of Minnesota; development of soils as influenced by climatic, topographic, geologic, and vegetative factors and their classification; productivity ratings of Minnesota soils. Prereq.: 4, 108. 3 cred. McMiller.
- 110w.\* Chemistry of the Soil.** Chemical composition of soils, organic matter, mineral matter, ionic exchange. Soil nutrient elements and factors affecting their availability. Prereq.: 4. 3 cred. MacGregor.
- 111f. Field and Laboratory Studies of Soils.** Soil texture, structure, and color, soil reaction; nutrient deficiencies; lime and fertilizer materials; fertilizer plot techniques and interpretation of yield data; soil maps, their use and interpretation. Lect., lab., and field. Prereq.: 4. 3 cred. Arneman.
- 202f,w,s,su.\* Research Problems in Soils.** Individual laboratory or field work upon special problems in soil physics, soil chemistry, or soil erosion other than the student's major thesis. Arrangements must be made in advance. 2 to 5 cred. Rost, Burson, McMiller, Caldwell, MacGregor.
- 203f.w. Seminar in Soils.** Assigned reading, reports, and discussions on soils topics. 1 cred. Rost.
- 205w. Soil Colloids.** Clay, colloidal clay; chemical composition of clay fraction; crystalline nature of soil colloids; clay minerals; base exchange and other reactions of the colloidal complex; the stability of suspensions; flocculation of inorganic soil colloids. Prereq.: Biochem. 119. 3 cred. Caldwell. (Offered in odd-numbered years.)
- 206w.\* Soil Physics.** Mechanical composition of soils, physical characteristics of soil colloids; soil consistence, structure, water, air, temperature, tillage; physical properties of soils in relation to runoff and erosion. Prereq.: 108. 3 cred. Caldwell. (Offered in even-numbered years.)
- 207w. Advanced Soils.** Principles of soil formation; chemical properties of soils, soil colloids, soil organic matter, reaction; physical properties of soils, soil temperature, structure, soil water; soil microbiology. Prereq.: one year of chem. 3 cred. Caldwell.
- 208s. Soil Fertility.** Principles of soil fertility and conservation. Use of farm manure, green manure, lime and fertilizers in fertility maintenance. Relation of fertilizer materials to crop sequences and rotations. Lect. and assigned readings. Prereq.: 4. 3 cred. Rost.

### SPEECH

Professors E. William Ziebarth, Bryng Bryngelson, Howard Gilkinson, Ernest H. Henrikson, Ralph G. Nichols, Frank M. Whiting; Associate Professors William S. Howell, David W. Thompson; Assistant Professors William W. Fletcher, Kenneth L. Graham, LeRoy D. Hedgecock, Frank M. Lassman, Donald K. Smith.

**Prerequisites**—For major work, 18 credits in speech. A comprehensive entrance examination is a prerequisite for graduate work in theater.

**Language Requirement**—For the Master's degree one foreign language. For the Doctor's degree either (a) two foreign languages or (b) one foreign language and the option of a special research technique or (c) one foreign language and a collateral field of knowledge.

**Master's Degree**—Offered under both Plan A and Plan B. Under Plan B, the candidate must earn from 21 to 27 credits in graduate courses in speech and the remaining credits in related graduate courses selected with the approval of his adviser.

Additional reading requirements in dramatic literature for a candidate emphasizing theater are to be selected with the approval of his adviser.

**Doctor's Degree**—In consultation with his major adviser the candidate will elect three of the following areas of study: theater, oral interpretation of literature, rhetoric, general speech, speech pathology, radio, voice science. The choice of a minor is subject to the approval of the major and minor advisers.

The student may earn the Ph.D. degree in Speech Pathology.

Additional reading requirements in dramatic literature for a candidate emphasizing theater are to be selected with the approval of his adviser.

**Examination**—Except in speech pathology a written comprehensive examination in the three phases of speech elected by the student is required for formal admission to candidacy for the Ph.D. degree.

### Courses

- 101f-102w-103s. Argumentation and Persuasion.** Theories of modern motivational rhetoric. Analysis of persuasive speaking; practice in preparation and delivery of oral argument. Prereq.: 1-2 or 5, Psy. 1-2, 10 cred. in soc. sci. 3 cred. per qtr. Howell.
- 105f.\* Theory of Reading and Acting.** The forms of literature; speech elements in literature; esthetics of auditory and visual symbols. Collateral readings, speech problems, reports. Prereq.: 81-82-83, Psy. 1-2. 3 cred. Ar. (Offered 1953-54 and alternate years.)
- 106f.w.s. Discussion.** Cooperative thinking; recognition and definition of problems, critical analysis, examination of possible solutions. Planning, preparing for, participating in, and leading classroom, public, and radio discussions. Prereq.: 1-2-3 or 5-6. 3 cred. Howell.
- 107f. Platform Reading.** Advanced course in the oral reading of selected plays. Speech melody, rhythm, platform technique. Problems in esthetic analysis. Lecture recitals. Prereq.: 81-82-83. 3 cred. Thompson. (Offered 1952-53 and alternate years.)
- 109.\* Classical Rhetoric.** Prereq.: 101-102-103, Psy. 140. 3 cred. (Offered 1953-54 and alternate years.)
- 111f-112w-113s. Stage Direction.** Advanced course in practice and theory of stage direction, including esthetics of the theater, analysis of the play, casting, centering attention, rhythm, reading, climaxes, organization for production, the unified whole. Prereq.: 31, 32-33, 34, 91, 92, 93. 3 cred. per qtr. Whiting.
- 115f-116s. Playwriting and Production.** Problems of dramatic form and content in writing. Original one-act or full-length plays. The best plays will be produced in the University Theatre. Prereq.: 31, 32-33 or permission. 3 cred. per qtr. Thompson.
- 117s. Writing Radio Drama.** Problems and techniques of aural drama, illustrated by the writing of an original radio drama through the stages of scenario, rough draft, and final draft. Prereq.: 31, 32-33, 65-66. 3 cred. Thompson.

- 119f.\* Introduction to Speech Correction.** Basic orientation in speech correction. Analysis of common disorders of speech, their characteristics, prevention, and elimination. Forms a basis for more advanced study in speech pathology or for basic understanding of the field. Prereq.: 1-2 or 5. 3 cred. Henrikson.
- 122f.\* Introduction to Research.** Selection of problems for research; techniques of investigation; preparation of the thesis. Required of all graduate majors in speech. Prereq.: 1-2-3 or 5-6, Psy. 1-2. 3 cred. Gilkinson.
- 124w. Experiments in General Speech.** Studies of the correlates of speech skills, audience reactions, and speech improvement. Prereq.: 1-2-3 or 5-6, Psy. 1-2. 3 cred. Gilkinson.
- 126s.\* History and Criticism of Public Address.** Historical and critical studies of oratory. Study of orators: education and training, style, speech composition, topics and issues, historical settings. Prereq.: 1-2-3 or 5-6, Psy. 1-2. 3 cred. Gilkinson.
- 131w. Creative Dramatics.** Principles and methods of developing original dramatizations with children. Observation of children's classes in creative dramatics. Readings, projects, term papers. Prereq.: 31, element. educ. major or permission. Ed.C.I. 63 recommended. 3 cred. Graham.
- 132s. Children's Theater.** Theory and practice of selection, direction, and production of plays for children's audiences, coordinated with current productions of the Young People's University Theatre. Prereq.: 31 or permission. 3 cred. Graham.
- 141f. Anatomy and Physiology of the Voice Mechanism.** Respiration, articulation, and phonation; practical applications to speech improvement. Prereq.: 1-2-3 or 5-6, 67, Psy. 4-5. 3 cred. Fletcher.
- 142w. Physical Bases of Speech.** Relationship of basic principles of sound to speech mechanism. Analysis of speech sound production. Prereq.: 1-2-3 or 5-6, 67, Psy. 4-5. 3 cred. Fletcher.
- 143s. Speech Instrumentation.** Application of mechanical and electronic equipment to speech; basic theory and uses. Prereq.: 1-2-3 or 5-6, 67, Psy. 4-5. 3 cred. Fletcher.
- 152f. Hearing Disorders.** Basic orientation to audiology. Physiology and anatomy of auditory mechanism. Symptomatology and pathology of hearing disorders, their medical and surgical treatment. Clinical and classroom management, including discovery programs, hearing aids, language development, lip reading, speech correction, auditory training, psychology of hard-of-hearing and deaf, vocational guidance, educational channels. Prereq.: 1-2-3 or 5-6, 61, 67, Psy. 1-2, or permission. 3 cred. Lassman.
- 153w. Audiometry and Hearing Aids.** Theory and practice of clinical and group audiometry; screening and diagnostic techniques, pure tone and speech audiometry; hearing conservation programs. Characteristics of modern hearing aids; selection and usage problems. Prereq.: 1-2-3 or 5-6, 61, 67, 152, Psy. 1-2, or permission. 3 cred. Lassman.
- 155s.\* Lip Reading and Lip Reading Methods.** Positions and movements involved in English speech and the current methods used in teaching lip reading. Prereq.: 1-2-3 or 5-6, Psy. 1-2, or permission. 3 cred. Lassman.
- 162w-163s.\*† Speech Pathology.** Physiological and psychological aspects of organic and functional speech problems. Theories of stuttering. Diagnosis, case histories, and treatment of speech cases. Observation of clinical diagnosis and treatment. Prereq.: 1-2-3 or 5-6, 61, 67, 119, permission. 3 cred. per qtr. Bryngelson, Henrikson.
- 164f-165w-166s.\* Clinical Methods and Practice in Speech Pathology.** (Same as Ed.C.I. 174-175-176.) Study of cases and practice in clinical diagnosis and remedial treatment. Prereq.: 1-2-3, 61, 67, 119, 162-163, and Ed.Psy. 142. 3 cred. per qtr. Bryngelson.
- 169w.\* Speech and Language in Human Behavior.** Basic orientation in place of speech and language in human behavior. Individualized projects and collateral reading. Prereq.: permission. 3 cred. Henrikson.
- 171f-172w-173s.\* History of the Theater.** Arts and crafts of the theater over a period of 3,000 years. Reports and projects. Prereq.: 1-2-3 or 5-6, 31; courses in dramatic literature highly recommended. 3 cred. per qtr. Graham.

- Scand.171f.\* Ibsen and the Beginnings of the Modern Drama.** Intensive examination of the plays of Ibsen, especially with reference to the role he has played as "the founder" of the modern European drama. Knowledge of Scandinavian not required. Prereq.: 4-5-6 or 10-11-12 or 8 cred. in lit. 3 cred. Gustafson.
- Scand.172w.\* Strindberg and the Drama in Revolt and Transition.** Strindberg as master of the naturalistic drama and as "the father of modernity" in the European and American theater since his day. Knowledge of Scandinavian not required. Prereq.: 4-5-6 or 10-11-12 or 8 cred. in lit. 3 cred. Gustafson.
- Scand.173s.\* Contemporary Scandinavian Theater.** The Scandinavian theater today, particularly with reference to its "experimental" trends in both dramatic composition and staging. Knowledge of Scandinavian not required. Prereq.: 4-5-6 or 10-11-12 or 8 cred. in lit. 3 cred. Gustafson.
- 174-175-176.\* Theater Backgrounds.** Study and analysis of play structure and content as limited and evolved through production practices. Materials to be selected from various dramatic epochs of the theater. Special reports and projects. Prereq.: 1-2-3 or 5-6, 31. 3 cred. per qtr. (Not offered 1952-54.)
- 181f-182w-183s. Readings in Speech.** Directed reading and the preparation of reports on selected subjects. Prereq.: 1-2-3 or 5-6 and 6 additional cred., permission. Cred. ar. Staff.
- Eng.184f-185w-186s. Interpretation of the Drama.** Prereq.: 6 cred. above Eng. 50, Eng. 55-56 advised. 3 cred. per qtr. Ar.
- 191f-192w-193s.\* Technical Stage Problems.** Advanced problems in design and construction; stage management, color effects, and wiring. Problems assigned to individual students. Prereq.: 111-112-113. 3 cred. per qtr. Whiting.
- 201f.w.s.\* General Seminar.** Survey of current literature and general problems in the field of speech. Prereq.: permission. 1 cred. per qtr. Gilkinson, Smith.
- 203f-204w. Debate Coaching.** Study of literature concerning and methods of directing extracurricular interscholastic public speaking, discussion, and debate activities. Each student directs preparation and practice of a group of undergraduate student speakers. Prereq.: 1-2 or 5, 101-102-103, Psy. 1-2, 10 cred. in soc. sci. 2 cred. per qtr. Howell.
- 207f-208w-209s.\* Seminar in Rhetoric and Persuasion.** English and American orators. Critical examination of the literature on rhetoric and persuasion. Methods in the study of persuasion. Prereq.: 1-2-3 or 5-6, 101-102-103, Psy. 1-2, 140, 10 cred. in soc. sci. 3 cred. per qtr. Howell.
- 211f-212w-213s.\* Seminar in Dramatic Theory.** Analysis of the critical theory of theatrical arts. Major trends in drama as related to dramatic production. Prereq.: 171-172-173 and 9 cred. in dramatic lit. 3 cred. per qtr. Thompson. (Offered 1953-54.)
- 221f-222w-223s.\* Seminar in Oral Interpretation of Literature.** Problems of silent and oral reading. Theories of speech in relation to language and types of literature. Prereq.: 1-2-3 or 5-6, 81-82-83, 105, 122, Psy. 74. 3 cred. per qtr. Thompson.
- 231f-232w-233s.\* Seminar in Advanced Speech Problems.** Analysis and evaluation of research methods in the general field. Prereq.: undergraduate major in speech, or equiv., permission. 3 cred. per qtr. Gilkinson.
- 241f-242w-243s.\* Seminar in Radio Research.** Analysis and evaluation of research methods in mass communication by radio. Examination of research literature. Prereq.: permission. 2 cred. per qtr. Ziebarth.
- 261f-262w-263s.\* Seminar in Speech Pathology.** Study of significant literature in speech pathology, with emphasis on analysis and evaluation of research methods. Prereq.: Courses 1-2-3 or 5-6, 61, 67, 122, 162-163, Psy. 1-2, or permission. 3 cred. per qtr. Henrikson.
- 271f.\* Seminar in Hearing.** Major experimental research in psychophysiological and psychoacoustical nature of hearing. Critical analysis of theory, experimental method, and treatment of data. Prereq.: 152, 153, 155, permission. 3 cred. Lassman.

- 281f-282w-283s. Seminar in Organic Disorders of Speech.** Consideration of anatomical, physiological, and neurological abnormalities that are characterized by disorders of speech or voice. Pertinent literature with emphasis on medical sources. May be repeated with permission. Prereq.: 261-262-263, permission. 2 cred. per qtr. Brown.
- 291f-292w-293s.\* Research.** Open to graduate students engaged in research on special problems. Cred. ar. Staff.

## SURGERY

(Including Divisions of General Surgery, Neurosurgery, Experimental Surgery, Orthopedic Surgery, Urology, Proctology, Anesthesiology, and Dental Surgery)

For staff and courses of study offered, see the *Graduate Medical Bulletin*.

## VETERINARY MEDICINE

Professors Martin H. Roepke, John N. Campbell, Reuel Fenstermacher, Howard C. H. Kernkamp, Benjamin S. Pomeroy; Associate Professors Henry J. Griffiths, Harvey H. Hoyt, Ralph L. Kitchell, George W. Mather, Robert A. Merrill, Jay H. Sautter, Alvin F. Sellers, Alvin F. Weber; Instructor David E. Bartlett.

**Prerequisites**—Graduate students who desire to take their major work in Veterinary Medicine must present a D.V.M. degree or its equivalent from a recognized veterinary medical college.

**Language Requirement**—For the Master's degree one foreign language. For the Doctor's degree either (a) two foreign languages or (b) German and the option of a special research technique or a collateral field of knowledge.

**Master's Degree**—Offered under only Plan A.

**Major Work**—Candidates taking major work for their Master's degree or Doctor's degree may, upon approval of the adviser, select courses in the various departments of the University including the Medical School.

**Doctor's Degree**—Work for the Ph.D. degree is offered in the division.

### Courses

- 101f-102w-103s. Animal Anatomy.** Gross anatomy of domestic animals. Open to graduate students with permission. (Enrolment limited.) 101, 7 cred.; 102, 5 cred.; 103, 4 cred. Kitchell.
- 104f.w.s. Special Studies in Animal Anatomy.** Individual problems for further study in animal anatomy. Prereq.: 101. 1 to 3 cred. per qtr. Kitchell, Weber.
- 106w. Veterinary Surgical Anatomy.** Topographical anatomy of domestic animals as applied to surgery and the practice of veterinary medicine. Prereq.: 103, 170, permission. 1 cred. Kitchell, Arnold.
- 107f. Animal Gross and Microscopic Anatomy.** General systematic presentation of microscopic and gross anatomy of the animal's body emphasizing the digestive, blood, vascular, and respiratory systems. Prereq.: Zool. 14-15 or permission. 5 cred. Kitchell, Weber.
- 108w.s. Special Animal Gross and Microscopic Anatomy.** Detailed study of individual species selected by the student with the consent of the instructor. Emphasis on study of the nervous, digestive, and the reproductive systems. Prereq.: 107. 3 cred. Kitchell, Weber.

- 109w. Anatomy, Physiology, and Hygiene of Poultry.** General anatomy of the fowl, the physiology of digestion and reproduction, and prevention and control of the more important diseases affecting chickens and turkeys. Prereq.: Zool. 14-15, Poul.Husb. 1. 3 cred. Pomeroy.
- 111f-112w-113s. Animal Histology and Embryology.** Microscopic studies of the various tissues and organs, including embryology, of domestic animals. Open to graduate students with permission. Limited enrolment. 111, 6 cred.; 112, 5 cred.; 113, 4 cred. Weber.
- 114f,w.s. Special Studies in Animal Histology and Embryology.** Individual problems for further study in animal histology and embryology and histological techniques. Prereq.: 111 or equiv. 1 to 3 cred. per qtr. Kitchell, Weber.
- 119f,w.s. Seminar in Animal Anatomy.** Prereq.: 101, 111, or permission. 1 cred. Kitchell, Weber.
- 121s,122f,123w. Animal Bacteriology.** Morphology, classification, and characteristics of pathogenic bacteria. Principles of infection and immunity and studies of bacteria, viruses, molds, and actinomycetes associated with animal diseases. Limited enrolment. Prereq.: zool. 10 cred., chem. 13 cred., permission. 121, 5 cred.; 122, 6 cred.; 123, 4 cred. Pomeroy.
- 125f. Poultry Diseases.** Lectures on diseases of poultry. Prereq.: 123, 153, 162, permission. 3 cred. Pomeroy.
- 126s. Dairy Hygiene.** The effect of bovine diseases and sanitation on quality and safety of milk and milk products. Prereq.: 123, 179, permission. 4 cred. Pomeroy.
- 127s. Veterinary Public Health.** Functions of veterinary public agencies and of epidemiologic methods in the study of animal diseases. Prereq.: 123, 179, permission. 2 cred. Pomeroy.
- 135f,136w. Animal Physiology.** Physiology of circulation, respiration, digestion, kidney function, endocrine function, reproduction, nervous system, and special senses in domestic animals. Limited enrolment. Prereq.: 103, 113, Physiol.Chem. 103, or permission. 135, 8 cred.; 136, 7 cred. Sellers, Good.
- 137f,w.s.u. Problems in Animal Physiology.** Prereq.: 135, 136 or Human Physiol. 106, 107. Cred. ar. Sellers.
- 140f,w.s. Seminar on Animal Physiology.** Prereq.: 136 or permission. 2 cred. Sellers, Good.
- 143w. Veterinary Clinical Pharmacology.** Continuation of general pharmacology with emphasis on clinical aspects in domestic animals. Prereq.: Pharmacol. 105, permission. 3 cred. Stowe.
- 151f,152w,153s. Animal Pathology.** Descriptions, discussions, and gross microscopic demonstrations of tissue reactions including retrogressive and inflammatory changes, neoplasms and reparative processes. Prereq.: 103, 113, 135 or equiv. with permission. 151, 4 cred.; 152, 5 cred.; 153, 6 cred. Sautter, Kernkamp.
- 154s. Veterinary Clinical Pathology.** Application and interpretation of laboratory tests used in clinical diagnosis in domestic animals. Prereq.: 152, permission. 2 cred. Rehfeld.
- 155f. Meat Hygiene.** Lectures and discussions of meat inspection procedures and regulations; consideration of various infections, degenerative, and disease processes affecting meat. Trips to local packing plants to observe details of antimortem and postmortem inspection procedures. Prereq.: 153. 3 cred. Sautter.
- 157f,w.s.u. Veterinary Postmortem Pathology.** Autopsies, techniques, examination of tissue sections, preparation of records and diagnosis. Prereq.: 153, permission. 1 to 3 cred. per qtr. Sautter, Kernkamp.
- 158f,w.s.u. Veterinary Surgical Pathology.** Neoplasms, surgical biopsies, post-mortem material, review of pertinent literature. Prereq.: 153, permission. 1 to 3 cred. Sautter, Kernkamp.
- 161w. Animal Parasitology.** Systematic and biological study of the protozoan and arthropod parasites of animals. Emphasis on their relationships to disease and the principles of parasite control. Prereq.: 103, 113 or equiv., permission. 4 cred. Griffiths, Henry.

- 162s. Animal Parasitology.** Helminth parasites and parasitic diseases of animals with emphasis on principles of control. Prereq.: 161, 6 cred. Griffiths, Henry.
- 168w. Diseases of Fur-bearing Animals.** Etiology, symptomatology, and treatment of diseases of fur-bearing animals. Prereq.: 123, 186, permission. 2 cred. Fenstermacher.
- 170s. Veterinary Clinical Diagnosis.** Procedures of physical diagnosis and restraint of animals. Prereq.: 136, 151, 3 cred. Pritchard and staff.
- 171df,171ew,171fs,† Clinical Conferences.** Group discussion of clinical cases. Prereq.: 170, permission. 1 cred. per qtr. Bartlett and staff.
- 172f. Animal Surgery.** Anesthesia, asepsis, hemostasis, preoperative and post-operative care and surgical techniques. Prereq.: 170, permission. 6 cred. Arnold, Moist.
- 173w. Special Animal Surgery.** Operative practices and etiology, diagnosis, treatment, and surgical diseases of large animals. Prereq.: 172, permission. 5 cred. Arnold, Moist.
- 174s. Advanced Animal Surgery.** Continuation of 173 in operative practices and procedures requiring more skillful techniques. Prereq.: 173, permission. 3 cred. Arnold, Moist.
- 177f,178w,179s. Large Animal Medicine.** Diseases of large animals. Prereq.: 170, permission. 5 cred. per qtr. Campbell, Pritchard.
- 180w,181s. Infectious Diseases of Domestic Animals.** Lectures and discussions of diagnosis, treatment, and control of diseases of domestic animals caused by infectious agents. Prereq.: 179, permission. 5 cred. per qtr. Hoyt.
- 185s. Small Animal Medicine.** Medical and surgical diseases of small animals. Prereq.: 178, permission. 4 cred. Mather, Low.
- 186f. Small Animal Medicine.** Continuation of 185. Prereq.: 165, permission. 4 cred. Mather, Low.
- 188f,189w,190s. Clinical and Laboratory Practice.** Medical, obstetrical, surgical, ambulatory, and postmortem clinics of animals. Prereq.: 170. 5 cred. per qtr. Staff.
- 191f,192w,193s. Clinical and Laboratory Practice.** Medical, obstetrical, surgical, and ambulatory clinics of animals. Prereq.: 190, permission. 5 cred. per qtr. Staff.
- 194s,195w. Veterinary Obstetrics and Problems of Animal Reproduction.** Lectures and laboratory studies on anatomical and physiological factors of reproduction, diseases of the newborn, obstetrical and sterility problems, and artificial insemination. Prereq.: 190, permission. 194, 3 cred.; 195, 5 cred. Bartlett.
- 196f. Veterinary Radiology.** Preparation and interpretation of radiographs and fluoroscopic examinations in veterinary medicine, consideration of radiant energy as a therapeutic agent and discussion of protective measures against radiation hazards. Prereq.: 190, permission. 3 cred. Spurrell.
- 197s. Animal Diseases and Poisonous Plants.** Systematic study of important plants poisonous to animals. Emphasis on identification, toxicology, diagnosis, and treatment. Prereq.: 143, 170, 179, 188, permission. 3 cred. Pritchard, Larson.
- 201f,w,s. Advanced Animal and Poultry Pathology.** Clinical material, collateral reading, and conferences. Prereq.: permission. Cred. ar. Kernkamp, Fenstermacher, Pomeroy, Sautter.
- 205f,w,s. Advanced Animal Bacteriology.** Clinical material, collateral reading, and conferences. Prereq.: permission. Cred. ar. Pomeroy, Fenstermacher.
- 209f,w,s. Advanced Clinical Technique.** A more detailed application of clinical techniques in diagnosis and therapy of animal diseases. Prereq.: permission. Cred. ar. Campbell and staff.
- 213f,w,s. Veterinary Obstetrics and Gynecology.** Affords more comprehensive training in disorders and diseases of reproduction of domestic animals through studies on clinical material, collateral reading, and conferences. Prereq.: permission. Cred. ar. Bartlett.
- 217f,w,s. Seminar in Veterinary Medicine.** Special assignments and review of research problems in veterinary medicine. 1 cred. Kernkamp and staff.

- 230f.w.s.su. Research in Veterinary Medicine.** Cred. ar. Staff.
- 235f.w.s.su. Research in Animal Physiology.** Prereq.: 135, 136 or Physiol. 106, 107. Sellers.
- 240w.s. Advanced Veterinary Parasitology.** The more important parasites of domestic animals, their identification, life histories, economic importance, and relationship to disease. Prereq.: 161, 162 or equiv. Cred. ar. Griffiths.
- 245f.w.s.su. Research in Veterinary Parasitology.** Lab., conference, assigned reading. Prereq.: permission. Cred. ar. Griffiths.

## ZOOLOGY

Professors Dwight E. Minnich, Samuel Eddy, Alexander C. Hodson, Clarence E. Mickel, Sheldon C. Reed, Otto H. Schmitt, Nelson T. Spratt, H. Burr Steinbach; Associate Professor Franklin G. Wallace; Assistant Professor David J. Merrell.

**Prerequisites**—For major work, Course 1-2-3, and at least 18 credits of advanced work approved by the department; for minor work, Course 1-2-3, or the equivalent.

**Language Requirement**—For the Master's degree one foreign language. For the Doctor's degree two foreign languages, of which one must be German.

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

**Doctor's Degree**—The Department of Zoology offers work leading to the Ph.D. degree.

## Courses

- 100f,101w,102s. Zoological Techniques.** These course numbers are a special arrangement for making up of certain deficiencies in background course work. For election of these course numbers majors must consult major advisers, others, the department chairman. Cred. ar., not to exceed 3 cred. per qtr. Ar.
- 107f. Protozoology.** General morphology, taxonomy, habits, and life histories of free-living and symbiotic protozoa. Lect., lab., reading. Prereq.: 15 cred. in zool. 3 cred. (Not offered.)
- 108s. Protozoology.** Cytology, physiology, reproduction, genetics, and identification of free-living protozoa. Lect., lab., reading. Prereq.: 107. 3 cred. (Not offered.)
- 109w. Sense Organs.** Survey of the structure and function of the sense organs of invertebrate and vertebrate animals. Lect. and demonstrations. Prereq.: 15 cred. in zool., permission. 3 cred. Minnich.
- 110s. Animal Reactions.** Survey of the nervous system, effectors, and behavior patterns of animals. Lect. and demonstrations. Prereq.: 15 cred. in zool., permission. 3 cred. Minnich.
- 112f. Advanced General Physiology.** Interactions between cells and environment; enzyme actions and general protoplasmic structure and metabolism. Lect. and lab. Prereq.: 15 cred. in zool., permission. 3 cred. Steinbach.
- 113w. Special Topics in Advanced General Physiology.** Lect. and lab. Prereq.: 15 cred. in zool., permission. 3 cred. Steinbach.
- 117f. Animal Ecology.** General ecology stressing ecological principles and land communities. Lect., lab., assigned reading, field trips. Prereq.: 15 cred. in zool. or ent. 3 cred. Eddy.
- 118w. Animal Ecology.** Experimental approach to study of environmental factors affecting animal populations. Lect. and lab. Prereq.: 15 cred. in zool. or ent. 3 cred. Hodson.

- 119su. § Limnology.** Conditions for life in the water and distribution of aquatic animals. Lect., lab., assigned reading, field trips. Offered at Itasca Park Biological Station. Prereq.: 15 cred. in zool. or ent. 3 cred. Eddy.
- 120s. § General Ecology of Insects.** Emphasis on its application to problems in economic entomology. Lect., field trips, reading. Prereq.: 117, 118. 3 cred. Hodson.
- 121f. Ichthyology.** Taxonomy and habits of North American fishes with special reference to those of upper Mississippi drainage. Lect. and lab. Prereq.: 15 cred. in zool. 3 cred. Eddy.
- 125f-126w-127s. Advanced General Entomology.** Morphology, biology, and classification of insects. Lect., lab. Frequent field trips in 127s. Prereq.: 52 or equiv. or permission. 3 cred. per qtr. Mickel.
- 128f-129w. Insect Physiology.** General and comparative physiology of insects, a survey of the organ systems and their functioning in various insects. Emphasis on research methods and evaluation of data. Lect., lab., and reading. Prereq.: 15 cred. in zool. or ent., permission; 50 or equiv. recommended. 4 cred. per qtr. Richards.
- 140s. Biological Microscopy.** Survey of microscopic optics, histology, and histochemistry with emphasis on the limits and the interpretation of microscopical data. Prereq.: permission. 4 cred. Richards. (Offered 1953-54 and alternate years.)
- 144f. Medical Entomology.** The principal arthropods noxious to man and animals, especially those which are vectors of disease. Lect. and lab. Prereq.: 15 cred. in zool. or ent., permission. Ar.
- 145w. Parasitic Protozoa.** Structure, life histories, and economic relations of protozoal parasites of man and animals. Lect., lab. Prereq.: 15 cred. in zool., permission. 3 cred. Wallace.
- 146s. Helminthology.** Worm parasites of man and animals, their structure, life histories, and biological relationships. Lect. and lab. Prereq.: 15 cred. in zool., permission. 3 cred. Wallace.
- 155w, 156w, 157w. § 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. Lect. and lab. Prereq.: 28 cred. distributed between phys. and biol.; permission; phys. chem. and general physiol. recommended. Any section of this course may be taken separately. Cred. ar. Schmitt.
- 160f-161s. Cytology.** Survey of cell structure and behavior with special reference to genetic cytology and cellular physiology. Lect., lab. work, and seminar reports. Prereq.: 15 cred., permission. 3 cred. per qtr. Gall.
- 170f. Advanced Genetics.** General laws involved in heredity and variation, with their applications to microorganisms, higher plants, and animals exclusive of man. Textbooks, lect., lab. Prereq.: 15 cred. in zool. including 83, or permission. 3 cred. Reed, Merrell.
- 171w. Genetics of Speciation.** Application of genetics to the study of mechanisms of evolutionary change. Prereq.: 15 cred. in zool. including 83, or permission. 3 cred. Merrell.
- 175s. Human Genetics.** Inherited characters in man, particularly from the point of view of medicine with some reference to the relation of genetics to marriage and to social conditions. Lect. and lab. Prereq.: 83, permission. 3 cred. Reed.
- 182s. Experimental Embryology.** Growth, differentiation, and metabolism of developing organisms. Prereq.: 15 cred. in zool. including 50 or 59 or equiv. 5 cred. Spratt.

§ Either 119su or 120s or both may be taken to complete Courses 117f, 118w.

¶ The schedule for this course is to be arranged. Students wishing to take it should consult the instructor. Offered in successive winter quarters.

**183w,184w,185w. Physiology of Development.** Trains advanced students in the organization, presentation, and evaluation of the results of research in experimental embryology. 183: Chemical embryology (metabolic aspects of growth, differentiation, and morphogenesis); 184: Embryonic differentiation, including neuroembryology; 185: Endocrines in development, including sex differentiation. Prereq.: 182 or equiv., permission. 4 cred. Spratt. (Offered in successive winter quarters.)

**Note**—For additional courses in the related economic field see Entomology and Economic Zoology in this bulletin.

**197f-198w-199s.\* Problems.** Advanced work in some special line. Prereq.: 1-2-3, special requirements. Cred. ar. Staff.

**201-203.\* Research in Entomology.** Mickel.

**211-213.\* Research in Ecology.** Eddy.

**217-219.\* Research in Physiology.** Minnich, Steinbach, Richards.

**221-223.\* Research in Biophysics.** Schmitt.

**229-231.\* Research in Histology.** (Not offered.)

**233-235.\* Research in Embryology.** Spratt.

**237-239.\* Research in Cytology.** Gall.

**241-243.\* Research in Protozoology.** (Not offered.)

**251-253.\* Research in Genetics.** Reed.

**261-263.\* Research in Parasitology.** Wallace.

**291-293. General Seminar.** Ar.

**296-298.\* Seminar in Special Research Fields.** Ar.

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UNIVERSITY of MINNESOTA

The Law School  
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1952-1954



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## THE STUDY OF LAW

The practice of law is only one of the opportunities open to a law graduate. Even in the practice of law there are widely different areas which the lawyer may enter. There is the general practice of law, either alone or in partnership, or in a junior position in a large legal metropolitan firm. The conditions of practice in a city differ substantially from those in the smaller communities. A substantial number of positions are constantly open to law graduates in government service, both nationally and locally. There is also a constantly increasing demand by large business organizations for lawyers in their legal departments. These positions frequently lead to important executive responsibilities. The study of law also opens up avenues to public service which lawyers render through election and appointment to various public offices. Demand for law graduates from law schools of good reputation is currently strong and particularly for those with good law school records.

There is no certain test or means of determining without trial and before entering the Law School whether a student will be able to be successful in law studies. This school does not require a legal aptitude test before entering. In general a student with a good record in high school and in college has a better prospect of attaining success in his law work. Important qualities are an analytical mind combined with an interest in human, social, and public affairs. A good training in English, both in high school and college, is important. Foreign languages and mathematics are not essential but ability in mathematics is an indication of probable success in the Law School. Ability in public speaking and success in courses primarily of factual content are not indications of aptitude for law study though they may contribute in other respects. The amount of college work taken has not been shown to result in improved ability to do law school work, although for purposes of a general education it is desirable.

Employment opportunities in Minneapolis and St. Paul are substantial. However, students are strongly advised to limit their outside work to the minimum. If a substantial amount of employment is necessary the amount of work taken in school should be reduced accordingly.

In selecting a school the student should make certain that its degree will qualify him for admission to the bar of the state in which he intends to practice. Some states, for example, require registration in their state before commencing the study of law. Others require an academic degree. The American Bar Association and the Association of American Law Schools will provide the prospective applicant with a list of the schools they have approved as complying with the minimum standards fixed by these associations. As a condition of approval, a school must require two years of academic work preceding a four-year law school program or three years of academic work preceding a three-year program.

## THE LAW SCHOOL

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 is located in a large metropolitan center within easy access to federal, state, and local courts and governmental units, and to their records. Judicial, legislative, and administrative hearings may be attended by students of the school. Public officials and judicial personnel may also be consulted. The library of the Law School contains approximately 190,000 volumes and is one of the large law school libraries in the United States. The general library of the University, containing approximately 1,432,000 volumes, is in close proximity to the school. These facilities provide unusual opportunities for study and research. The State Law Library, located in the State Capitol Building at St. Paul, Minnesota, is also available to students of the school.

### Method of Instruction

The "case system" is the basic method of instruction. This consists of a study of selected judicial decisions in each course. A legal research and writing program extends, in progressive stages, through the four years of instruction. Seminar and tutorial courses are also available to advanced students. Under the four-year program described below, emphasis is placed on the study and use of the contributions to the legal system from nonlegal sources such as economics, political science, humanities, philosophy, and the like. The aim of the school is to provide a thorough and basic training in the law and legal techniques for the practice of law, combined with an understanding of the purposes and ideals of the administration of justice and of the legal profession, and to add to the qualifications for the leadership that is expected of the profession in the functioning of the democratic processes.

The faculty consists chiefly of 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.

### The Minnesota Plan

The four-year law school plan, pioneered by this school in 1930, is designed to meet the demands of modern law practice and to prepare the graduate for the larger responsibilities of the legal profession. The professional status of the lawyer demands of him a thorough training in the law and its techniques. But it demands also that he be more than a legal technician and that he have some comprehension of the purposes and methods of the legal system and the administration of justice, and of his own role and responsibilities as a lawyer and citizen. It expects him to provide the leadership necessary for the improvement of the law and for the advancement and development of his community and country. To enable the development of a program directed to these objectives the Law School course has been extended to four years. It is felt that these aims can be better attained by this means than by extending the required period of study prior to entry into the Law School.

The first and second years in the Law School are directed to basic courses in substantive law such as Criminal Law, Contracts, Torts, Legal Research, Property, Constitutional Law, etc. The third year is concerned to a large extent with procedural law incident to the trial of a law suit and electives chosen by the student.

During the last two years courses are available which, in addition to the technical training they provide, offer unusual opportunities for a broadened conception of the legal order and the administration of justice and a better understanding of the relation of the law to other disciplines. These courses include Modern Social Legislation, Judicial Administration, International Law, Legislation, Administrative Law, Trade Regulation, Jurisprudence, Labor Law, the several seminars, and others. Taking one of these examples, in Labor Law, the economic and social aspects of the labor movement are included in the study of the law of labor relations. It includes also a laboratory program in which students are taken through the arbitration and collective bargaining processes with the aid of experienced instructors.

Under the Minnesota plan, the nontechnical aspects of the law are considered more particularly in the last two years, after the student has mastered the technique and art of legal reasoning and is grounded in a substantial area of the law. But, in some of the earlier courses as well, particularly in Criminal Law, these aspects of the subject are given special consideration. Since the law is essentially a form of social control and is concerned principally with problems of human affairs, courses generally in the Law School afford, in varying degrees, occasion for training in the technical science of law on a broad base.

During the last two years, with the approval of the dean's office, the student may elect up to 21 quarter credits of advanced work in other departments. With a substantial knowledge of law as a background, the student is in a better position to exercise a sound judgment as to the areas in which he should extend his understanding. The substantial number of electives in the third and fourth years permits a large degree of specialization both in the Law School and in other departments of the University.

Students entering the Law School in the fall of 1952 with a B.A. degree or its equivalent may qualify for the LL.B. degree in three academic years. Thereafter, three and one-half years will be required and the additional time will be devoted to basic courses of the four-year plan.

### Requirements for Admission

To be admitted to the Law School an applicant must have earned 90 quarter credits at the University of Minnesota or other accredited college with an average required for graduation by the college from which the credit is received. The number of required credits is not reduced by excess honor points. A legal aptitude test is not required.

The courses below, outlined by the Law School for the two years of college work required, are designed to provide an elementary knowledge of fields with which lawyers should be familiar. A distinct prelaw course is available in the College of Science, Literature, and the Arts of this University.

Accounting: Economics 27 (Survey, 5 credits) or 24-25-26 (Principles, 9 credits)

Economics: 6-7 (Principles of Economics, 10 credits)

English: A-B-C (Freshman English, 15 credits) or Composition 4-5-6 (Freshman Composition, 9 credits) or Communication 1-2-3 (12 credits) and Composition 27 (Advanced Writing, prelegal section, 3 credits)

History: 70-71-72 (English Constitutional History, 9 credits)

Humanities: 1-2-3 (Humanities in the Modern World, 15 credits)

Philosophy: 1A-2A-3A (Selected Problems of Philosophy, Selected Problems of Logic, Selected Problems of Ethics, 9 credits) or 1, 2, 3 (Problems of Philosophy, Logic, Ethics, 15 credits)

Political Science: A-B (First two quarters of A-B-C) (The State in the Modern World, 6 credits); and either C (3 credits) or 25 (World Politics, 3 credits)

Psychology: 1-2 (General, 6 credits)

The humanities courses may be taken in place of, or in addition to, the courses in political science.

Electives to make the total at least 90 credits. Foreign language (0 to 20 credits),† natural science (10 or 15 credits)‡ and Public Health 3 (Personal Health, 2 credits) should be included in these electives by students taking the combined course leading to the degrees of bachelor of arts and bachelor of laws which is outlined below. Such students may take Philosophy 50 and 52 (courses in the general history of philosophy) instead of Philosophy 1 and 3. Suggested electives for other students are: English History or Civilization of the Modern World, Modern Philosophies of Social Reform (Philosophy 70), and other courses in Anthropology, Economics, Political Science, Sociology, and Speech.\*

If academic work additional to the two years is taken before entering the Law School, the foregoing courses will serve as a basis for advanced work in the same fields. Such advanced work in accounting, business and writing courses are helpful to law practice. Likewise, a deeper insight into the problems of human affairs, with which the law deals, will be gained in the areas indicated.

Students in high school, who intend to qualify for later admission to the Law School, should study such courses as history, English, higher arithmetic, natural science, and courses dealing with current social problems in a penetrating manner.

Applicants who have a bachelor of arts or equivalent degree and a satisfactory scholastic record, are admitted in the fall of 1952 to a three-year law course, leading to the degree of bachelor of laws. Thereafter three and one-half years will be required to permit the taking of the basic courses of the Minnesota four-year plan.

The requirements for admission of nonresidents of Minnesota are as above specified except that the academic record should be better than average, as determined by the dean of the Law School. Applications from nonresidents must be accompanied by a credential examination fee of \$5.

Students are admitted to the Law School only in the fall of the year. For dates of registration see the *Bulletin of General Information*. Forms for application for admission may be obtained by writing to the Dean of Admissions and Records, University of Minnesota, Minneapolis 14.

### Seven-Year Combined Courses in Arts and Law, Leading to the Degrees of Bachelor of Arts and Bachelor of Laws

This course requires three years of college work and four years in the Law School. The first two years of the college work may be taken in any accredited college, but the third year must be taken in the College of Science, Literature, and the Arts of this University. All three years of college work may be taken before entering the Law School, or two years before entering the Law School, and the third year after the completion of one year or more of law work. The latter plan enables the student to select college work in which he may become interested during his law course. The three years of college work should include the subjects specified on page 5 for the prelaw course.

Further details concerning this combined course may be obtained from the *Bulletin of the College of Science, Literature, and the Arts, 1951-53*, page 167.

\* A Veteran of World War II will be admitted although the program outlined above has not been pursued. A maximum of 18 credits may be earned toward the prelaw requirements by G.E.D. tests and a limited amount of credit is also allowed for military service. Further details may be obtained by communicating with the dean's office.

† For schedule see *Bulletin of the College of Science, Literature, and the Arts, 1951-53*, page 11.

### **Seven-Year Combined Course in Business Administration and Law, Leading to the Degrees of Bachelor of Business Administration and Bachelor of Laws**

This program consists of two years of prelaw and prebusiness work as specified below, approximately one and one-half years in the School of Business Administration instead of the full two-year program, and three and one-half years in the Law School instead of the full four-year program thus qualifying for both the bachelor of business administration and the bachelor of laws degrees in seven years.

The prelaw and prebusiness work must amount to 90 credits, exclusive of quality credits, and shall include the regular prelaw course except Economics 27 and in addition Economics 5 (Elements of Statistics) and Economics 22-23 (Principles of Accounting).

There are two options for the remaining five years:

- A. The first year exclusively in the Law School and the second year exclusively in the School of Business Administration, or vice versa. The third and fourth years exclusively in the Law School and the fifth year to be divided between the two schools, approximately half of the program being in each school.
- B. The distribution of both the business and law course throughout the five-year program.

The course requirements in Business Administration include the general core group courses exclusive of Business Law, B.A. 51-52-53. This amounts to a total of 36 credits. Substitutes such as Econ. 185 for B.A. 77, B.A. 184 for B.A. 89 may be made with the approval of an adviser. The remaining courses—approximately 32 credits—may be elected from the Senior College courses in economics and business administration with the approval of an adviser.

The course requirements in the Law School include all the courses of the first and second years, the required courses of the third and fourth years, and electives sufficient with the required courses to make a total of approximately 68 credits in the last two years.

Students will be registered for the joint program in the Law School and the School of Business Administration throughout the five-year period. Their programs will be subject to approval of an adviser from the Law School and an adviser from the School of Business Administration.

### **Combined Course in Law and Engineering**

The Law School and Departments of Civil, Electrical, and Mechanical Engineering of the Institute of Technology have arranged for a joint program leading to degrees of bachelor of laws and bachelor of civil, electrical, or mechanical engineering. The details of the program may be obtained at the departmental offices or the office of the College of Engineering.

### **Combined Course Leading to the Degrees of Bachelor of Laws and Master of Science in Library Science**

The Law School and the Division of Library Instruction offer a combined program leading to the respective indicated degrees. Those who are interested should consult the dean or librarian of the Law School.

### Degree of Bachelor of Science in Law

This degree is conferred upon those who enter the Law School without an academic degree and who have completed the first two years of work in the Law School with an average of at least 70 under the numerical system of grading used in this school. For those who do not intend to continue in the Law School beyond these two years and to qualify for the LL.B. degree, special adjustment in programming in both prelaw and law work may be made by the Law School to meet special needs and interests. This degree does not qualify for admission to the bar.

### Degree of Bachelor Laws

Those who have completed the first two years in the Law School with an average of 73 for the two years or have earned an average of 75 in one of them and not less than 70 in the other, may continue in the Law School as candidates for the bachelor of laws degree. Two additional years of work in the Law School are required of those who do not enter with an academic degree, 21 credits of which may be earned in other departments in courses of Senior College standing and approved by the dean's office.

Courses required for the degree include Pleading, Practice, Evidence, and Legal Ethics taken in the third year. Those under the four-year program are required in addition to take courses in Modern Social Legislation, Legislation, Judicial Administration, and one seminar course.

Those who have entered or will enter the Law School prior to the fall of 1953 with a B.A. or equivalent degree may qualify for the LL.B. degree after three years in the Law School. Those entering with a B.A. degree in the fall of 1953 and thereafter must complete three and one-half years in the Law School.

An average of 75 in the third and fourth years is required to qualify for this degree. The degree is a prerequisite for admission to the bar of this and most other states.

### Degree of Master of Laws

A candidate for this degree must have a bachelor of laws degree from this school or from another law school which is a member of the Association of American Law Schools. He must also present a superior scholastic record in his undergraduate law work. The specific program of study is planned for the individual candidate and directed toward his special purposes and interests. Ordinarily a thesis, making a substantial contribution and worthy of publication, is expected. Candidates who, in their undergraduate law work, did not receive training in the basic courses of the Minnesota four-year plan, are expected to devote some course-hours in these areas.

### Advanced Standing

No credit is given for time spent in private reading or for study in a law office. The 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 law school must have the preliminary education required for admission to this school and must spend at least one 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 record in both prelaw and law work.

### Expenses

Careful estimates of the expenses of a student attending the Law School, together with other general information useful to students, are to be found in the *Bulletin of General Information*,\* to be had upon application to the dean of admissions and records of the University. The estimated expense of a law student who is a resident of Minnesota is \$1,078 per year.

### Fees

#### All university fees subject to modification without notice

Quarterly resident tuition fee .....	\$ 45.00
Quarterly nonresident tuition fee .....	115.00
Credit hour fee (resident) .....	3.75
Credit hour fee (nonresident) .....	9.75
Quarterly incidental fee .....	18.85
Deposit fee (first quarter only) .....	5.00
Special examination .....	5.00
Graduation fee .....	10.00
Large diploma fee .....	5.00

### Reserve Officers Training Corps

The four-year program of the Law School permits an entering student to begin his work in any of the branches of the ROTC and to complete the requirements for a commission at the end of his final year in the Law School.

Six credits for ROTC work will be accepted toward the prelaw requirements. They cannot be used in fulfillment of the requirements for the LL.B. degree.

For further information consult the *Bulletin of General Information* and the *Bulletin of Army, Navy, Air ROTC*, or call at the Military Science and Tactics office, Room 106, Armory.

### Loan Funds

Loans are available to law students of good character and scholarship, who have completed one year in the Law School, from the following funds, made possible to students of the Law School through the generosity of the respective donors:

**Frank B. Kellogg Loan Fund**—A bequest of \$25,000 by the late Frank B. Kellogg.

**Henry J. Fletcher Memorial Aid Fund**—Consisting of a gift of \$2,000 from Charles L. Horn, LL.B., 1912, given to perpetuate the memory of the late Professor Henry J. Fletcher and to assist students attending the Law School.

**Law Alumni Loan Fund**—Approximately \$30,000 donated by alumni and friends of the Law School. To students who maintain a B average, loans are without interest for two years.

Applications for loans from these funds should be made at the dean's office.

\* See *Bulletin of General Information* for the provisions as to privilege fees for late registration.

### Scholarships

Scholarships are awarded periodically as the funds permit on recommendation of the Law School faculty from the following funds:

**Curtis Lloyd Jensen Scholarship**—A fund of \$10,000 bequeathed by Verna Blanche Jensen in memory of her brother, Curtis Lloyd Jensen, LL.B. 1935, the income to be used for scholarship for Law School students of high character, all-around promise, and need.

**Weed Munro Scholarship**—A bequest of \$1,000, and a residuary fund after the death of life beneficiaries, to establish a Weed Munro Scholarship in the Law School.

**Law Faculty Scholarship**—A fund of \$9,500 donated by members of the Law School faculty for scholarships in 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 sum of \$250 is to be awarded annually to a member of the Student Editorial Board of the *Minnesota Law Review* who has completed one year's work on the board, such member to be selected by the student officers of the board for that year.

**Charles B. Wartenbe Fund**—Consisting of a gift of \$2,000 from Mrs. Virginia Dixon Wartenbe, given in memory of her husband, a graduate of the class of 1905, to be used as a scholarship fund or for law library acquisitions.

**Minnesota State Bar Foundation Scholarships**—Each year this foundation, representing the bar of the state of Minnesota, provides several scholarships to needy and outstanding students of the school.

**Wilbur H. Cherry Memorial Scholarship Fund**—A fund created through the efforts of the Minnesota Law Alumni Association and the generosity of alumni and friends in memory of the late Professor Wilbur H. Cherry for scholarships for needy and promising students of the Law School. At the time of the preparation of this bulletin, contributions to the fund continue to be made, and the total amount to be received has not yet been established.

Students qualified for scholarships from the funds listed above should make their applications at the dean's office.

### Honors

The *Minnesota Law Review* is a legal periodical of the Law School now in its thirty-seventh year. In addition to leading articles on law and related subjects, notes and comments on recent developments of the law are prepared by an editorial board consisting of students who, on the basis of their high scholastic achievements, become candidates for election to the board. Membership is a high honor and an opportunity for experience in research and writing, which is of unexcelled value in the development of professional and technical skills.

**Order of the Coif**—The school has a chapter of the Order of the Coif, a national honorary society of law students. Election to the 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.

### Student Government

**Student Council**—The Student Council consists of two representatives from each class and two representatives of the faculty. The council, as representative of the student body, plays an important role in the administration of the school. It super-

vises the functioning of the honor system under which examinations in the school are written. It has charge of social functions involving the school as a whole, such as the activities of Law School Day. 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. The council, as representative of the student body, is a member of the American Law Students Association sponsored by the American Bar Association.

#### **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 \$1.00 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.

## COURSES

The normal course load consists of 16 hours per week in the first, second, and fourth years and 15 hours in the third year. Additional work cannot be taken without the dean's approval.

Attendance at all classes and at all special lectures is required. All students in the Law School are required to serve as jurors or witnesses in proceedings before the Practice Court.

All subjects in the first and second years are required. Pleading, Practice, Evidence, and Legal Ethics are required in the third year.

Those under the four-year program are required to take, in addition, Legislation, Modern Social Legislation, and Judicial Administration—the last two in the fourth year. In addition, one seminar is required.

### First Year Subjects

- Agency and Introduction to Public Law. Davis, Mimeographed materials. 3 credits. Davis.
- Contracts. Fuller, *Basic Contract Law*. 9 credits. Kinyon.
- Criminal Law. Hall, *General Principles of Criminal Law*; Paulsen, Mimeographed materials. 6 credits. Paulsen.
- Judicial Remedies I. McBaine, *Introduction to Civil Procedure* (2nd ed.); Riesenfeld, Mimeographed materials. 6 credits. Anderson.
- Judicial Remedies II. McCormick, *Cases and Materials on the Law of Damages*; Wright, Mimeographed materials. 3 credits. Wright.
- Legal Research I. Morgan and Dwyer, *Introduction to the Study of Law* (2nd ed.); Flesch and Lass, *The Way to Write*; Gowers, *Plain Words*; Price, *A Practical Manual of Standard Legal Citations*. 3 credits. Liddell.
- Property I. Fraser, *Cases and Readings on Property*, Vol. 1, (2nd ed.). 9 credits. Rarick.
- Torts. Thurston, Seavey and Keeton, *Cases on Torts* (1950). 9 credits. Lockhart.

### Second Year Subjects

- Banking and Negotiable Instruments. Aigler, *Cases on the Law of Negotiable Paper and Banking*. 6 credits. Kinyon.
- Constitutional Law. Freund, *Cases on Constitutional Law* (1952 temporary ed.). 6 credits. Lockhart.
- Judicial Remedies III. Durfee and Dawson, *Cases on Remedies*, Vol. 2, Restitution; McCormick, *Cases on Damages*; Walsh, *Cases on Equity*; Wright, Mimeographed materials. 6 credits. Wright.
- Legal Research II. Wiener, *Effective Appellate Advocacy*; Price, *A Practical Manual of Standard Legal Citations*. 6 credits. Anderson.
- Private Corporations. Ballantine and Lattin, *Cases and Materials on the Law of Corporations*. 6 credits. Rottschaefer.
- Property II. Kirkwood, *Cases on the Law of Conveyances* (2nd ed.); Fraser, *Cases and Readings on Property*, Vol. II (2nd ed.). 6 credits. Bade.
- Sales. Lattin, *Cases and Materials on the Law of Sales; Uniform Commercial Code*, with comments (Fall, 1952 ed.). 6 credits. McClure.
- Trusts. Scott, *Cases on Trusts* (4th ed.). 6 credits. Rarick.

## Third and Fourth Year Subjects

- Administrative Law. Davis, *Cases on Administrative Law*. 6 credits. Davis.
- Advanced Future Interests Seminar. Simes, *The Law of Future Interests*, Hornbook Series, 1951. 3 credits. Rarick.
- Conflicts. Cheatham, Goodrich, Griswold and Reese, *Cases and Materials on Conflict of Laws* (3rd ed.). 6 credits. Paulsen.
- Creditors Remedies. Moore and Countryman, *Debtor's and Creditor's Rights* with Bankruptcy Pamphlet. 6 credits. Deinard.
- Criminal Law Seminar. No text. 3 credits. Paulsen.
- Estate Planning Seminar. M. A. Shattuck, *An Estate Planner's Handbook*; G. T. Stephenson, *Working Provisions of Wills and Trust Agreements*. (First, second, and third series.) 3 credits. Bade.
- Evidence. McCormick, *Cases and Materials on the Law of Evidence*. 6 credits. Louisell.
- Family Law. Fuchs, *Cases and Materials on Domestic Relations*; Paulsen, Mimeographed materials. 3 credits. Paulsen.
- Insurance. Patterson, *Cases on the Law of Insurance* (2nd ed.). 3 credits. McClure.
- International Law Seminar. Briggs, *The Law of Nations* (2nd ed.). 6 credits. Liddell.
- Judicial Administration. Pirsig, *Cases and Materials on Judicial Administration*. 6 credits. Pirsig.
- Jurisprudence. Fuller, *The Problems of Jurisprudence*. 6 credits. Rottschaefer.
- Labor Law I. Cox, *Cases on Labor Law* (2nd ed.), 1951. 3 credits. Lockhart.
- Labor Law II. Cox, *Cases on Labor Law* (2nd ed.), 1951. 3 credits. Lockhart.
- Legal Ethics. Pirsig, *Cases and Materials on Legal Ethics*. 1½ credits. Pirsig.
- Legislation. Read and McDonald, *Cases and Other Materials on Legislation*. 6 credits. McClure.
- Local Government Law Seminar. Fordham, *Local Government Law*. 3 credits. Wright.
- Modern Pleading. Clark, *Handbook of the Law of Code Pleading* (2nd ed.). 6 credits. Wright.
- Modern Social Legislation. Riesenfeld and Maxwell, *Modern Social Legislation*. 6 credits. Anderson.
- Mortgages. Campbell, *Cases on Mortgages of Real Property* (2nd ed.). 3 credits. Bade.
- Practice. McBaine, *Cases on Trial Practice* (3rd ed.). 12 credits. Louisell.
- Regulatory Process Seminar. Assigned readings. 3 credits. Davis.
- Security Transactions. *Uniform Commercial Code*, with comments (Fall, 1952 ed.); Mimeographed materials. 3 credits. McClure.
- Taxation. Rottschaefer, *Cases on Taxation* (3rd ed.). 6 credits. Rottschaefer.
- Trade Regulation. Schwartz, *Free Enterprise and Economic Organization*. 4½ credits. Davis.
- Wills and Administration. Mechem and Atkinson, *Cases and Other Materials on the Law of Wills and Administration* (3rd ed.). 3 credits. Bade.

## COURSES IN OTHER DEPARTMENTS

Students under the four-year program in their third and fourth years may elect not to exceed 21 credits of work in other departments of the University approved by the dean's office. The Senior College courses listed on page 13 may presently be taken without further application. The list is based on courses selected by

students and approved by the school in areas contributing to the cultural and professional development of the lawyer. The list is subject to change. A student may apply for approval of other courses on a showing of their value to him. Only in exceptional circumstances will a Junior College course be approved.

On completion of a course, a report of its contributions to the student's development must be made to the dean's office in such form as may be specified. Credit in the Law School may be withheld in the absence of such a report.

### Economics and Business

Elementary Accounting: Combined Course	Elements of Public Finance
Money and Banking	Principles of Accounting
Transportation Services, Charges I	Insurance Principles
Business Statistics	Economics of Money and Banking
Survey of Office Management	Manpower Economics, Labor Problems
Life Insurance	Corporation Finance
Income Tax Accounting	Government Regulation of Business
Investments	Business Cycles
Intermediate Accounting I	Labor Movements
Intermediate Accounting II	Economics of Marketing
Introduction to Industrial Relations	Public Finance
	The Modern Corporation

### English

American Literature

### History

Civilization of Modern World	World War II
English History	Social and Intellectual History of U.S.
American History	Europe in the 20th Century
American Diplomatic History	Readings in Medieval English History
Continental Europe	

### Humanities

Humanities in the Modern World

### Philosophy

General History of Philosophy	Introduction to American Philosophy
Principles of Philosophy	Elements of Symbolic Logic and Semantics
Plato	History of Religions

### Political Science

National Government in the United States	American Political Parties
Principles of the American Constitution	Government, Politics of British Empire
Legislative Organization and Procedure	American Political Thought
Municipal Administration	Problems of Democracy
Social Legislation and Social Institutions in the Scandinavian Countries	Political Thought
	Municipal Problems
	Recent Political Thought

**Psychology**

Abnormal Psychology

Topics in Psychology

**Social Science**

Public Affairs Forum

**Sociology**

Social Problems

Intergroup Relations

Elements of Criminology

The Family

Case Method: Study of Human  
Problems

Rural Community Organization

**Speech**

Argumentation and Persuasion

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**CALENDAR**

The annual calendar will be found in the *Bulletin of General Information* which may be obtained by application to the Dean of Admissions and Records, University of Minnesota, Minneapolis 14.