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The Graduate School
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UNIVERSITY CALENDAR

1948

Fall Quarter

Aug. 2-Oct. 1			Registration for graduate students
September	27	Monday	Fall quarter classes begin, 8:00 a.m. ¹
October	7	Thursday	Language examinations
November	4	Thursday	Last day for filing Ph.D. theses for the fall quarter
November	4	Thursday	Last day for filing Master's theses for the fall quarter
December	16	Thursday	Commencement, 8:00 p.m. Fall quarter closes

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Winter Quarter

January	3-7		Registration for graduate students
January	4	Tuesday	Winter quarter classes begin, 8:00 a.m. ¹
January	13	Thursday	Language examinations
February	3	Thursday	Last day for filing Ph.D. theses for the winter quarter
February	3	Thursday	Last day for filing Master's theses for the winter quarter
March	17	Thursday	Commencement, 8:00 p.m. Winter quarter closes

Spring Quarter

March 28-April 1			Registration for graduate students
March	28	Monday	Spring quarter classes begin, 8:00 a.m. ¹
April	7	Thursday	Language examinations
April	29	Friday	Last day for filing Ph.D. theses for the spring quarter
April	29	Friday	Last day for filing Master's theses for the spring quarter
June	11	Saturday	Commencement, 8:00 p.m. Spring quarter closes

Summer Session

June	13, 14		Registration, first term. First term fees due
June	15	Wednesday	First term Summer Session classes begin, 8:00 a.m. ¹
June	23	Thursday	Language examinations Last day for filing theses for first term of Summer Session
July	21	Thursday	Commencement, 8:00 p.m.
July	23	Saturday	First term closes
July	25	Monday	Registration, second term. Second term fees due
July	26	Tuesday	Second term classes begin, 8:00 a.m. ¹
July	28	Thursday	Last day for filing theses for second term of Summer Session
August	27	Saturday	Second term closes

¹ First hour classes begin at 7:45 a.m. at St. Paul Campus.

THE 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 1946, the Graduate School had awarded 1,858 Ph.D. degrees and some 7,000 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 and the making of contributions to knowledge by faculty and students in an atmosphere of freedom of inquiry.

The Graduate School crosses the boundaries of the departments, schools, and colleges comprising the University, and it includes the Mayo Foundation at Rochester. Its faculty of full and associate members, numbering more than nine hundred, teach both in the Graduate School and in the several undergraduate and professional colleges.

In the following pages detailed information is given with respect to the structure and rules of the Graduate School, fellowships and scholarships open to graduate students, the programs of study made possible by the offerings in more than seventy-five departments, 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 whose Bachelor's degree was granted by an institution on the list of colleges and universities approved by the Association of American Universities will be admitted, with the approval of the major department concerned, for graduate work involving a major in that department.

The scholastic records of applicants from institutions other than those on the approved list of the Association of American Universities will be reviewed and the applicant may be admitted, with or without conditions. Such conditions as may be found necessary will be determined in each case by the dean and the department of the student's proposed major. If more than six additional prerequisite credits must be earned, the applicant may be asked to register as an adult special student in the appropriate undergraduate college.

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

An applicant whose scholastic record and qualifications are unsatisfactory 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 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 the successful completion of this probationary quarter 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. Residence credit in the Graduate School will be granted with such transferred credits.

College graduates who desire simply to take additional work of undergraduate character without a view to ultimate preparation for an advanced degree should not apply for

admission to the Graduate School but should apply to the Office of Admissions and Records for registration as special students in the college giving the work. Under university rules the status of adult special normally is closed to nonresidents.

Certain departments at present require that the student complete the Miller Analogies Test, Form G, as part of the application process. At present these departments are: Child Welfare, Economics and Business Administration, Political Science, including Public Administration, Psychology, 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 the admission of students. It would be wise therefore for candidates to arrange to complete this test either in their senior year of undergraduate work or prior to filing an application for admission. For further information with regard to this examination and places where it may be taken, students should write to the Carnegie Foundation for the Advancement of Teaching, 522 Fifth Avenue, New York 18, New York. Students in the vicinity of the University of Minnesota may make arrangements 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, 234 Administration Building, University of Minnesota, Minneapolis 14, Minnesota. Applications for admission must be accompanied by official transcripts in duplicate of undergraduate work and single official transcripts of any graduate work that may have been taken. 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.

CANDIDACY FOR A DEGREE

Admission to the Graduate School does not admit a student to candidacy for a degree. Admission to such candidacy is contingent upon the ability of the student and the quality of his work in the Graduate School of the University of Minnesota. 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. Under no circumstances will a student be admitted to candidacy until he has been in residence for at least one quarter or one Summer Session and until he has removed any deficiencies which may have conditioned his admission to the Graduate School. The procedure in applying for candidacy will be found in connection 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 tho 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 as stated apply to the beginning of the quarter in which the courses for graduate credit are carried. The 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 the transfer of a maximum of 9 quarter credits of graduate work satisfactorily completed at other approved graduate schools toward meeting 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 may be substituted for the required 9 credits in starred courses.

If the maximum of 9 credits is transferred, it 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. The transfer of all such graduate credit and of residence from another institution will be dependent upon the recommendation of 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.

The maximum number of credits a student may transfer 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) is 9 quarter credits 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 100 and above offered by the Extension Division of the University of Minnesota in the Twin Cities area, and taught by regularly approved members of the graduate faculty. Petition to transfer is limited to extension credits earned since September, 1943. Such transfers of extension credits will not give residence credit. This rule is *not* to be interpreted as approval of transfer of graduate credits earned in any other institution through extension courses.

From the United States Armed Forces Institute—Petitions of students to transfer graduate credit for a Master's degree in courses taken under the program of the Armed Forces Institute in other institutions will be subject to the rules stated in the first three paragraphs under "From other institutions to apply toward the Master's degree."

Credits of graduate quality earned through the Armed Forces Institute may apply toward the Ph.D. only if they are accepted through the usual procedure as part of the student's three-year program.

All credit transfer from the Armed Forces Institute, whether toward the Master's degree or the Doctor's degree, is subject to an evaluation of the graduate caliber of such courses by examinations approved by the Graduate School of the University of Minnesota.

From military training programs offered by the University of Minnesota—Credit in the Graduate School will be allowed to qualified students for work done in the various military programs on this campus in accordance with the recommendations presented by staff members with regard to specific courses. These recommendations are on file in the office of the Graduate School and are too extensive to be quoted here. Students interested should write to the Graduate School indicating the nature of the military training program completed on this campus.

No student using credit secured in military courses at the University of Minnesota may receive his Master's degree with less than one additional quarter in residence.

From military training programs offered by other institutions—Credits in courses taken under military training programs in approved institutions may be transferred to apply toward either the Master's degree or the Doctor's degree under the usual regulations applying to transfer of credits from other institutions. (See page 6, "From other institutions to apply toward the Master's degree," and Requirements for the Doctor's Degree, page 13 of this bulletin.) Such transfers will not be authorized without favorable recommendations from the graduate schools in the institutions at which the work was taken.

For other types of military training not received through educational institutions—All petitions for graduate credit on the basis of such military training will be acted upon individually.

For correspondence study—No graduate credit toward either the Master's degree or the Doctor's degree is allowed for credits earned through correspondence study.

REGISTRATION

Full directions concerning 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 copy of an official transcript of graduate work, should be forwarded to the Graduate School at least four weeks before the opening of the quarter in which the student enters the Graduate School.

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. The student must report for a physical examination by the Students' Health Service of the University of Minnesota at the time of his first registration in the Graduate School for more than four credits of work. In making an appointment for this examination, he should present his receipted fee statement to the Health Service.

FEEES

Tuition fee for residents (except for clinical medicine) per quarter	\$35.00
Tuition fee for nonresidents per quarter	75.00
Tuition fee per credit hour for students carrying less than full work	
Residents	3.00
Nonresidents	6.25
Tuition fee for graduate study <i>in absentia</i> for the professional engineer degrees (to be paid but once for each degree)	105.00
Tuition fee for thesis registration only per quarter	5.00
Incidental fee	11.45
Matriculation deposit (first quarter in residence)	3.00
Special deposit for chemistry laboratory	5.00
Graduation fee	10.00
Fee for binding Master's thesis	2.50
Fee for publication of Ph.D. thesis summary	50.00

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

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 adviser and by the Graduate School office must be turned in at the Office of Admissions and Records to obtain 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 details about living expenses.

REQUIREMENTS FOR THE MASTER'S DEGREE§

The degree of master of arts is, in general, conferred for advanced nontechnical study; the degree of master of science, for advanced technical study, such 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 from 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 which may be secured from the Graduate School office. This application should be submitted as soon as a student has earned sufficient credits to be eligible to 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 which is thought 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, be able to meet 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 services to the University, or who must do other work for self-support will find the necessary 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 at the minimum of 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 doing more than this must modify their program or expect the completion of the thesis and examinations to extend beyond the minimum one-year period. The same limitations apply to those who lack a satisfactory command of spoken and written English or a reading knowledge of those modern languages which are the necessary tools in so many fields of graduate work.

In all courses *open to graduates only*, the student may be given a mark of "pass" or "satisfactory." This will be interpreted as the instructor's approval of the quality of the student's work viewed from the level of graduate standards. It signifies a letter grade of B at least. In the courses open to both graduates and undergraduates the system of

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

§Under specified conditions a limited number of graduate students of exceptionally high scholastic standing who take the degree of master of arts or master of science may be certified for high school teaching in Minnesota even though they lack formal residence in the College of Education. Students who expect to qualify for certification under this plan must meet certain requirements in the College of Education and also secure the approval of the dean of that college at the outset of their program of professional study.

marking by letters is normally used. No graduate credit is allowed for course work of D quality.

Under regulations adopted in 1936, qualified matriculants in the Graduate School may earn the Master's degree in certain departments† by one of two plans called hereafter 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 indicate the plan he proposes to follow. After admission to candidacy, this choice must be approved by an adviser or departmental committee acting for the major department and will be confirmed by the group committee in which the major department falls. Before making up and approving the student's choice and his program, the adviser must be supplied by the student with a statement of his undergraduate record and any additional work done with credit.

PLAN A: THE MASTER'S DEGREE WITH THESIS

Major and minor work—In choosing any 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. A grade of not less than B must be obtained in any course of this character offered as fulfilling the requirements in the major. A grade of not less than C must be obtained in minor courses. No graduate credit is allowed for course work of D quality.

The minor must be in a department whose work can be logically related to that of the department in which the student is doing 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 first registration, except in social work where the time limit is eight years.

Language requirement—A reading knowledge of a foreign language, modern or ancient, the language to be determined by the major department, is required of candidates for the Master's degree, unless exemption is made in individual cases with the approval of the Executive Committee of the Graduate School or the requirement is specifically waived in a given area. A 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 manner 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 will not be honored.

Where certification 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 that proper arrangements for proctoring can be made.

† Students should consult departmental announcements in this bulletin for information with respect to their policy as to the use of Plan B.

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 the first 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 which may be 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 one 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 is required to be in quadruplicate in order to facilitate its consideration. Two copies are retained for the University Library (as noted below), the third copy being finally returned to the candidate. Since one copy is usually desired by the adviser or department concerned, a fourth copy should be provided for this purpose. One copy must be upon the specially required red-ruled twenty-pound linen stock of 60 or 70 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 margin should be left for binding purposes. Samples in the dean's office of both the linen stock and paper to be used for carbon copies 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 and four copies, certified by the adviser as complete on a form to be secured in the Graduate School office, must be registered in the office of the dean of the Graduate School *at least six 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 deposit with the recorder, at least three 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, topics, reports, etc., of the classes in which they are registered. A special examination in the field of the minor is not 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 three 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. The candidate is not eligible for the oral examination until the thesis has been accepted and any language requirement absolved.

If the final written examination is satisfactory and the thesis accepted, the final oral examination of the candidate will be held not later than three weeks before the end of the quarter in which he takes his degree. The thesis committee, of which the adviser is chairman, will conduct 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 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.

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
Filing of thesis	Graduate School office	Six weeks before graduation (in Summer Sessions, five weeks, with the exception of medical students, whose theses may be due at an earlier date)
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 three weeks before final oral examination.
Final oral examination on all work	Committee	Not later than three weeks before commencement
Graduation fee and fee for binding thesis	Office of Admissions and Records	Not later than three weeks before commencement

Candidates who are eligible for the "preliminary examination" for the Doctor's degree may substitute this examination for the final oral examination for the Master's degree, provided all other requirements for the preliminary examination (see page 15) 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 *three weeks before the end of the last quarter.*

Candidates meeting the requirements as above outlined 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 individual committee. 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 17.) While it does not permit an indiscriminate scattering of courses over unrelated departments, it does not stress so definitely the concentration on one major and one minor field. It is understood that more than one field will be included outside of the field of concentration. Programs which 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 presumably more adapted to those who as teachers or school administrators 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 and not on a different level from those required for Plan A. The 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, 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, 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 first registration, except in social work where the time limit is nine years.

The student's program, recorded on a blank provided by the Graduate School, shall have the approval of a major adviser and shall be submitted following approval for candidacy and before the final quarter or final summer term. The program will be subject to review by the appropriate group committee. The intelligent planning of the student's program requires that he shall 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 courses 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 requested to call at the Graduate School office, before taking his final examinations for the degree, to secure the examination report form for signatures by the examining committee.

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

REQUIREMENTS	UNDER THE DIRECTION OF	DATE
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 three weeks before commencement
Graduation fee	Office of Admissions and Records	Not later than three weeks before commencement

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 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, to be shown, first, by the preparation of a thesis, and second, by successfully passing the required examinations covering both the general and the special fields of the candidate's subjects as detailed later.

Candidates for the Doctor's degree must spend at least three years§ 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 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 three-year program blank in triplicate and submit to his adviser, his minor department, and the group committee, for approval, a statement of graduate work done and an outline of his work for the second and third years, including both the major and minor subjects. This three-year program should include a detailed list of graduate course work taken elsewhere that the candidate wishes to present toward the Ph.D. from the University of Minnesota. The matter of transfer of such credit will be considered in the process of acting on the three-year program. Transfers of credit toward the Ph.D. will not become final and official until the student has successfully passed his preliminary examination. This program is then to be submitted to the dean for final approval. The student shall also file with his adviser's approval the title of his Doctor's dissertation. The blank for filing the thesis title may be obtained in the Graduate School office.

LANGUAGE REQUIREMENTS

Before admission to the preliminary examinations, the student must present to the dean of the Graduate School a statement from the Department of German, certifying that the applicant has a reading knowledge of German, and a statement from the Department of Romance Languages that he has a reading knowledge of French or, if the major adviser has recommended the substitution of Spanish for French, a reading knowledge of Spanish.¶ In addition, a knowledge of other languages may be required in certain cases, as the candidate's major department may prescribe. For the dates of these language examinations consult the calendar at the beginning of this bulletin. Repetition of the language examination because of failure is considered a special examination for which a fee of \$5 is charged. For transfer of language certification, see page 9.

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

§ This time requirement will be met in three years only by those students who devote all their time to graduate study. Students who devote the intervals between periods of professional or other regular employment to graduate study 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.

¶ The substitution of other foreign languages of greater service in the major field may be permitted by the Executive Committee on recommendation of the group committee.

or all of this preliminary work may consist of designated prerequisite courses in the same or allied departments.

During the period of work for the Doctor's degree a student shall spend not less than two thirds of his time§ on the major subject, including the work on the thesis.

THE MINOR WORK

The minor work must be selected in a department in which the student is prepared to pursue courses advanced enough in character to be included in the group designated "For undergraduate and graduate students," and numbered 100 or above.

The choice of 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, and the department in which the minor is taken must certify that all this work has been completed before admission to the preliminary examination.

DOCTOR'S THESIS

The thesis, for which the accumulation of material may well be started not later than the middle of the second year, must give evidence of 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 of knowledge. 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. The four copies, certified by the adviser as complete on a form to be secured in the Graduate School office, must be registered in the dean's office and distributed to the thesis committee *not later than six weeks* (five weeks in the first term of the Summer Session) 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 appropriate graduate group committee. The student's adviser will as a rule be the chairman of this committee. Unanimous approval by the committee will be necessary for the acceptance of the thesis.

After the final oral examination, two copies of the thesis are to be bound and deposited in the Graduate School office. The thesis report must be bound with the first of these two copies.

REQUIRED SUMMARY FOR PRINTING

Each candidate for the Doctor's degree shall submit with his completed thesis a summary of about ten pages, acceptable to his adviser, embodying the principal findings of the research, and pay to the Graduate School the sum of \$50 before being finally recommended for the degree. Such summaries will be published in appropriate volumes and should therefore be carefully edited. If, prior to publication of his summary by the University of Minnesota, the candidate publishes his thesis through some other channel and files 100 reprints, approved by his adviser, the deposit will be refunded, less the cost of binding of the reprints with the required covers, title page, and vita.

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

§ In estimating the distribution of time, a week of 15 credit hours may be assumed.

Directions for Preparing the Summary

1. Original copy on good quality bond, double-spaced, student's name on each page.
2. Signature of the adviser following careful editing for both content and form.
3. No bibliography.
4. No acknowledgments.
5. Extra charges will be imposed for summaries exceeding ten pages in length and for summaries containing tables and plates.

MICROFILM METHOD OF PUBLICATION

An alternative and inexpensive means of satisfying the publication requirement is the microfilm method. It is hoped, however, that attempts at publication in the regular way will not be relaxed because of this privilege. The understanding is that before the thesis is microfilmed it must be put in condition for publication *with just as much care as if it were to appear in printed form.*

If this method is followed, the student is expected to make the \$50 payment to the Graduate School and deposit with it the usual summary of not more than ten pages. When a microfilm copy of the thesis is deposited with the University of Minnesota Library, the \$50 deposit will be refunded as in case of other publication.

The University Microfilms of Ann Arbor has agreed, upon contract with the student, to do the filming under the condition that the student pays the cost of filming. In addition, the student must purchase one positive print, with container and spool, for the University of Minnesota Library.

Before the thesis is submitted for microfilming it must have the written approval of the student's doctoral committee. The written approval of the committee, together with the thesis and two copies of a 500-word abstract, are then submitted to the dean of the Graduate School for his final endorsement. One copy of the abstract must be placed on file in the office of the Graduate School, and one copy must accompany the thesis when it is forwarded to be filmed. For further details, including costs, consult the Graduate School office.

EXAMINATIONS

Written examinations—There shall be a written examination in the major subject, to be given by the members of the graduate faculty in the major department prior either to the preliminary or to the final examination or to both, as the department may decide. This examination shall cover all the work done in the major, and *may include any work fundamental thereto.*

Preliminary examinations—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 a candidate for the doctorate degree in the preliminary examination there must be a two-thirds affirmative vote of the examining committee which shall include 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 the successful completion of this examination may the student be enrolled as a candidate for the Doctor's degree. Students failing to pass 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 examinations for the June com-

mencement—normally from about April 25 to May 25—or during the second term of the Summer Session.

Final oral examination—After successful completion of the written examinations and acceptance of the thesis and not less than three 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 has special reference to the thesis and the field of the candidate's special studies and shall not exceed three hours.

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.

Reports—Special blanks are provided for signed reports concerning 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 three 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.

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.

TABULAR SUMMARY OF REQUIREMENTS FOR THE DOCTOR'S DEGREE

REQUIREMENTS	UNDER THE DIRECTION OF	DATE
FIRST YEAR		
Selection of major	Adviser and dean of Graduate School	
Selection of minor		
SECOND YEAR		
Three-year 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
Languages	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
THIRD YEAR		
Filing of completed thesis certified by adviser	Graduate School office	Six weeks before graduation
Approval of thesis	Thesis committee	Before admission to final oral examination
Final oral examination	Committee	Not later than three weeks before commencement
Two bound copies, summary of thesis, and deposit of \$50.....	Graduate School office	Not later than three weeks before commencement
Release card	Graduate School office	Not later than three weeks before commencement
Graduation fee	Office of Admissions and Records	Not later than three weeks before commencement

GRADUATE WORK IN THE SUMMER SESSION

Many possibilities for graduate work in fields of special interest to teachers are open in the Summer Session. Graduate students interested in summer study for purposes other than teaching will find many possibilities 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*, which is published annually.

Students who desire graduate credit for work in the summer must register through the office of the Graduate School.

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

The *course work* for the Master's degree, according to Plan A (see page 9), may be completed in four separate 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 the first registration. 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 the completion of the first half of the required work. Theses of Summer Session students must be completed at least *five weeks* before the end of the session in which they take the degree. (See page 11.)

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 first registration. (See page 12.)

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 United States, in its relations both to its own regions and to its neighbors throughout the world, contributes to the building of human understanding and to the achievement of world peace.

An interdepartmental curriculum in this field leads to the degrees of M.A. and Ph.D. 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. The prerequisite for graduate work in American Studies is an undergraduate major in that program, or a major in one of the departments concerned, or other preparation which the Committee on American Studies considers adequate.

Candidates for the M.A. degree distribute their courses among four fields: history, English, fine arts and philosophy, social sciences. Candidates for the Ph.D. degree work

also in the European background of American civilization in addition to the four fields just named.

For further information, see special bulletins and address the Chairman of the Program in American Studies, Folwell Hall, University of Minnesota.

GRADUATE WORK IN DENTISTRY

Two programs for Graduate Dental Education are available at the University of Minnesota: a course of study leading to the degree, master of science in dentistry, and a program that leads to the degree of master of science without designation. 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. The 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. The basic science courses necessary as a foundation for advanced study are outlined under the departmental offerings in the *Graduate Medical Bulletin*. Although a reading knowledge of German is recommended as highly desirable, candidates for both Master's degrees in dentistry are exempted from the foreign language requirement. When full time is devoted to study, two to three years in residence will be needed to complete the program for the master of science in dentistry degree and two academic years for the master of science without designation.

MASTER OF SCIENCE IN ENGINEERING OR ARCHITECTURE

The requirements and procedure for the degree of master of science in aeronautical, agricultural, chemical, civil, electrical, mechanical, metallurgical, mining, and petroleum engineering, and in architecture correspond to those outlined for this degree in other fields. The major subject and, under Plan A, the thesis subject will be in the field represented by the degree. The thesis must be filed in the Graduate School office *at least four weeks* (in the spring quarter, five weeks) before the date of graduation. The final written and oral examinations must be taken at least three weeks before graduation. In certain of these engineering fields the language requirement is waived. German is required in chemical engineering. The usual language requirements apply to metallography, metallurgy, and mining engineering.

GRADUATE WORK IN ENGINEERING

The advanced professional degrees, aeronautical engineer, agricultural engineer, chemical engineer, civil engineer, electrical engineer, mechanical engineer, metallurgical engineer, mining engineer, and petroleum engineer, will be conferred upon the recommendation of the Graduate School faculty as a result of the satisfactory completion of the following requirements:

a. Bachelor's degree from an approved school in the corresponding branch of engineering.

b. One full academic year of graduate engineering study (three quarters) in residence at this University. Graduates of this University may be permitted to carry on this study *in absentia* under the direction of the faculty. Work done *in absentia* may not be substituted for the residence work required for the master of science degree.

c. Four years of engineering experience in positions of responsibility, subsequent to

receiving the Bachelor's degree. (If the graduate study is done *in absentia*, five years of experience are required.)

d. A thesis of professional grade.

Candidates for the degree of chemical engineer must have a reading knowledge of German.‡

For graduates of this University, a Master's degree in the corresponding branch of engineering will be accepted as fulfilling the requirements of the year of graduate study.

The Engineer degree will not be granted in less than five years after the Bachelor's degree has been received.

If the Bachelor's degree is in another branch of engineering than that in which the professional degree is sought, the student must complete the equivalent of the subjects required for the Bachelor's degree in the new field before admission to candidacy for the desired degree.

THE MASTER'S DEGREE WITH THE ENGINEER DEGREE

It is recommended that the student who is entering upon the graduate year's study in residence for the Engineer degree file an application for candidacy for the Master's degree (see page 8) and obtain that degree for the year's work—that is, the degree of master of science in the corresponding branch of engineering. The essential difference lies in the requirement of a thesis if the Master's degree is sought. However, the aggregate amount of work is intended to be the same in both cases, namely, from 15 to 18 credit hours per week for the three quarters. If the graduate study does not lead to the Master's degree, the student is not required to prepare a thesis as a part of the year's work. The Master's thesis, however, will not satisfy the requirement for the professional thesis, which is intended to be related to the practical experience after the Bachelor's degree was received.

PROGRAM OF STUDY

Upon entrance to the Graduate School, the candidate, with the approval of the dean, will select his adviser in the field represented by the desired degree, in which field the major work and the thesis will lie. With the approval of his adviser and the dean, he will also select a minor and will outline a study program for the year. Official admittance to candidacy for the degree will not take place until after one quarter of study and will be in conformity with the rules for admission to candidacy listed under Requirements for the Master's Degree, page 8.

If the student registers for the Master's degree in engineering or architecture, he will conform to the requirements for that degree as regards major and minor work, thesis, examinations, etc.

If the graduate study during the year of residence or *in absentia* is toward the Engineer degree only, it will be divided into major and minor work, of which the major will usually constitute about two thirds and the minor one third of the total credit hours which will be carried each quarter.

STUDY IN ABSENTIA

Only graduates of this University will be permitted to undertake the graduate study *in absentia* toward one of the Engineer degrees. This permission must be obtained from the head of the department represented by the degree, who will usually act as the adviser, and from the dean of the Graduate School. It is not necessary that this study be coincident with the academic year; it may be undertaken at any time.

The proposed plan of study should be arranged with the approval of the adviser. The study may, and generally will, extend over more than nine months. At least 1,500 actual hours of work should be performed as the equivalent of a year's study in residence.

‡ In special cases approved by the department, French may be substituted.

The detailed requirements of reports and examinations will be established by the adviser. A separate written report must be submitted at the end of each quarter's work. A written examination covering the study, both major and minor, will be held at the close of the year's work. Under favorable circumstances this examination may be held in the place where the candidate resides.

Upon the satisfactory completion of the year's work, the proper credits will be recorded toward the Engineer degree.

FEEES

A fee of \$105, to be paid in advance, is required for the year of graduate study toward the professional Engineer degrees if taken *in absentia*. Students in residence are charged the regular Graduate School fees. In addition the graduation fee of \$10 must be paid for each degree obtained, at the time of qualifying for the degree. The student must also pay \$2.50 for the binding of two copies of each thesis submitted.

STUDY IN RESIDENCE

The work will consist of regular courses and may include research if desired by the student, even though the Master's degree is not sought.

ENGINEER'S THESIS

At least six months before the graduate degree is expected, the thesis subject must be approved by the adviser and the group committee. The thesis itself must be filed with the Graduate School office normally six weeks before the commencement at which the degree is to be obtained. The deposit of \$2.50 to cover the cost of binding the thesis must be made with the recorder at least three weeks before commencement. Candidates are requested to consult the Graduate School office with respect to necessary report forms to be filed.

STATEMENT OF EXPERIENCE

With the thesis, the candidate must file a detailed statement of his professional experience since receiving his Bachelor's degree. This should extend over at least four years, if the graduate study was in residence, or five, if *in absentia*.

See tabular summary of requirements for the Engineer degree, below :

REQUIREMENTS	UNDER THE DIRECTION OF	DATE
Program, major and minor	Adviser and dean of the Graduate School	On registration
Application for candidacy	Committee, normally from the major department, division, and dean	On completion of 9 to 15 credits
Quarterly reports if <i>in absentia</i>	Adviser	
Thesis subject	Adviser and group committee.....	Following approval for candidacy and at beginning of second quarter
Written examination	Adviser and major and minor staff	At end of year's study or later, as arranged
Experience statement	Adviser and major staff	Four weeks before graduation
Filing thesis	Dean of the Graduate School.....	Six weeks before graduation
Graduation fee and fee for binding thesis	Office of Admissions and Records	Not later than three weeks before commencement

ATTENDANCE AT COMMENCEMENT

Unless especially excused by the dean of the Graduate School, the candidate must be present in person to receive the degree.

FOOD TECHNOLOGY

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

Through an all-University committee, the various colleges of the University are co-operating to provide an integrated program of teaching and research to 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 1947-49 in the *College of Agriculture, Forestry, and Home Economics Bulletin*, pp. 20-22.) The course and research programs of students desiring to do graduate work 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 the Master's degree may pursue a program of study in any one of six political and cultural areas: Western Europe, Central Europe, Russia, the Scandinavian countries, the Far East, and Latin America. In this program they will pursue correlated courses in the language, literature, history, social and political organization, fine arts, and philosophy of a selected area. They may also combine with area studies courses in international law, international organization, and international relations. General regulations for admission and graduation apply except that an equivalent program replaces the normal major and minor requirement.

Candidates for the Doctor's degree may combine courses and seminar work in one of the six areas with legal, political, historical, and other international studies. It is not recommended that such candidates major exclusively in area studies.

For a complete statement of requirements, recommended courses, and vocational suggestions, see special bulletin: *Programs in International Relations and Area Studies*. Advisers who may be consulted are: Professors L. D. Steefel (Western Europe), H. C. Deutsch (Central Europe), G. W. Anderson (Russia), L. D. Steefel or A. Gustafson (Scandinavia), H. S. Quigley (Far East), and E. C. LeFort or J. A. Cuneo (Latin America).

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 medical faculty in Minneapolis and by members of the graduate faculty on the Mayo Foundation at Rochester, Minnesota, where part or all of the residence work may be done. Teaching fellowships 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.

TRAINING IN PSYCHOMETRICS

A Master's degree, under either Plan A or Plan B, may be taken by students who desire training in psychometrics, with a major in psychology, educational psychology, or child welfare. Training in these departments may be combined with related courses in other departments, e.g., personnel work in the School of Business Administration or in Public Administration, case work in the School of Social Work, etc. Training in psychometrics prepares for positions in school clinics, psychiatric clinics, institutions for the feeble-minded, mental hospitals, educational and vocational guidance bureaus, civil service examining, public and private employment agencies, business and industrial personnel departments, etc. Students seeking such training should combine work in the above departments with courses in statistics, technical courses in psychological testing, and field work, supplemented whenever possible by internships.

Professors Dale B. Harris (Child Welfare), Guy L. Bond (Educational Psychology), and Donald G. Paterson (Psychology), among others, are advisers in their respective departments for candidates preparing for positions in psychometrics.

Graduate students who desire to prepare for higher level positions in these same fields should plan to fulfill the requirements for the Ph.D. degree in psychology, educational psychology, or child welfare.

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 properly 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 of not less 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 those students who desire them.

Other requirements—Candidates for this degree will be required to have a reading knowledge of a foreign language (French or German will ordinarily be required), or a working knowledge of the principles of governmental accounting or statistics. A foreign language is recommended for those who expect to go on for further graduate study.

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

Advanced graduate students who are interested in majoring in public administration with a view to careers in teaching or in government service are advised to become candi-

dates 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 Training Center, 13 Library, 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, P. O. Johnson, B. D. Mudgett, A. E. Treloar, W. C. Waite.

Prerequisites—Candidates for advanced degree with the major in statistics will be expected to present undergraduate preparation in mathematics up to and including differential and integral calculus.

MASTER OF ARTS

Major in Statistics

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—The general supervision of programs of study for these degrees shall be placed in the hands of 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.

DOCTOR OF PHILOSOPHY

Major in Statistics

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 program 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 formulated with the aid of that adviser selected from the special committee named above who is most closely associated with the subject-matter field in which the minor work is taken. This program will be presented first to the special committee for evaluation and recommendation, and this committee will recommend a thesis committee for the candidate. These recommendations will then be referred to the Graduate School.

Language requirement—A reading knowledge of two foreign languages is required. These are usually French and German, but Spanish may be substituted for French by petition if recommended by the student's adviser. With the approval of the Executive Committee of the Graduate School another language such as Italian or Swedish may be

substituted for one of the required languages if its value for the student's graduate education can be clearly demonstrated.

Minor in Statistics

A student whose major for the Ph.D. is one of the sciences and who looks forward to research requiring statistical techniques may take a minor in statistics. The minor program should be worked out in consultation with an adviser from the special committee listed above.

MATHEMATICS

		Credits
Math. 106	Differential Equations	3
Math. 107-108	Advanced Calculus	6
Math. 118-119-120	Vectors and Matrices	9
Math. 121-122-123	Mathematical Theory of Statistics	9
Math. 131	Advanced Algebraic Theory	3
Math. 137	Advanced Theory of Equations	3
Math. 144-145-146	Topics in Analysis	9
Math. 206-207-208	Theory of Functions	9

STATISTICS

P.H. 110	Biometric Principles	3
P.H. 111	Biostatistics Laboratory	2
P.H. 120	Correlation Analysis	3
P.H. 121	Correlation Laboratory	2
P.H. 130	Random Sampling Distributions	3
P.H. 131	Sampling Laboratory	2
P.H. 140	Vital Statistics	3
P.H. 150	Life Tables	3
P.H. 200	Research in Biometry	Ar.
P.H. 210	Seminar in Biometry	1
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	2
Ed.Psy. 216-217-218	Statistical Methods in Education	9
Ed.Psy. 243	Problems of Statistics	Ar.
Plant Genetics 248	Applied Statistics	3
Soc. 122	Statistical Methods	3

TRAINING PROGRAM IN VOCATIONAL DIAGNOSIS AND COUNSELING
FOR REHABILITATION WORKERS

The University of Minnesota has a flexible program to train students for the particular types of rehabilitation counseling work they plan to enter.

Students working for the Master's degree must complete the requirements for that degree under either Plan A (with thesis) or Plan B (without thesis). (For a statement of these requirements, see pages 8-12 of this bulletin.)

Programs should be formulated in conference with an adviser selected after consultation with the co-ordinator, Professor H. P. Longstaff, 113 Psychology Building.

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

A large number of teaching and research assistantships are offered through the various colleges, divisions, and departments of the University. Both teaching and research assistantships with certain exceptions carry exemption from tuition, provided the appointments are made on the basis of 25 per cent or more of full-time service to the University and enrollment in the Graduate School. The amount of graduate work that can be carried is proportionate to the service burden of the assistantship.

Stipends for these appointments are paid on the basis of \$1,800 for full-time service for the academic year of nine months. In general they vary from \$450 for 25 per cent of full-time service to \$900 for half-time service for the academic year.

Applications are due February 15 of each year 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.

Personnel assistantships, providing board and room but not carrying exemption from tuition, are available in the university dormitories. Application blanks may be obtained from the directors of dormitories or from the Office of the Dean of Students, 209 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 unit.

FELLOWSHIPS

Open Only to Graduates of the University of Minnesota

Albert Howard Fellowship—This fellowship affords a stipend of \$240 and exemption from tuition in the Graduate School and is 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 Fellowships—Two fellowships of \$500 each and exemption from tuition in the Graduate School are open to graduates of the University of Minnesota who major in botanical and zoological science.

Arthur Andersen Fellowship—This fellowship of \$500 without tuition exemption in accounting or related fields is open to men students holding a Bachelor's degree from the University of Minnesota.

§ Applications for fellowships and assistantships must be made on or before February 15, unless specifically stated otherwise in this announcement. Application blanks may be obtained from the Graduate School, 234 Administration Building, University of Minnesota, Minneapolis 14, Minnesota, but should be returned to the departments involved.

Minnesota State Pharmaceutical Association Fellowship—This fellowship of \$500 with exemption from tuition in the Graduate School is available to a qualified graduate of the College of Pharmacy of the University of Minnesota. Applications should be made on or before March 1.

Class of 1890 Fellowship—Whenever sufficient funds have accumulated, this fellowship of approximately \$250 without tuition exemption is open to a graduate of the College of Science, Literature, and the Arts or the College of Engineering and Architecture.

Open to Qualified Graduates of Any College or University

Foreign Student Tuition Scholarships—Thirty foreign student tuition scholarships open in any department or college are offered to qualified foreign graduate and undergraduate students. Exemption from tuition only; no stipend. Applications should be sent to the Office of the Foreign Student Adviser, 302 Eddy Hall, University of Minnesota, Minneapolis 14, Minnesota.

Grace Ellis Ford Fellowship of the Minneapolis College Women's Club—This carries a stipend of \$750 and is open in alternate years to a graduate woman student without restriction as to major field. Offered for 1948-49.

Minnesota State Division of the American Association of University Women Fellowship—This stipend of \$850 is open in alternate years to a graduate woman student without restriction as to major field. Offered for 1949-50.

Norwegian-American Graduate Fellowships—A limited number of these fellowships are open to qualified graduate students from Norway. Stipend is \$500 without exemption from tuition.

Shevlin Fellowships—Four graduate fellowships of \$500 each per annum have been established by the late Thomas H. Shevlin of Minneapolis. Two of these will be offered in 1948-49, one in the School of Chemistry and one in the Medical School. Similar fellowships will be offered in 1949-50 in the College of Agriculture, Forestry, and Home Economics and the College of Science, Literature, and the Arts. These fellowships carry exemption from tuition in the Graduate School.

Woman's Club Fellowship—This stipend of \$750 is available every second year beginning with the academic year 1948-49 to a woman graduate student, without restriction as to field, stage of progress in graduate work, or geographical origin, and with emphasis in selection not only upon high scholarship but also upon qualities of outstanding leadership and initiative.

Caleb Dorr Research Fellowship—A \$500 stipend is available in the College of Agriculture, Forestry, and Home Economics, awarded on the basis of scholarship and the prospect of productive research. It carries exemption from tuition in the Graduate School. 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 Conway MacMillan Memorial Research Fellowship in Botany—Established in 1946 by Charles J. Brand, former student of Professor MacMillan. The fellowship is awarded to doctoral students of promise and ability who have their Master's degree and are graduates of the University of Minnesota or of institutions of similar standing. It carries a stipend of \$1,200 for the academic year with exemption from tuition in the Graduate School.

Midland Co-operative Fellowships—Two fellowships of \$1,000 each are available annually to graduate students. The fellowships are primarily intended for training in business administration and the various fields of economics, but they are not limited to these areas of study. The holders of the fellowships are not exempt from tuition fees. They are eligible to apply for a renewal of the fellowship.

Applicants for the fellowships must be graduates from an accredited college or university and interested in the co-operative movement. Although eligibility does not depend on actual experience in a co-operative or on declared intention to seek employment in a co-operative, preference will be given to those who show a genuine and enthusiastic interest in the economic and social development of co-operatives.

The fellowships provide unusual opportunities for study at a university located in a metropolitan area which is itself the center of a region noted for leadership in the co-operative movement. Opportunities for observation, research, and field training are numerous.

Normally the fellowships will begin with the fall quarter. Candidates should send in applications by February 15.

The California Company Fellowship in Geology—This fellowship offers \$1,000 and provides for payment of tuition, work to be done under the direction of Dr. George A. Thiel.

E. J. Longyear Company Graduate Fellowship in Economic Geology—This fellowship affords a stipend of \$750 but does not carry exemption from tuition. Work is under the direction of Professor G. M. Schwartz.

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 small fund varying from \$250 to \$400, with exemption from tuition in the Graduate School, is available at intervals of two or three years to a graduate student majoring in geology.

Carl Schlenker Memorial Fellowship—This stipend of \$300 annually without tuition exemption is open to an unmarried American-born student who is majoring in German language and literature. Preference is given to graduate students.

Clara H. Ueland Memorial Fellowship—This stipend of \$350 annually is open to recent women graduates whose interests are in problems of government and politics. The recipient is exempt from tuition in the Graduate School.

Scandinavian Area Studies Fellowships—Four fellowships of \$1,200 plus tuition have been established to train American students in the Scandinavian fields.

Abbott Laboratories Fellowship—This fellowship of \$1,000 plus tuition and fees not to exceed \$200 is open to graduate students majoring in organic chemistry under Professor Walter M. Lauer.

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.

Carbide and Carbon Chemicals Corporation Fellowship in Organic Chemistry—This fellowship of \$1,200 (or \$1,800 if the student is married) also provides for payment of tuition and fees not to exceed \$500 per year. Work is to be done under Professor C. F. Koelsch.

Du Pont Fellowship in Chemistry—This is a fellowship 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.

Du Pont Postdoctoral Fellowship in Chemistry—This is a fellowship of \$3,000 plus payment of tuition and fees not otherwise paid by the government or private agency.

Kimberley-Clarke Corporation Fellowship in Physical Chemistry—This stipend of \$1,000 also pays tuition and fees not to exceed \$500.

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

Monsanto Chemical Company Fellowship in Organic Chemistry—This fellowship provides a stipend of \$1,200 without tuition exemption, with study under Professor C. F. Koelsch.

Procter and Gamble Fellowship in Physical Chemistry of Detergents—This is a stipend of \$1,200 plus payment of tuition and fees not otherwise paid by any governmental or private agency. Work is to be done under Dr. I. M. Kolthoff.

Shell Fellowship in Chemistry—This is 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—This is 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.

Polymerization Research—These ten fellowships carry a stipend of \$1,300 for half time and \$2,600 for full time, without exemption from tuition. Work is to be done under Dr. I. M. Kolthoff.

Allied Chemical and Dye Corporation Fellowship in Chemical Engineering—One fellowship of \$1,200 plus payment of tuition is available. The 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 Chemical Engineering—This is a stipend of \$1,200 plus payment of tuition and fees not to exceed \$300.

Du Pont Fellowship in Chemical Engineering—One fellowship at \$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 is available.

Minnesota Mining and Manufacturing Company—One fellowship at \$1,200 plus payment of tuition and fees not to exceed \$300 is available for research in chemical engineering.

Standard Oil (Indiana) Fellowship—One fellowship for basic research in chemical engineering of \$1,000 plus payment of tuition and fees not to exceed \$400.

Consolidated Vultee Aircraft Corporation Fellowships—Two fellowships of \$750 each without tuition exemption are offered to graduates of accredited engineering, metallurgy, physics, or mathematics schools for graduate study and research in the fields included in aeronautical engineering. One year's in-plant training is required of the holders prior to work under these fellowships. The Corporation will make holders of these fellowships offers of employment at completion of graduate work. Applications should be addressed to the Office of the Assistant Dean of the Institute of Technology, 133 Engineering Building, University of Minnesota, Minneapolis 14, Minnesota.

tion offered for work in civil engineering.

Standard Oil (Indiana) Fellowship in Hydraulics—One fellowship of \$1,000 plus payment of tuition and fees not to exceed \$500 per year, with study under Professor L. G. Straub. Requests for application blanks should be addressed to Hydraulics Laboratory, 301 Engineering Building, University of Minnesota, Minneapolis 14, Minnesota.

International Nickel Fellowship—This stipend of \$1,500 plus payment of tuition is offered for work in metallurgy or an allied subject.

Gulf Oil Corporation Fellowship in Physics—For the study of the physical properties of hydrocarbons and related problems, under the direction of Professor John T. Tate. This fellowship carries a stipend of \$1,000 with an additional allowance for tuition for nine months' tenure.

Academy of Time Fellowship—A stipend of \$500 without exemption from tuition is offered for the study of time in any of its phases.

Eli Lilly and Company Fellowships in Pharmaceutical Organic Chemistry—Two fellowships of \$1,000 each without exemption from tuition are available.

Samuel W. Melendy Memorial Fellowships—Not more than three \$1,000 fellowships, without exemption from tuition, will be offered annually through this fund. The major study must be pharmaceutical chemistry or pharmacognosy, and full time must be devoted to graduate study and research.

Parke Davis and Company Fellowship in Pharmaceutical Chemistry—This fellowship offers a stipend of \$1,000 without exemption from tuition.

Dentistry—Five fellowships without stipend, carrying free tuition, are offered for graduate study in a field of dentistry.

John Morrell Company Fellowship in Bacteriology—This is a stipend of \$1,720 without exemption from tuition.

Maico Company, Incorporated, Fellowship—One fellowship at \$500 without exemption from tuition is offered for work in the field of hearing.

In-service Fellowships in Public Administration—Two fellowships at \$1,000 to \$1,200 with exemption from tuition fees are offered only to state or local government employees who can secure leaves of absence for the required period of study. Applications should be filed on or before March 1 with the Public Administration Training Center, 13 Library, University of Minnesota, Minneapolis 14, Minnesota.

Industrial Relations Center Assistantships—Eight half-time research assistantships at \$100 per month with tuition exemption in the Graduate School are open to people with backgrounds in political science, public administration, labor economics, sociology, psychology, or engineering.

Audio-Visual Education Fellowships—Two half-time administrative fellowships at \$900 with tuition exemption in the Graduate School are offered to provide advanced in-service training through work in the phases of the audio-visual program of the University—operation of the teaching film library, production of teaching films, and providing

audio-visual materials and services for university classes. This training is intended to lead to positions as directors or co-ordinators of audio-visual education in many fields. Applications should be sent before August 15 to the Director, Visual Education Service, 3 Westbrook Hall, University of Minnesota, Minneapolis 14, Minnesota.

Junior College Office—Eleven administrative fellowships with tuition exemption in the Graduate School are available to students trained in psychology and educational psychology with emphasis on counseling.

Administrative and Clinical Fellowships—Five clinical fellowships in the Student Counseling Bureau, one in the Bureau of Student Loans and Scholarships, nine in the Bureau of Veterans' Affairs (open only to veterans), four in the Student Housing Bureau, five in the Student Activities Bureau, one in the Foreign Student Adviser's Office, and one in the Office of the Dean of Students, are offered through the Office of the Dean of Students. These carry varying stipends and exemption from tuition. Application blanks may be obtained from the Office of the Dean of Students, 200 Eddy Hall, University of Minnesota, Minneapolis 14, Minnesota.

The Graduate School offers three administrative fellowships, one in the Graduate School office and two in the Social Science Research Center. Application blanks may be obtained from the Graduate School, 234 Administration Building, University of Minnesota, Minneapolis 14, Minnesota.

Social Work Fellowships—One fellowship is offered for graduate students in social work at \$150 a quarter and exemption from tuition, and one in medical social work with a stipend in varying amount. These are available only to students who have had at least one quarter of work in the School of Social Work. Several agency fellowships at \$75 a month without exemption from tuition are also provided by social agencies in the Twin Cities.

Six United States Public Health Stipends of \$1,200 each, provided from a grant to the School of Social Work under the National Mental Health Act. Limited to psychiatric social work students in their second or third year of graduate social work training who indicate they will enter psychiatric social work practice on completion of their training.

A limited number of work-study stipends approximating \$170 per month in cooperation with the Veterans Administration. These are available only 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 without exemption from tuition. Students accepting these fellowships are committed to accept employment with the Minnesota Division of Social Welfare or one of the Minnesota County Departments of Public Welfare.

A limited number of scholarships of the Board of Charities of the American Lutheran Church with a stipend up to \$800, conditioned by the student's financial need. Available to Lutheran students with acceptable scholarship. No exemption from tuition. Students accepting the scholarships are committed to accept employment approved by the Lutheran Board of Charities.

Several teaching assistantships varying from one-fourth time at \$450 per year with exemption from tuition to larger amounts of time and stipend with exemption from tuition. These are ordinarily open only to students who have had some graduate study or experience in social work.

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.

MEDICAL FELLOWSHIPS

The University of Minnesota offers both on the University 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 may 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 as 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 University 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 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 \$250 during any one year or a maximum of \$600. All applications should be made to the Bureau of Student Loans and Scholarships, 211 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 assist him at any time either by personal interview or by correspondence.

AIDS TO VETERANS

Graduate students eligible to 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, 10 Shevlin Hall. They are also invited to communicate with or to call at the office of the Graduate School where every effort will be made to give them 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; financial arrangements including exchange privileges; orientation to federal, state, and local regulations; and other problems, educational or social 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 desire college and university as well as other types of positions may be sought through advisers and departments, the dean of the Graduate School, and the deans of various colleges throughout 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. Students wishing further information from the bureau are advised to address the director at 210 Burton Hall, University of Minnesota, Minneapolis 14, Minnesota.

HOUSING FACILITIES

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. Graduate women students are eligible for residence in Comstock Hall. Inquiry should be addressed to the director of Comstock Hall.

A limited number of prefabricated housing units owned by the University of Minnesota are available for rental by graduate students, and certain units have been set aside for foreign students and for teaching assistants. In general the prefabricated houses are available only to new graduate students who are married and have children. Apart from the units reserved for foreign students and teaching assistants, the prefabricated houses are further restricted to United States veterans.

Quarters are rented by lease on a twelve-month basis from September 1 to August 31, and residence is limited to one year. The lessee may be given the privilege of canceling the lease, with the consent of the University. Therefore occasions might possibly arise when quarters would become available to new tenants before or after September 1.

Graduate students interested in securing one of these units should communicate with the director of Service Enterprises, Room 10, Administration Building, regarding application, prices, and other details.

DESCRIPTION OF COURSES

An asterisk (*) indicates courses that may be taken for independent work under Plan B, see pages 11-12. These courses require preparation of written reports representing the quality but not the range of the Master's thesis.

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

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 primarily for graduate students.

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, Jean F. Piccard, Burton J. Robertson, Ralph H. Upson; Associate Professor Joseph A. Wise; Assistant Professors Alfred E. Cronk, William W. Harris.

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

Doctor's degree—Work toward 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.: Course 1 and M.&M. 25. 3 cred. per quarter. Stolarik, Cronk.
- 103f-104w-105s. Advanced Aerodynamics. Prereq.: Course 102 or special permission. 3 cred. per quarter. Cronk.
- 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.: Course 83. 3 cred. Harris.
- 116f. Advanced Airplane Stresses. Theory and design of monocoque fuselages; multispar and unit construction wings; vibrations; wing and control-surface flutter; analysis and design of seaplane hulls and floats. Prereq.: Course 115. 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.: Course 116. 3 cred. Wise.
- 118s. Advanced Airplane Stresses. Seaplane floats and hulls, stability, hydrostatics. Theory of flexure of flat plates; buckling of plates; combined bending and axial stress in plates. Applications to design of seaplane floats and hulls. Prereq.: Course 117. 3 cred. Wise.
- 119f. Advanced Airplane Stresses. Theory of model studies, similitude. Maxwell's theorem of reciprocal deflections. Begg's deformeter. Strain gauges, mechanical, optical, magnetic, and electrical resistance types. Interpretation of tests and measurement of deflection. Prereq.: Course 118. 3 cred. Wise.

- 120f-121w*-122s. Airplane Design. Stress analysis of wings, fuselages, chassis, control surfaces, etc.; specifications; performance and design calculations; propellers. Prereq.: Courses 83, 102, M.&M. 128. 2 cred. per quarter. Upson, Stolarik.
- 123f,w,s-124f,w,s-125f,w,s.* Advanced Airplane Design. Problems in airplane design or development. Prereq.: Course 121, permission of instructor. 2 to 5 cred. per quarter. Akerman.
- 126s.* Propeller Design. Graphical and analytical methods of investigation. Prereq.: Course 120, permission of instructor. 3 cred. Akerman.
- 127f,w,s*-128f,w,s. Advanced Problems in Airscrew Design. Prereq.: Course 126, permission of instructor. 2 to 5 cred. per quarter. Akerman.
- 130f. Aerodynamic Design Laboratory. To be taken concurrently with Course 120. 2 cred. Stolarik, Harris.
- 131w-132s. Airplane Design Laboratory. Prereq.: for 131, registration in Course 121; for 132, registration in Course 122. 2 cred. per quarter. Stolarik, Harris.
- 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.: Course 101. 3 cred. Cronk, Upson.
- 160s. Lighter-Than-Air Craft. Theory and design. Rigid and nonrigid types; stresses; performance. Prereq.: Courses 83, 102, M.&M. 128. 3 cred. Piccard.
- 164s. Problems Relating to the Stratosphere. 3 cred. Prereq.: Course 102. Piccard.
- 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.: Course 141, permission of instructor. 2 to 4 cred. per quarter. Akerman, Piccard.
- 170s. Air Transport Economics. Airports and airways and their equipment; air commerce rules and regulations; communication. 2 cred. (Not offered in 1947-48.)
- 173f-174w-175s. Airway Meteorology. Organization of airways meteorology service: decoding of teletype weather reports, progressive study of consecutive synoptic charts, ceiling and pilot balloon observations, applications of air mass analysis and polar front theory to the construction and interpretation of airway synoptic charts, high altitude sounding with aero meteorographs, special applications of meteorology to airline operations. Prereq.: permission of instructor. 2 to 5 cred. per quarter. Piccard.
- 190f-191w-192s.* Seminar. Readings, reports, conferences, and discussions. Prereq.: Course 102. 1 cred. per quarter. Akerman, Piccard.
- 193f,w,s-194f,w,s-195f,w,s.* Advanced Problems in Aeronautical Engineering. Prereq.: permission of instructor. 2 to 5 cred. per quarter. Akerman, Piccard, Robertson, Wise, Stolarik, Cronk.
- 201f-202w-203s. Advanced Problems in Aerodynamics. Prereq.: Course 102 or special permission. 3 cred. per quarter. Braithwaite.
- 240f,w, or s. Dynamics of Structures (for Aeronautical Engineers). 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.: Course 240. 3 cred. Wise.
- 260s.* Advanced Airship Stresses. Coplanar and space rigid frameworks; secondary stresses; buckling and elastic instability; framework of dirigibles, gondolas, and cabins. Prereq.: Course 115. 3 cred. Wise.
- 272f-273w-274s.* Research in Aeronautical Engineering. 2 to 5 cred. per quarter. Akerman, Piccard, Robertson, Upson, Stolarik, Cronk.

275f,w,s-276f,w,s-277f,w,s.* Advanced Aircraft Engines. An 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 quarter. Akerman, Robertson, Braithwaite.

AGRICULTURAL BIOCHEMISTRY§

Professors William F. Geddes, Clyde H. Bailey, David R. Briggs, W. Martin Sandstrom, Max O. Schultze, Fred Smith; Associate Professors Paul D. Boyer, Robert Jenness.

Prerequisites—For major work, undergraduate courses in mathematics, physics, chemistry, biology, and biochemistry that are substantially equivalent to those required of undergraduate students majoring in agricultural biochemistry must have been completed. These include mathematics through integral calculus, general physics (15 credits), general inorganic chemistry (10 credits), qualitative analysis (4 credits), quantitative analysis (5 credits), organic chemistry (8 credits), biochemistry (6 credits), general biology, botany, or zoology (9 credits), and general bacteriology (5 credits); physical chemistry is strongly advised. The major adviser may require additional prerequisites.

For minor work, credits in general inorganic chemistry, qualitative analysis, quantitative analysis, organic chemistry, and biology are required.

Majors—With the approval of the adviser, courses in bacteriology, biostatistics, botany, chemistry, chemical engineering, dairy husbandry, genetics, plant physiology, physiological chemistry, and other basic medical sciences may be included as part of the major course of study. Candidates for the Ph.D. degree must have completed at least one year of advanced organic chemistry (105, 106, 107, or equivalent) and one year of physical chemistry (101, 102, 103, or equivalent). Students who do not present credits in these subjects upon entrance will be required to register for them during their first year of graduate study. Course 224 must be included in the study program of all students majoring in the division.

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 123 inclusive and 129 to 133 inclusive provide a basic training in biochemistry and are particularly recommended to students desiring to minor in this subject for the Ph.D. degree. Upon approval of the chief of the division, applied phases of biochemistry, such as cereal chemistry, dairy chemistry, and animal nutrition may be included in the study program in lieu of some of the courses enumerated above. Candidates for the M.S. degree should arrange their minor course program by consultation with their major adviser.

Language requirement—Candidates for the Master's degree must have a reading knowledge of German or French. In special cases, where some other language is needed for the development of the thesis, Russian, Italian, or one of the Scandinavian languages may be substituted by petition. For certain foreign students to whom English is an acquired language, a similar substitution of English may be granted on recommendation of the major adviser and approval by the graduate group committee. In no instance where English is the native language will the language requirement be waived. It is strongly recommended that candidates for both the M.S. and Ph.D. degrees acquire

§ Thesis work fee. A fee of \$10 per quarter for a maximum of two quarters for candidates for master of science degrees, and for a maximum of five quarters for candidates for doctor of philosophy degrees is charged for thesis work privileges. Students will purchase agricultural biochemistry deposit cards in payment of this fee. Anyone registering in the Graduate School for thesis work only must also pay the regular thesis tuition fee of \$5 per quarter.

facility in reading the necessary foreign languages before entering on their major and minor courses of study.

Master's degree—In general, work for the Master's degree is offered only under Plan A. In exceptional cases Plan B may be offered upon approval of a committee composed of all the major advisers of the division.

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

COURSES

- 103s.§ Dairy Chemistry. Lectures and laboratory work on the physical, colloidal, and chemical properties of milk and dairy products, and on the processes involved in the manufacture of dairy products. Prereq.: Courses 2 and 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 based on the organic and inorganic compounds which are characteristic of plants and plant products, and their reactions and interactions. Prereq.: organic chemistry, Course 3 or equiv. 3 cred. Siminovitch.
- 106s.* Animal Biochemistry. An introduction to the chemistry, metabolism, and nutrition of animals based on the organic and inorganic compounds which are characteristic of animals and animal products and their reactions and interactions. Prereq.: organic chemistry, Course 3 or equiv. 3 cred. Schultze.
- 108s. Chemistry of Wheat and Wheat Products. A lecture course, with collateral library reference work on the chemical technology of the production and milling of wheat and its conversion into food. Prereq.: Course 5. 3 cred. Geddes.
- 110s.‡ Flour Laboratory Methods. A laboratory course. Analysis of wheat and its products. Designed to train students for research in the cereal industry. Prereq.: Course 2 or equiv., parallel Course 108. 3, 4, or 5 cred. depending on the amount of work completed. Geddes.
- 116w. Advanced Animal Nutrition. Lectures and reading on the biochemistry of animal nutrition. Prereq.: Course 6 or equiv., 120 advised. 3 cred. Schultze.
- 117s.‡ Laboratory Problems in Animal Nutrition. A laboratory course on methods used in nutrition studies. Prereq.: Course 116, permission of instructor. 3 cred. Schultze.
- 118f,w,s.‡ Laboratory Problems in Biochemistry. Laboratory work in the preparation and isolation of pure compounds, and in special methods of identification or determination of biochemical products. Prereq.: permission of instructor. 3 to 5 cred. per quarter. Staff.
- 119f. Colloids. Lectures and assigned readings dealing with the colloidal state of matter, the preparation and properties of colloidal systems, and the relation of these to biochemical processes. Prereq.: Physics 9 advised, Course 3, or 8 cred. in organic chemistry. 3 cred. Briggs.
- 120w,121w,122s. Lectures and assigned reading on composition, structure, chemical and physical properties, and the functions of proteins, carbohydrates, and lipides. Prereq.: Course 119 or permission of instructor. 3 cred. per quarter. 120w. Proteins. Sandstrom; 121w. Carbohydrates. Smith; 122s. Lipides. Briggs.
- 123s. Enzymes. Lectures and assigned readings on enzyme action, including the methods of preparation and investigation of enzymes and their function in biological and industrial processes. Prereq.: Course 119 or permission of instructor. 3 cred. Boyer.

‡ A laboratory fee of \$5 is required for each quarter of this course. The \$5 card purchased from the cashier's office, St. Paul Campus, must be presented before laboratory space will be assigned. A \$5 breakage card against which breakage can be charged must be purchased also. Veterans will obtain authorizations for cards from the Bureau of Veterans' Affairs and obtain cards directly from the secretary of the Division of Agricultural Biochemistry.

§ Lectures may be taken only upon permission of instructor.

- 124f. Vitamins. Lectures and reading on the biochemistry of vitamins and their physiological action. Prereq.: Course 6 or equiv. 3 cred. Schultze.
- 129f.‡ Colloids Laboratory. Methods for the preparation, purification, and study of the physico-chemical properties of inorganic and biocolloid systems. Prereq.: Course 2 or equiv., parallel Course 119. 2 cred. Briggs.
- 130w.‡ Proteins Laboratory. Preparation, identification, and analysis of proteins and their hydrolytic products. Prereq.: Course 2 or equiv., parallel Course 120. 2 cred. Sandstrom.
- 131w.‡ Carbohydrates Laboratory. Preparation, identification, and analysis of sugars and polysaccharides. Prereq.: Course 2 or equiv., parallel Course 121. 2 cred. Smith.
- 132s.‡ Lipides Laboratory. Preparation, identification, and analysis of lipides. Prereq.: Course 2 or equiv., parallel Course 122. 2 cred. Briggs.
- 133s.‡ Enzymes Laboratory. Preparation and measurement of enzymes and the study of their properties. Prereq.: Course 2 or equiv., parallel Course 123. 2 cred. Boyer.
- 201w. Advanced Colloids. Lectures and library studies involving modern colloid concepts and techniques. Prereq.: Course 119 and Phys. Chem. 103. 3 cred. Briggs.
- 202f.‡ Biochemical Micromethods. Laboratory work on the use of selected biochemical techniques including microtitrations, microdiffusion, absorption spectrophotometry and colorimetry, chromatographic analysis, fluorometry, microbiological assay, and manometric methods. Prereq.: 6 cred. from Courses 129 to 133 inclusive, advanced biochemistry, or permission of instructor; Bact. 53 advised. 3 cred. Boyer.
- 203f,w,s,*.‡ Research Problems. Work on particular research problems other than the student's major thesis. Facilities are provided for biochemical investigations and for advanced studies in plant or animal nutrition. Prereq.: permission of instructor. 2 to 5 cred. per quarter. Staff.
- 205f,w,s,*. Special Topics in Biochemical Literature. Library work followed by the preparation of written reports upon either the historical development or the current literature of special biochemical problems. A reading knowledge of German is necessary and of French desirable. Prereq.: permission of instructor. 1 to 3 cred. per quarter. Staff.
- 208f,w,s. Cereal Chemistry Seminar. Prereq.: Course 108 or permission of instructor. 1 cred. per quarter. Geddes.
- 212f,w,s.* Special Topics in Nutritional Chemistry. A special library course with written reports on assigned readings in protein, mineral, and vitamin nutrition, primarily to train the student as a critic in this field. Prereq.: Course 116, permission of instructor, and a reading knowledge of German. 3 cred. per quarter. Schultze, Boyer.
- 213f,w.* Seminar in Dairy Chemistry. Prereq.: Course 103, permission of instructor. 1 cred. Jenness.
- 216f,w.* Nutrition and Enzymes Seminar. Prereq.: Course 116, permission of instructor. 1 cred. Schultze, Boyer.
- 219f,w.* Colloid Chemistry Seminar. Prereq.: Course 119, permission of instructor. 1 cred. Briggs.
- 220f,w.* Protein Chemistry Seminar. Prereq.: Course 120, permission of instructor. 1 cred. Sandstrom.
- 221f,w. Carbohydrate Chemistry Seminar. Prereq.: Course 121, permission of instructor. 1 cred. Smith.

‡ A laboratory fee of \$5 is required for each quarter of this course. The \$5 card purchased from the cashier's office, St. Paul Campus, must be presented before laboratory space will be assigned. A \$5 breakage card against which breakage can be charged must be purchased also. Veterans will obtain authorization for cards from the Bureau of Veterans' Affairs and obtain cards directly from the secretary of the Division of Agricultural Biochemistry.

- 222f,w.* Chemistry of Lipides Seminar. Prereq.: Course 122, permission of instructor. 1 cred. Briggs.
- 224f,w,s.* General Seminar. Reports of research work of the division. Required of all students majoring in the department. 1 cred. Staff.

AGRICULTURAL ECONOMICS

Professors Oscar B. Jesness, Austin A. Dowell, E. Fred Koller, George A. Pond, Warren C. Waite; Associate Professor Selmer A. Engene; Assistant Professor Rex W. Cox.

Prerequisites—For major work 18 quarter credits consisting of courses acceptable to the student's adviser. Further courses may be required if in the opinion of the adviser this is 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 the 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—Candidates for the Master's degree in agricultural economics are exempt from the requirement of a reading knowledge of a foreign language.

Master's degree—Work for the Master's degree is 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.: Course 2. 3 cred. Pond.
- 103s. Farm Management: Operation. A continuation of 102 with special attention to efficiency in farm operation. Prereq.: Course 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.: Course 2. 3 cred. Pond.
- 107s. Farm Work Simplification. A study of principles and methods of accomplishing work in less time and with less effort. Methods for analyzing jobs, principles of motion economy, and efficient working methods for different enterprises. Practice in planning improved working methods. Prereq.: Course 2. 3 cred. Engene.
- 110f. Economics of Agricultural Production. The principles of production economics elaborated in terms of the production of the major farm products and producing areas. Economic geography and agriculture. National production policies. Prereq.: Course 2. 3 cred. Dowell.
- 126f,s. 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.: Course 2 or 3. 3 cred. Waite.
- 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.: Courses 30, 40. 3 cred. Waite.
- 135s. Methods of Price Analysis. Statistical technique involved in analyzing seasonal and year-to-year movements in prices of farm products. Interpretation of results. Prereq.: Course 191. 3 cred. Waite.

- 140f. Marketing Organization: Staples. Principles of production economics applied to the organization of markets and marketing organization for the grains, tobacco, cotton, and wool. Special attention to co-operative organization. Prereq.: Course 40. 3 cred. Cox.
- 141w. Marketing Organization: Dairy and Poultry Products. Prereq.: Course 40. 3 cred. Jesness.
- 142s. Marketing Organization: Fruits and Vegetables. Prereq.: Course 40. 2 cred. Cox.
- 143w. Marketing Organization: Livestock and Meats. Prereq.: Course 40. 3 cred. Dowell.
- 144f. Co-operative Organization. Prereq.: Course 40. 3 cred. Jesness.
- 150s. Advanced Farm Finance. Prereq.: Course 50 or equiv. 3 cred. Koller.
- 170w. Land Economics. Prereq.: Course 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.: Course 110 or permission of instructor. 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.: Course 190. 3 cred. Waite.
- 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. Attention will be given to methods used in collecting and compiling these data with special emphasis on farm records and accounts as a basis for farm organization study. 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. A study of methods of conducting research work and analyzing problems in farm organization and operation. Students will be assigned to individual research problems or to special phases of research work being conducted by members of the staff. Reports covering progress of work and analysis of findings required as a basis for credit. Cred. ar. Pond. (Offered when the demand warrants.)
- 241f.* Seminar in the Marketing of Livestock and Livestock Products. 3 cred. Dowell. (Offered when the demand warrants.)
- 244w.* Seminar in Co-operative Marketing. 3 cred. Jesness, Koller. (Offered when the demand warrants.)
- 246f.* Seminar in Economics of Consumption. 3 cred. Waite. (Offered when the demand warrants.)
- 270s. Seminar in Land Tenure. 3 cred. Dowell. (Offered when the demand warrants.)

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

AGRICULTURAL ENGINEERING

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

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, subject to review and amendment by the adviser, a major in some phase of agricultural engineering for which his undergraduate work has furnished the foundation.

In any case, additional supporting work may be required where such seems desirable to the adviser in the case of a major, and to the instructor in charge in the case of a minor.

Master's degree—Work for the Master's degree is 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 science which are considered essential in any given case.

COURSES

- 101f,*102w,*103s.* Advanced Problems in Soil Moisture Regulation. Drainage problems in surface run-off, soil permeability, relation of soil and crop type to soil moisture, shape and regulation of water table in relation to root growth. Prereq.: Course 51. 2 to 6 cred. per quarter. Manson, Allred.
- 104f,su. 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.: 9 cred. in agricultural engineering including physics. 3 cred. Manson.
- 105s. Advanced Soil and Water Conservation. Advanced studies of the principles and practices of land drainage, soil erosion control, and irrigation. Prereq.: Course 51 or equiv. 3 cred. Manson, Allred.
- 111f,*112w,*113s.* Farm Building Problems. Investigations in building materials, methods of construction, cost, and efficiency of farm buildings. Prereq.: Course 67. 2 to 6 cred. per quarter. Otis.
- 114w,su. 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.: 9 cred. in agricultural engineering including Courses 3 and 6 or equiv. 3 cred. Christopherson, Otis.
- 121f,*122w,*123s.* Farm Power and Machinery Problems. Studies of mechanical and electrical power and machinery for the farm, including tests, design, and adaptability to various farm conditions. Prereq.: Courses 71, 72. 2 to 6 cred. per quarter. Schwantes, Hustrulid, Strait.
- 124s,su. Agricultural Machinery and Mechanical Power Management. Machinery and power management, use, and costs. Lect. and special problems. Not open to engineers. Prereq.: 9 cred. in agricultural engineering including physics and Course 12. 3 cred. Schwantes, Hustrulid, Strait.

- 125s. Topics in Agricultural Physics. Advanced studies of the essential physical principles involved in the utilization of electricity in agriculture. Prereq.: Course 72 or calculus and Courses 24, 25 or equiv. 3 cred. Hustrulid.
- 126w. Selection and Management of Agricultural Machinery. Special problems in economical power and machine combinations and their application to the farm. Prereq.: Courses 18, 71, Agr.Econ. 102. 3 cred. Schwantes.
- 201f-202w-203s.* Research in Soil Moisture Relations. Studies of design and functioning of soil moisture control works with special reference to soil types and soil water conditions. Prereq.: Course 101, 102, or 103, and one quarter's work in mathematical theory of statistics. 2 to 6 cred. per quarter. Manson, Allred.
- 211f-212w-213s.* Farm Structures Research. Studies in farm structures as related to other factors in the farm business. Prereq.: Course 111, 112, or 113. 2 to 6 cred. per quarter. Otis.
- 221f-222w-223s.* Farm Power and Machinery Research. Studies involving the design or utilization of mechanical and electrical power and machinery used in farm operations. Prereq.: Course 121, 122, or 123. 2 to 6 cred. per quarter. Schwantes, Hustrulid, Strait.

AGRONOMY AND PLANT GENETICS

Professors Herbert K. Hayes, Elmer R. Ausemus, Charles R. Burnham, Joseph O. Culbertson, Raymond S. Dunham; Associate Professors Ernest H. Rinke, Horace L. Thomas; Assistant Professors Jean W. Lambert, Alois R. Schmid.

Prerequisites—In agronomy, sufficient work in plant sciences to satisfy the adviser that advanced work may be purchased profitably. Further courses may be required without credit if in the opinion of the adviser this is necessary.

In plant genetics, for major or minor work, sufficient credits in plant sciences must be presented to satisfy the adviser.

Major and minor work—With the approval of the adviser, courses in agricultural biochemistry, botany, horticulture, plant pathology, plant genetics, plant physiology, soils, and other biological sciences may be accepted as part of the major work in agronomy.

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

Language requirements—A reading knowledge of French or German is advised although not required for the Master's degree. 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—Work for the Master's degree is 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. Structure, functions, culture, improvement, and uses of corn, wheat, oats, barley, rye, flax, and buckwheat. 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. 3 cred. Lambert.

- 123f. Forage Crops. Characteristics, culture, and management of meadow and cultivated crops used for forage. Hay and silage making and storage. 4 cred. Schmid.
- 126f. Crop Judging. Identification of crops, weeds, and diseases in relation to judging and grading farm crops. Prereq.: Course 122. 4 cred. Schmid.
- 133s. Pasture Crops and Management. Characteristics, economic value, and distribution of pasture plants. Methods of obtaining stands. Management of temporary and permanent pastures to maintain and improve production. Prereq.: Course 123. 4 cred. Schmid.
- 134s. Seminar in Agronomy. Critical studies of problems in agronomy. Prereq.: 9 cred. in agronomy. 2 cred. Staff.
- 135f. Weed Control. Prereq.: Course 1, Pl.Path. 3. 3 cred. Dunham, Heggeness.
- 201f,w,s,su.* Research in Farm Crops. Problems in physiology, production, and classification of crop plants. Prereq.: Courses 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 quarter. Dunham, Thomas, Schmid.

PLANT GENETICS

- 131f,w. Principles of Genetics. Fundamental principles of breeding, heredity, variation, biometry, and evolution. 4 cred. Lambert.
- 132w. Farm Crops Plant Breeding. Applied genetics. Methods of breeding each of the important agricultural crops. Prereq.: Course 131. 4 cred. Rinke.
- 241f,w,s,su.* Research in Plant Genetics. Special problems in plant genetics: inheritance of plant characters, and cytological studies in relation to plant genetics. May be taken as major or minor work. Cred. ar. Hayes, Burnham, Rinke, Thomas.
- 242f,s.* Plant Breeding Seminar. Plant genetics in relation to plant breeding, a discussion of research problems. 1 cred. per quarter. Agronomy and Horticulture staffs.
- 243f. Methods in Plant Breeding. The application of biometrical methods to field plot technique, the results of inbreeding and outbreeding, and the results of selection and crossing as a means of improving crop plants. Practice in outlining the correct mode of attack for special plant breeding problems. 3 cred. Hayes.
- 244f,su. Laboratory Methods in Plant Breeding. Practice in plant breeding technique, methods of controlling pollination, and handling of plant cultures. 3 cred. Staff.
- 245f. Advanced Genetics. Statistical tests as applied to genetic experiments; the establishment of genetic hypotheses; linkage and mutation are emphasized. 3 or 5 cred. Burnham.
- 246f.* Genetics Seminar. Important contributions to genetic theory and practice. 2 cred. Agronomy, Horticulture, and Animal Husbandry staffs.
- 247w. Cytogenetics. Recent advances in the study of chromosome behavior, polyploidy, and chromosomal aberrations are considered in relation to genetics. Includes supplementary laboratory work in smear and paraffin techniques used in the study of chromosomes. Prereq.: Bot. 119. 3 or 5 cred. Burnham.
- 248w. Applied Statistics. The application of statistical methods to the analysis of biological data, particularly with small samples. Analysis of variance, X^2 test, correlation, regression, and the design of experiments will be emphasized. Prereq.: P.H. 110. 3 cred. Thomas.

ANATOMY

Professors Edward A. Boyden, Ph.D., Chairman, Andrew T. Rasmussen, Ph.D., Richard E. Scammon, Ph.D., LL.D.; Associate Professors Berry Campbell, Ph.D., Arthur Kirschbaum, Ph.D., M.D., Lemen J. Wells, Ph.D.; Assistant Professors J. Francis Hartmann, Ph.D., R. Dorothy Sundberg, Ph.D., W. Lane Williams, Ph.D.

Prerequisites—The prerequisite work for all students who desire a major or minor in the Department of Anatomy includes general zoology, 9 credits, and advanced zoology or elementary courses in anatomy (including embryology, gross anatomy, histology, and neurology), 9 credits.

Major and minor work—Each student who desires a 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. Students majoring 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, 107, and 111).

Language requirement—Substitutions for the general Graduate School requirements are occasionally permitted by petition.

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

Doctor's degree—The Department of Anatomy provides excellent facilities for students who wish to take advanced work or to pursue investigations in anatomy leading to the Ph.D. degree.

COURSES

- 100f-101w. Gross Human Anatomy. Dissection, including osteology. 9 cred. per quarter. Enrolment limited. Boyden.
- 103w,s. Human Histology. Microscopic study of the various tissues and organs. Prereq.: Course 100-101 or equiv. 9 cred. Kirschbaum.
- 107f. Human Embryology. Development of the human body. Prereq.: Course 100-101 or equiv. 6 cred. Wells.
- 111s. Human Neurology. A study of the gross and microscopic structure of the central nervous system and sense organs of man. Prereq.: Courses 103 and 107, or Zool. 149-150. 6 cred. Rasmussen.
115. History of Anatomy. Prereq.: Course 100-101. 2 cred. (Temporarily discontinued.)
116. Correlated Anatomy. Review of anatomy by dissections and demonstrations. Prereq.: Course 100-101. 2 cred. (Temporarily discontinued.)
- 129-130. Topographic Anatomy. Based upon a study of cross sections of the human body. Lect. and lab. work. Prereq.: Course 100-101. 2 cred. or more per quarter. (Temporarily discontinued.)
- 132w. Anatomical and Functional Aspects of Reproduction. Lectures and demonstrations with experimental animals. 2 cred. Wells.
- 134w. Anatomy of the Newborn. A detailed laboratory study of the anatomy of the newborn. Prereq.: Course 107 or equiv. 3 cred. per quarter. Wells.
- 149f,w,s. Experimental Neurology. A study of the morphology of the central nervous system as determined by experimental methods. Prereq.: Course 111. Hours and cred. ar. Campbell.

- 150s. Special Topics in Neurology. Study of the literature in selected phases of human neurology. Prereq.: Course 111. Hours and cred. ar. Rasmussen.
- 153f,154w,155s,156su. Advanced Anatomy. Individual topics for advanced work in embryology, gross anatomy, hematology, histology, or neurology will be assigned to students who have completed the elementary courses in the corresponding subjects. Special courses are arranged for clinical graduate students. Hours and cred. ar. Boyden, Rasmussen, Campbell, Kirschbaum, Wells, Hartmann, Sundberg, Williams.
157. Developmental Anatomy of the Head. Prereq.: Course 107. 3 cred. Boyden. (Temporarily discontinued.)
- 158s. Special Histology and Neurology of the Head Region. Prereq.: Courses 103, 111. 3 cred. Rasmussen.
- 159f. Experimental Methods for the Study of Neoplastic Growths. Prereq.: Courses 103 and 165. Hours and cred. ar. Kirschbaum.
- 160w. Seminar in Problems of Reproduction. Prereq.: Course 107. 1 cred. Wells.
- 161f-162w-163s. Quantitative Methods. Same as Courses 110-111, 120-121, 130-131 in Biostatistics. 5 cred. per quarter. Treloar and others.
- 164w. Segmental and Topographic Anatomy of the Lungs. Prereq.: Course 101. Cred. ar. Boyden.
- 165f-166w. Hematology. Normal and pathologic morphology of the blood and blood-forming organs, with special emphasis on the study of the blood from the standpoint of diagnosis and prognosis. Prereq.: Course 103 or equiv. 4 cred. per quarter. Sundberg.
- 201f,202w,203s,204su. Research in Anatomy. Qualified students may undertake the investigation of problems in anatomy, including 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, Rasmussen, Scammon, Campbell, Kirschbaum, Wells, Sundberg, Williams.
- 205f-206w-207s. Anatomical Seminar. Reviews of the current literature and discussion of research work being carried on in the department. Prereq.: reading knowledge of French and German desirable. 1 cred. per quarter. Boyden and staff.

ANIMAL HUSBANDRY

Professors Walter H. Peters, Evan F. Ferrin, Alfred L. Harvey, Laurence M. Winters ; Associate Professors Philip A. Anderson, Willard W. Green.

Prerequisites—For major work, 18 quarter credits in animal and poultry husbandry or closely allied subjects; for minor work, 12 quarter credits.

Major and minor—Candidates doing major work for the Doctor's degree may major in 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, upon approval of the Graduate School, be exempted from the language requirement.

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

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

COURSES

- 101f. Livestock Selection. Competitive selection of all types and breeds of livestock. Evaluation of pedigrees, performance records, and other factors as aids to observation in selecting breeding animals. Visits to stock farms. Prereq.: Course 5. 3 cred. Harvey.
- 107s.* Meat Problems. The 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.: Course 53. 3 cred. Anderson.
- 112w. Animal Breeding. The application of the physiology of reproduction and genetics to the breeding of farm animals. Prereq.: Agron. 31. 3 cred. Winters.
- 113s. Livestock Management. A study of the management principles involved and the problems of care in each of the several types of specialization in livestock production. A general course covering beef cattle, sheep, hogs, and horses. Prereq.: Courses 56-57, 112. 3 cred. Peters.
- 114s. Artificial Insemination. Lectures and laboratory on the fundamentals and techniques involved in artificial insemination. Problems and procedures in managing artificial breeding associations. Prereq.: Course 112, permission of instructor. 5 cred. Green.
- 116f. Prenatal Development of Farm Animals. Textbook, lectures, and demonstrations dealing with prenatal development of farm animals. Prereq.: Course 112 or equiv. and permission of instructor. 3 cred. Green. (Offered in even numbered years only.)
- 201w.* Advanced Animal Breeding I. Assigned reading and lectures. Genetic facts and theories fundamental to an understanding of current approaches to the problems of breeding farm animals. Prereq.: Course 112 or P.H. 110. 3 cred. Winters. (Offered in odd numbered years only.)
- 202s.* Advanced Animal Breeding II. A seminar course devoted to the review of current literature in this field. Prereq.: Course 201. 3 cred. Winters. (Offered in odd numbered years only.)
- 203s.* Physiology of Reproduction. Assigned readings and discussions of recent literature concerning physiology of reproduction with special reference to farm animals. Prereq.: Course 116. 3 cred. Green.
- 205s.* Seminar in Animal Breeding. Review of current literature and discussion of topics having special emphasis on constructive livestock breeding. Prereq.: Course 112. 2 cred. Winters.
- 206w.* Advanced Livestock Feeding I. A study of experimental results bearing on feeding problems and review of literature applicable to them. Prereq.: Course 56-57, Agr.Biochem. 6, or equiv. 3 cred. Ferrin.
- 207s.* Advanced Livestock Feeding II. Prereq.: Course 206. 3 cred. Ferrin.
- 208f,209w,210s.* Animal Husbandry Seminar. Special assignments and review of literature pertaining to the livestock industry. 1 cred. per quarter. Peters.
- 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.
- 212f,w,s.* Research in Meats. Problems assigned to fit the needs of the student. 3 to 9 cred. per quarter. Anderson.
- 213f,w,s.* Research in Animal Husbandry. Problems assigned to fit the needs of the student. 3 to 9 cred. per quarter. Peters, Ferrin, Winters, Harvey.

ANTHROPOLOGY

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

Master's degree—Work for the Master's degree is 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. (Not offered in 1948-49.)
106. European Prehistory. Types of prehistoric men and cultures. 3 cred. (Not offered in 1948-49.)
- 109s. General Linguistics. 3 cred. Ar.
- 110f. Physical Anthropology. Physical types of man, prehistoric and contemporary. 3 cred. Wilford.
- 111w. Advanced Physical Anthropology. Prereq.: Course 110, or Zool. 22 or 133, or a course in human anatomy, or permission of instructor. 3 cred. Wallis.
116. Indians of the Southwest. Pueblo and nomadic tribes. 3 cred. (Not offered in 1948-49.)
117. Anthropology and Contemporary Problems. 3 cred. (Not offered in 1948-49.)
118. Indian Civilizations of Mexico and Peru. 3 cred. (Not offered in 1948-49.)
- 119w. The 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 aboriginal inhabitants of the prairies and 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. For students with special problems. Prereq.: permission of instructor. Cred. ar. Wallis, Wilford, Spencer.
129. Primitive Economics. 3 cred. (Not offered in 1948-49.)
- 130f. The Pre-Muslim Cultures of the Near East. 3 cred. Ar.
- 131w. The Growth of Islam. 3 cred. Ar.
- 132s. The Contemporary Near East. 3 cred. Ar.
- 133w. Races and Cultures of China. 3 cred. Spencer.
- 134s. Races and Cultures of Japan. 3 cred. Spencer.
- 140su. § Field Trip in Archeology. Prereq.: limited to male students, permission of instructor. 1 to 8 cred. Wilford.
- 150-151-152. Selected Readings in Ancient History. Early cultures of the Mediterranean Basin. 3 cred. per quarter. (Not offered.)
- 161w. 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. (Not offered in 1948-49.)
- 163f. Ethnology of India. A survey of primitive cultures in India, and relations with other areas. 3 cred. Spencer.
- 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.

§ This course may be taken for credit only once.

167. Primitive Mythology. The role of myth in culture. Cosmogonic and animal myths. Plots, motifs, and their diffusion. 3 cred. (Not offered in 1948-49.)
- 169s. Peoples of the South Seas. A survey of the native cultures of the Pacific Islands. 3 cred. Spencer.
170. Primitive Art. An ethnographic survey of forms of primitive art in the New World and the Old. Motifs and techniques. 3 cred. (Not offered in 1948-49.)
- 171s. Peoples of Northern Asia. 3 cred. Spencer.
172. Indians of South America. 3 cred. (Not offered in 1948-49.)
- 204f-205w-206s. Seminar in Anthropology. Individually directed research. 3 cred. per quarter. Wallis, Wilford, Spencer.

ARCHITECTURE

Professors Roy C. Jones, Robert T. Jones; Associate Professor Rhodes Robertson.

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.

COURSES

- 104f. City Planning. (Same as Political Science 123, Sociology 106.) Social, economic, political, and technical phases of modern city planning. Intended for mature students in the College of Science, Literature, and the Arts and the Institute of Technology. 3 cred. Robert Jones, Anderson, Caplow, Filipetti, Vaile.
- 105w,s. Professional Relations. Relations of the architect to clients, contractors, and fellow practitioners. Procedures of architectural practice. 2 cred. Roy Jones.
- 106s. City Planning. Technical phases of modern city planning, with special reference to the architects' functions therein. Prereq.: Course 104. 3 cred. Robert Jones.
- 201f,w,s. Special Researches in Architectural History. Prereq.: Course 61-62-63. Cred. ar. Robertson.
- 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.

ART

Professor H. Harvard Arnason; Assistant Professors Kyle R. Morris, Ransom R. Patrick, Walter W. Quirt, Josephine L. Rollins, John Rood.

Prerequisites—A minimum undergraduate preparation of 18 Senior College credits in the history of art or its equivalent. (To be determined by comprehensive examination.)

Language requirement—For the Master's degree, a reading knowledge of one foreign language, preferably German, is required.

Master's degree—Work for the Master's degree is offered under both Plan A and Plan B. The thesis subject and major work may be chosen from either the historical, theoretical, or creative (i.e., practical studio) fields; in the latter case it is expected that the various historical and theoretical aspects of the problem undertaken will be thoroughly integrated.

In those cases where the candidate is interested in a combination of creative, theoretical, and historical work in fine arts he may, with the permission of the department head, the dean, and the group committee, choose the minor subject from within the department.

COURSES

HISTORY OF ART

- 106f.* (F.A. 141, 142). Art in Egypt, the Near East, and Greece. The development of architecture, painting, sculpture, and the minor arts of vase painting, mosaic, and metal work in Egypt, Mesopotamia (Hittite, Sumerian, Babylonian, and Assyrian), and Persia. Study of the various Aegean styles (Minoan, Helladic) and particularly the evolution of Greek architecture and sculpture from the archaic through the Classic and Hellenistic period. Prereq.: 9 cred. in art, history, or literature, permission of instructor. 3 cred. Ar.
- 107w.* (F.A. 143, 151). Roman and Byzantine Art. Architecture, painting, and sculpture, from the early Etruscan period through Rome of the Republic and Imperial epochs and the period of Constantine. The rise of Christianity and its expression in early Christian, Byzantine, and Carolingian art. Prereq.: 9 cred. in art, history, or literature, permission of instructor. 3 cred. Ar.
- 108s.* (F.A. 152, 153). Romanesque and Gothic Art and Architecture. A study of architecture, sculpture, and related religious art as developed in the great monastic centers of Europe, particularly in the eleventh and twelfth centuries. The important cathedrals of Europe, both from the standpoint of the development of the Gothic style in architecture, sculpture, and painting, and as expressions of medieval culture. Prereq.: 9 cred. in art, history, or literature, permission of instructor. 3 cred. Ar.
- 116f.* (F.A. 154). Italian Painting and Sculpture of the Early Renaissance. The development of painting and sculpture in Italy from Giotto and Duccio to Donatello, Botticelli, and the Bellinis. Prereq.: 9 cred. in art, history, or literature, permission of instructor. 3 cred. Ar.
- 117w.* (F.A. 155). Masters of the High Renaissance. A study of the sources and the important works of Leonardo da Vinci, Raphael, Michelangelo, Titian, and their followers, with a survey of their influences on the Renaissance art of Spain, France, and Flanders. Prereq.: 9 cred. in art, history, or literature, permission of instructor. 3 cred. Ar.
- 118s.* (F.A. 156). Renaissance Art in Northern Europe. The development of painting and sculpture in Flanders, France, and Germany from the Van Eycks to Albrecht Dürer and Hans Holbein. Particular emphasis will be given to the evolution of the graphic arts in the fifteenth century, their influences and contribution to the culture of the Renaissance. Prereq.: 9 cred. in art, history, or literature, permission of instructor. 3 cred. Ar.
- 126f.* (F.A. 157). Baroque Art: The Classic Tradition. The development of painting from the Late Renaissance in Italy, through Peter Paul Rubens in Flanders, and the classic period of French painting (Poussin, Lorraine). Prereq.: 9 cred. in art history, history, or literature, permission of instructor. 3 cred. Ar.
- 127w.* (F.A. 158). Baroque Art in Spain. Painting during the Golden Age of Spanish culture with particular emphasis on the painting of El Greco and Velasquez. Prereq.: 9 cred. in art history, history, or literature, permission of instructor. 3 cred. Ar.
- 128s.* (F.A. 159). Baroque Art in Holland. Painting and the graphic arts in the Low Countries during the seventeenth century, with special study of Rembrandt, Frans Hals, and the minor masters of the Dutch schools. Prereq.: 9 cred. in art history, history, or literature, permission of instructor. 3 cred. Ar.
- 146f.* 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. The

- influence of Jefferson. Prereq.: 9 cred. in art history, history, or literature, permission of instructor. 3 cred. Patrick.
- 147w.* 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. The beginnings of modern architecture. Prereq.: 9 cred. in art history, history, or literature, permission of instructor. 3 cred. Patrick.
- 148s.* 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. Prereq.: 9 cred. in art history, history, or literature, permission of instructor. 3 cred. Patrick.
- 206f-207w-208s.* Seminar in Modern European Art. Prereq.: 18 cred. in Senior College courses in art history or permission of instructor. Hours ar. 3 cred. per quarter. Arnason and staff.
- 216f-217w-218s.* Seminar in American Art. Prereq.: 18 cred. in Senior College courses in art history or permission of instructor. Hours ar. 3 cred. per quarter. Arnason and staff.
- 236f-237w-238s.* Seminar Problems in Art History and Criticism. Prereq.: 18 cred. in Senior College courses in art history or permission of instructor. Hours ar. Cred. ar. Arnason and staff.

STUDIO COURSES

- 133f, 134w, 135s.‡ Advanced Design. (Formerly ArtEd. 150-151.) An advanced course in organic design based on the execution of practical problems leading to a wider understanding of art in commerce and industry. Prereq.: permission of instructor. 3 cred. per quarter. Lien.
- 150f, 151w, 152s.‡ Drawing and Painting V. Special problems. (Formerly D.P. V, Art Ed. 124E.) Prereq.: permission of instructor. Cred. ar. Quirt, Morris, Rollins.
- 183f, 184w, 185s.‡‡ Sculpture III. Special Problems. (Formerly ArtEd. 170E.) Prereq.: permission of instructor. Hours ar. 3 cred. per quarter. Rood.
- 193f, 194w, 195s.‡‡ Ceramics II. Special Problems. (Formerly ArtEd. 173E.) Prereq.: permission of instructor. Hours ar. 3 cred. per quarter. Lupori.
- 200f, 201w, 202s.‡ Advanced Problems. Prereq.: permission of instructor. 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—Work for the Master's degree is offered under Plan A and Plan B.

COURSES

- 101f. Celestial Mechanics. A course dealing with Newton's Laws of Motion and their application to gravitational astronomy. Attention is directed toward the theory of planetary motion and perturbations. Prereq.: Math. 51. 3 cred. Luyten.

‡ A fee of \$1 per quarter is charged for this course.

‡‡ A fee of \$2 per quarter is charged for this course.

- 121f-122w-123s.* Astrophysics and Stellar Statistics. An introductory course, with emphasis upon measurement of photographic plates, and discussions of the motion of the stars. 3 cred. per quarter. 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 quarter. Luyten.

BACTERIOLOGY AND IMMUNOLOGY

Professors Jerome T. Syverton, M.D., H. Orin Halvorson, Ch.E., Ph.D.; Associate Professor Newell R. Ziegler, M.D., Ph.D.; Assistant Professor William F. McLimans, Ph.D.

Master's degree—Work for the Master's degree is offered under Plan A, and Plan B may be followed in exceptional cases by petition.

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

NOTE—For information on work in Cancer Biology, see pages 56-57.

COURSES

- 102s. Medical Bacteriology. See *Bulletin of the Medical School*. Prereq.: Course 101. 4 cred. Syverton, Ziegler.
- 103f. Soil Microbiology. Studies of the microscopic inhabitants of the soil. Prereq.: Course 53 or 101 and 8 cred. in organic chemistry. 3 cred. Ar.
- 104w. 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. Limited to 15 students. Prereq.: 9 cred. in bacteriology, 4 cred. in organic chemistry. 4 cred. Ar.
- 114s.* Molds, Yeasts, and Actinomycetes. Introduction to mycology: study of lower fungi important in medicine and industry. Prereq.: 9 cred. in bacteriology or 5 cred. in bacteriology, 4 cred. in plant pathology. 4 cred. Ar.
- 116w.* Immunity. Laws of hemolysis; quantitative relationship between antigen and antibody; Wassermann reaction; opsonins; vaccines; toxin; antitoxin; precipitin reactions; blood grouping; atopy; anaphylaxis. Prereq.: Course 102. 3 cred. McLimans.
- 120w.* Diseases of Animals Transmissible to Man. Detailed studies of plague, tularemia, undulant fever, typhus fever, spotted fever, and other human diseases obtained from animal reservoirs. Prereq.: Course 102. 3 cred. McLimans.
- 121f-122w.*† Physiology of Bacteria. Effect of environment on growth; enzymes; food requirements; carbohydrate, protein, and fat metabolism; products of growth; dormancy; death. Prereq.: Course 53, 8 cred. in organic chemistry or biochemistry. 3 cred. per quarter. Halvorson.
- 123s. Applied Bacteriology. Industrial fermentations; bacteriology of water and sewage; interpretations of bacteriological data. Prereq.: Course 121-122. 3 cred. Halvorson.
- 124f. Filterable Viruses. Characters of filterable viruses; nature of virus infections; transmission of viruses by insects; important virus diseases of man and animals. Prereq.: Course 102, Anat. 103 or Zool. 149, and Path. 101. 4 cred. Staff.
- 201f,w,s. Research in Bacteriology. Graduate students with the necessary preliminary training may elect research, either as majors or minors, in bacteriology. Hours and cred. ar. Syverton, Halvorson, Ziegler, McLimans.
- 203f,w,s. Seminar in Bacteriology. 1 cred. McLimans.

204f-205w. Advanced Bacteriology. Special techniques in bacteriology: microscopy and photomicrography, methods for studying variation, quantitative methods. Cultivation and identification of anaerobes, etc. Methods of studying bacterial reactions catalyzed by enzymes. Prereq.: Course 121-122, which may be taken concurrently. 3 cred. per quarter. Halvorson.

BIOPHYSICS

Professor K. Wilhelm Stenstrom (adviser for Medical Physics and Radiology); Associate Professor Otto H. Schmitt (adviser for Biophysics); Professor 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 is required. Each program for graduate work in biophysics must be approved by the appropriate adviser.

Master's degree—Work for the Master's degree is 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 Radiology 121.) By arrangement with instructor. 1 cred. Stenstrom.

Biophys. 138f,w,s. Seminar in General Physiology and Biophysics. Cred. ar. Staff.

Biophys. 155w.‡ A survey of the theoretical and experimental aspects of biology which can be studied by quantitative physical means. Prereq.: 10 cred. in zoology, permission of instructor; physics recommended. 3 cred. 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-223f,w,s. Research in Biophysics, Cred. ar. Schmitt.

Phys. 101f-103w-105s. Theoretical Physics. An analytical survey of fundamental principles of mechanics, heat, electricity, and magnetism designed to supplement the general courses and to prepare students for more specialized graduate courses. Prereq.: 15 cred. in physics, Math. 106 or registration in 106. 3 cred. per quarter. Nier.

Phys. 110w,s,su*‡‡-112w,s,su.*‡‡ Modern Experimental Physics. Laboratory work. Characteristics of vacuum gauges, mass spectroscopy, electronic tubes and associated circuits, radioactivity, Geiger counters, ionization of gases. Prereq.: Phys. 144. 3 cred. per quarter. Schmitt.

Phys. 114f,w,s-116f,w,s-118f,w,s. Elementary Physical Investigation. Problems, either experimental or theoretical, in which the student may have some special interest. Permission of department chairman required for registration. Student may enter any quarter. Prereq.: 15 cred. in physics, Math. 51. 3 cred. per quarter. Staff.

Phys. 134f,w.‡‡ Experimental Optics. Laboratory work in spectrometry, optics of compound lenses, photometry, absorption, interferometry, and polarized light. Prereq.: 15 cred. in physics. 3 cred. Valasek.

‡ A fee of \$1.50 will be charged for this course.

‡‡ A fee of \$2 will be charged for this course.

- Phys. 136w,s.‡‡ Spectrum Analysis. Laboratory work dealing with the measurement of wave lengths, intensities, and absorption coefficients in the infra-red, visible, and ultra-violet regions of the spectrum. Prereq.: 15 cred. in physics. 3 cred. Valasek.
- Phys. 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 physics, Math. 51. 3 cred. Wall.
- Phys. 146f.‡‡ Electronics. Physics of vacuum tubes and associated circuits. Thermionics. Prereq.: Phys. 144, permission of instructor. 3 cred. Schmitt.
- Physiol. 103s,su. Physiology of Muscle, Circulation, Respiration, Digestion, Metabolism, and Nutrition. Prereq.: organic chemistry and zoology. 9 cred. Visscher, Gellhorn, Hemingway, King, Lifson.
- Physiol. 104f,su. Physiology of Excretion, the Endocrines, Nervous System, and Special Senses. Prereq.: Physiol. 103 or organic chemistry and neurology. 6 cred. Visscher, Gellhorn, Hemingway, King, Lifson.
- 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 quarter. Ar.
- Zool. 112f‡-113w.‡ Advanced General Physiology. Interactions between cells and environment; enzyme actions and general protoplasmic structure and metabolism. Prereq.: 15 cred. in zoology, permission of instructor. 3 cred. per quarter. Steinbach.
- Zool. 128f‡-129w.‡ Insect Physiology. General and comparative physiology of insects, a survey of the organ systems and their functioning in various insects. Special emphasis is placed on research methods and evaluation of data. Lect., lab., and reading. Prereq.: 15 cred. in zoology or entomology, permission of instructor. Zool. 50 or equiv. is recommended. 4 cred. per quarter. Richards.
- Zool. 291-293. General Seminar. Ar.

Other courses in appropriate subjects may be considered for credit in Biophysics.

BIOSTATISTICS

Professor Alan E. Treloar, Ph.D.; Assistant Professor Marion W. Thornton, Ph.D.; Instructor Jean M. Hartman, B.A.

Prerequisites—Satisfactory evidence of high aptitude for quantitative reasoning is the primary prerequisite for major work in this field. This should be supplemented by scientific training of a broad character, although considerable specialization may be accepted. Preparation in college mathematics through differential calculus is highly desirable, but not essential if there is a compensating breadth in scientific background.

Major—Courses in mathematics, applied statistics, philosophy, and those sciences deemed necessary to appreciation of the problems of quantitative description may be required in individual cases at the discretion of the adviser as part of the major program.

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

Master's degree—Work for the Master's degree is offered under both Plan A and Plan B. [See also the *Bulletin of the School of Public Health* for the requirements for the master of public health degree.]

Doctor's degree—Work for the Ph.D. degree is offered in this department and under the Statistics curriculum (see page 23) in accordance with the general requirements of the Graduate School.

‡ A fee of \$1.50 will be charged for this course.

‡‡ A fee of \$2 will be charged for this course.

COURSES

- P.H. 110f,w,s. Biometric Principles. An introduction to statistical analysis with emphasis on the basic principles of statistical reasoning. The description of univariate distributions, normal correlations, simple tests of significance, and goodness of fit. Prereq.: college algebra; Course 111 must be taken concurrently unless excused by instructor. Fall quarter class primarily for those registering in 130w and 120s; winter primarily for undergraduates; and spring for graduates taking Course 110 only. 3 cred. Treloar, Thornton, Hartman.
- P.H. 111f,w,s,‡ Biostatistics Laboratory. Practical training in machine calculation and statistical techniques discussed in Course 110, which must be taken concurrently. 2 cred. Thornton, Hartman.
- P.H. 120s. Correlation Analysis. Total, partial, and multiple normal correlation and regression; correlation ratio and curvilinear regression; contingency; biserial methods, tetrachoric and rank-order correlation; the symmetrical table. Prereq.: Course 110 or permission of instructor; Course 121 must be taken concurrently. 3 cred. Hartman.
- P.H. 121s,‡ Correlation Laboratory. Practical training in techniques of correlation analysis. Course 120 must be taken concurrently. 2 cred. Hartman.
- P.H. 130w. Random Sampling Distributions. A discussion of the sampling distributions of the more familiar statistics, the principles of statistical inference, and analysis of the problems of interpretation of differences, with special reference to small samples. Prereq.: Course 110 or permission of instructor; Course 131 should be taken concurrently. 3 cred. Thornton.
- P.H. 131w,‡ Sampling Laboratory. Study of the distributions of statistics derived from small samples by practical tests. Prereq.: Course 130 must be taken concurrently. 2 cred. Thornton.
- P.H. 140f,‡ Vital Statistics. Study of official sources of vital statistics, including population changes, calculation of rates and graphical exposition of trends; tests of significance. Prereq.: permission of instructor. 3 cred. Treloar.
- P.H. 150w,‡ Life Tables. Errors in mortality registration and census enumeration as they affect life table construction; calculation of abridged life tables; applications of life tables to public health problems. Prereq.: permission of instructor. 3 cred. Treloar.
- P.H. 200f,w,s,* Research in Biometry. Prereq.: permission of instructor. Cred. ar. Treloar, Thornton.
- P.H. 201f,w,s,* Topics in Biometry. Individual studies in special topics for advanced students by special arrangement. Prereq.: permission of instructor. Cred. ar. Staff.
- P.H. 211f,w,s. Seminar in Biometry. Prereq.: permission of instructor. 1 cred. per quarter. Treloar.

BOTANY§

Associate Professor A. Orville Dahl, Chairman; Professors Ernst C. Abbe, William S. Cooper; Associate Professors Allan H. Brown, Donald B. Lawrence; Assistant Professors Harlan P. Banks, Albert W. Frenkel, Gerald B. Ownbey.

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

* With special work, these courses count toward the nine credits of independent work required for the Master's degree under Plan B.

‡ A fee of \$1 per quarter is charged for this course.

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

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

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

COURSES

- 108w. Pteridophytes. Prereq.: Course 54. 5 cred. (Not offered in 1948-49.)
- 110w. Gymnosperms. Prereq.: Course 54. 5 cred. (Not offered in 1948-49.)
- 112w.‡ Aquatic Flowering Plants. A study of the higher plants of aquatic and marsh habitats. Identification; adaptive morphology and food value to wildlife. Lect., lab., and reference reading. Prereq.: 10 cred. in botany or permission of instructor. Ownbey.
- 113f.‡ Flora of Minnesota. A survey of the flowering plants and ferns of the state with particular reference to the fall flora of the local area. Collection and identification of species; distribution in Minnesota; literature and taxonomic methods. Lect., lab., and reference reading. Prereq.: Course 1-2-3 or 4-5 or permission of instructor. 3 cred. Ownbey.
- 114w.‡ Phyletic Taxonomy of Angiosperms. A detailed study of the characteristics and arrangement of the orders and families of flowering plants with emphasis upon natural or ancestral relationships. Lect., lab., and reference reading. Prereq.: Course 52 or permission of instructor. 3 cred. (Not offered in 1948-49.)
- 115s.‡ Spring Flora of Minnesota. A survey of the flowering plants of Minnesota. The use of keys and taxonomic descriptions; collection, preparation, and identification of the spring flora of the local area. Lect., lab., and reference reading. Prereq.: Course 1-2-3 or 4-5 or permission of instructor. Ownbey.
- 116su. Summer Flora of Minnesota. Same as Course 113f but with particular reference to the summer flora of the Itasca area. Offered at Itasca Biological Station. Lect., lab., and reference reading. Prereq.: Course 8su or permission of instructor. 4 cred. Tryon.
- 117s. Floristic Plant Geography. Principles and theories of plant migration and of the evolution and distribution of floras. Lect. and reference reading. Prereq.: Course 52 or permission of instructor. 5 cred. (Not offered in 1948-49.)
- 118w.‡ Extranuclear Cytology. A detailed study of the structure of protoplasm, cytoplasmic constituents, and the cell wall in the light of their chemical and physical properties. Lect., lab., and reference reading. Prereq.: Course 1-2-3 or 4-5. 3 cred. Dahl.
- 119f.‡ Nuclear Cytology. The non-mitotic nucleus, mitosis, meiosis, and the bearing of chromosome behavior on genetics, taxonomy, sex, and the life cycles of plants. Lect., lab., and reference reading. Prereq.: Course 1-2-3 or 4-5, and an elementary course in genetics. 3 cred. Dahl.
- 120s.‡‡ Research Methods in Cytology. Principles and practice of preparing materials for cytological investigation; methods of investigating such preparations and presenting the results. Lect., lab., and reference reading. Prereq.: Courses 1-2-3 or 4-5, 118 or 119, and permission of instructor. 3 to 5 cred. Dahl, Hansen.
- 121f.‡ Developmental Anatomy. The microscopic structure of vascular plants with particular attention to development in the root, stem, and leaf. Lect., lab., and reference reading. Prereq.: Course 1-2-3 or 4-5 and permission of instructor. 3 cred. Abbe.
- 123w.‡‡ Research Methods in Histology. Principles and practice of preparing materials for histological investigation; methods of investigating such preparations and presenting the results. Lect., lab., and reference reading. Prereq.: Courses 1-2-3 or 4-5, 121, permission of instructor. 3 to 5 cred. Abbe, Hansen. (Not offered in 1948-49.)

‡ A fee of \$1.50 per quarter is charged for this course.

‡‡ A fee of \$3 per quarter is charged for this course.

- 127w.‡ Morphology of Vascular Plants. A detailed consideration of the evolutionary interrelationships of the vascular plants. Lect., lab., and reference reading. Prereq.: Course 1-2-3 or 4-5. 5 cred. Abbe.
- 130f.*‡ General Plant Ecology. An introduction to the science of plant ecology, with emphasis upon the adjustment of the individual plant to its environment. To obtain graduate credit for this course the student must complete an acceptable term paper. Prereq.: Course 1-2-3 or 4-5 or equiv. 3 cred. Cooper.
- 131f. Field Ecology. A survey of the local plant communities and their development, and a study of the general principles of plant association and succession. Lect., field work, reference reading. Prereq.: Course 50 or 130 or Forestry 2, 3, 4. 5 cred. Cooper.
- 132w.‡ Morphological Ecology. The vegetative body of the plant in relation to environment. A survey of evolutionary adaptation in the plant kingdom. Lect., lab., reference reading. Prereq.: Course 50 or 130 or Forestry 2, 3, 4. 5 cred. Cooper.
- 133s. Ecological Plant Geography. Preliminary discussion of ecological principles of plant distribution followed by a detailed study of the vegetation regions of North America. Lect., reference reading. Prereq.: Course 50 or 130 or Forestry 2, 3, 4. 5 cred. Cooper.
- 134f.‡ Research Methods in Ecology. Theory and practice of instrumental study of the habitat and of precise investigation of community and succession. Field work, lect., lab., reference reading, and preparation of a scientific article for publication. Prereq.: 18 cred. in plant science including Course 50 or 130, permission of instructor. 5 cred. Lawrence.
- 137s.‡ Experimental Ecology. The ecological life history of a single native species is worked out in detail, and the principles involved are applied to the study of plant distribution. Field work, lab., lect., reading, and class reports. Prereq.: 18 cred. in plant science including Courses 50 or 130, 51, and permission of instructor. 5 cred. Lawrence.
- 140f. Advanced Survey of Plant Physiology. Advanced study of major topics in plant physiology. Membrane phenomena, enzyme catalysis, respiration, fermentation, photosynthesis, mineral nutrition, water metabolism, translocation of solutes, growth hormones, tropisms. Prereq.: Course 51 or its equiv., and elementary inorganic chemistry. 3 cred. Brown.
- 154f.‡‡ Spectroscopy and Photochemistry Applied to Biology. Lect., lab., class reports. Prereq.: 20 cred. in chemistry or biochemistry or permission of instructor. 3 to 5 cred. (Not offered in 1948-49.)
- 165s.‡ Introduction to Pollen Analysis. The ontogeny, comparative morphology, and identification of pollen grains; preparation of reference collections; applications of pollen analysis to allergy, ecology, and phylogeny; practice in atmospheric analysis. Lect., lab., reference reading. Prereq.: permission of instructor. 3 cred. Dahl.
- 170f. Water Relations of Plants. Study of colloid phenomena, diffusion, osmosis, and characteristics of living membranes. Cell water relations. Absorption, transport, and transpiration of water by higher plants. Translocation of solutes. Lect., reading, and class reports. Prereq.: Course 51 or 140, 20 cred. in chemistry or biochemistry, Phys.Chem. 101-102-103 or 107, or permission of instructor. 3 cred. Brown, Frenkel.
- 171w. Mineral Nutrition of Plants. A study of the chemical elements necessary for plant nutrition and of their role in normal metabolism. Relationship of nutritional factors to other physiological processes. Deficiency and toxicity of mineral elements. Prereq.: Course 51 or 140, 20 cred. in chemistry or biochemistry, Phys.Chem. 101-102-103 or 107, or permission of instructor. 3 cred. Brown, Frenkel.

‡ A fee of \$1.50 is charged for this course.

‡‡ A fee of \$3 is charged for this course.

- 172s. Plant Growth. Study of hormonal physiology. Consideration of external factors influencing growth. Study of dormancy, germination, growth periodicities, movement of plants, and physiology of reproduction. Prereq.: Course 51 or 140, 20 cred. in chemistry or biochemistry, Phys.Chem. 101-102-103 or 107, or permission of instructor. 3 cred. Brown, Frenkel.
- 173f,††174w,††175s.†† Advanced Physiology Laboratory. To be taken with or after 170, 171, 172, respectively. 2 cred. per quarter. Brown, Frenkel.
- 176f. Plant Respiration. A study of the biochemical mechanism of carbohydrate degradation in plants with emphasis on fundamental aspects of biological oxidation. Prereq.: Course 51 or 140, 20 cred. in chemistry or biochemistry, Phys.Chem. 101-102-103 or 107, or permission of instructor. 3 cred. Brown, Frenkel. (Not offered in 1948-49.)
- 177w. Photosynthesis. A detailed survey of the present state of knowledge of the photosynthesis of organic matter by plants. Prereq.: Course 51 or 140, 20 cred. in chemistry or biochemistry, Phys.Chem. 101-102-103 or 107, or permission of instructor. 3 cred. Brown, Frenkel. (Not offered in 1948-49.)
- 178s. Nitrogen Metabolism of Plants. Conversion of inorganic nitrogen compounds into organic compounds. Nitrogen fixation. Interrelation with other metabolic processes of plants. Prereq.: Course 51 or 140, 20 cred. in chemistry or biochemistry, Phys. Chem. 101-102-103 or 107, or permission of instructor. 3 cred. Brown, Frenkel. (Not offered in 1948-49.)
- 179f,††180w,††181s.†† Advanced Physiology Laboratory. To be taken with or after 176, 177, 178, respectively. 2 cred. per quarter. Brown, Frenkel. (Not offered in 1948-49.)
- 196su,*†197f,*†198w,*†199s.*† Problems. Advanced work in a specialized field. Prereq.: 20 cred. in natural science and permission of instructor. 1 to 5 cred. per quarter. 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.
- 209f*-210w*-211s.* Research Problems in Paleobotany. Cred. ar. Banks.
- 221f,*222w,*223s,*224su.* Research Problems in Ecology. Cred. ar. Cooper, Lawrence.
- 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 quarter. Abbe.
- 243f-244w-245s. Seminar in Taxonomy. 1 cred. per quarter. Ownbey.
- 246f-247w-248s. Seminar in Paleobotany. 1 cred. per quarter. Banks.
- 249f-250w-251s. Seminar in Ecology. 1 cred. per quarter. Cooper, Lawrence.
- 252f-253w-254s. Seminar in Plant Physiology. 1 cred. per quarter. Brown, Frenkel.
- 255f-256w-257s. Seminar in Cytology. 1 cred. per quarter. Dahl.

CANCER BIOLOGY

Professors John J. Bittner, Ph.D., Chairman, Elexious T. Bell, M.D., 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. Since cancer investigation is based upon several fundamental sciences, it is recommended that those intending to do graduate work in this field include in their undergraduate study vertebrate zoology, chemistry, physics, and modern languages.

† A fee of \$1.50 per quarter is charged for this course.

†† A fee of \$3 per quarter is charged for this course.

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 and Assistant Dean Lloyd H. Reyerson.

The work in the School of Chemistry is organized in five divisions or branches; namely, Analytical, Inorganic, Organic, and Physical Chemistry, and Chemical Engineering.

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—Candidates for the Master's degree must have a reading knowledge of German or French; German is preferred. For the Doctor's degree, both are required. Another language may be substituted for French by petition.

Examinations—The 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—The School of Chemistry offers work leading to the Ph.D. degree.

CHEMISTRY, ANALYTICAL

Professors Izaak M. Kolthoff, Ernest B. Sandell; Associate Professor Edward J. Meehan; Assistant Professor Paul R. O'Connor.

COURSES

- 101w-102s.‡ Quantitative Analysis. Discussion of the general principles, methods, and procedure of quantitative analysis, both gravimetric and volumetric. Typical problems are assigned and attention is given to proper laboratory practice. Prereq.: Inorg. Chem. 13. 5 cred. per quarter. Meehan.
- 103s.‡ Quantitative Inorganic Microanalysis. Representative methods of micro- and semi-microanalysis, gravimetric, volumetric, and colorimetric. Class limited to 16 students. Prereq.: Course 1-2. 3 cred. 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.: Course 1-2. 3 cred. Sandell.
- 105w.‡ Polarizing Microscope. Its use and application to chemistry. Identification of substances. Prereq.: Phys.Chem. 101. 3 cred. 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. Quantitative analysis of heterogenous mixtures, particle size determinations. Prereq.: Course 1-2. 2 or 3 cred. per quarter. Sandell.
- 109f,w,s.‡¶ Rock Analysis. Laboratory course covering the technique of rock analysis. Prereq.: Course 1-2. 3 cred. Ar.
- 122f. Advanced Analytical Chemistry. Condensed review of modern fundamentals of gravimetric and volumetric analysis. Prereq.: quantitative chemistry. Cred. ar. Meehan.
- 123f.*‡ Advanced Analytical Chemistry. Analysis of complex materials by modern methods. Prereq.: Course 1-2, or permission of instructor. 3 cred. Meehan.
- 127s.*‡ Optical Methods in Analytical Chemistry. Prereq.: Phys.Chem. 103. 2 to 3 cred. Meehan.
- 131f.‡ Applications of Indicators in Neutralization Reactions and pH Determinations. Prereq.: Course 1-2, Phys.Chem. 103. 3 cred. Kolthoff.
- 132w.‡ Electrometric Measurements and Titrations. Applications of potentiometric and conductometric methods in analytical work. Prereq.: Course 1-2, and Phys.Chem. 103. 3 cred. Kolthoff.
- 133s.* Voltammetry and Amperometric Titrations. A discussion of the use of the dropping mercury electrode (polarograph) and the platinum microelectrode in pure and applied chemistry. Prereq.: Phys.Chem. 103. 2 cred. Kolthoff.
- 134f,w,s,su.* Voltammetry and Amperometric Titrations. Laboratory for Course 133. 2 cred. Kolthoff.
- 135f-136w-137s.* Seminar: Modern Problems in Analytical Chemistry. Prereq.: Course 1-2, Phys.Chem. 103. 1 cred. per quarter. Kolthoff.
- 138s.‡ Advanced Volumetric Analysis. Prereq.: Course 131. 3 cred. Kolthoff.
- 140w.‡ Water Analysis. Analysis of potable water with interpretation of results. Prereq.: Course 1-2. 2 cred. Sandell.
- 201f-202w-203s.* Selected Topics in Analytical Chemistry. Cred. ar. Kolthoff.
- 301f-302w-303s.* Research in Quantitative Analysis. Cred. ar. Kolthoff, Sandell, Meehan.

‡ A fee of \$3 per quarter is charged for this course. The student should purchase a \$5 chemistry deposit card from the bursar in the Administration Building. No student will be assigned a desk in the laboratory until he presents this card. The \$3 course fee, laboratory material, and breakage will be charged against the deposit.

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

CHEMISTRY, INORGANIC

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

COURSES

- 102s.† Semimicro Qualitative Analysis. A course designed to acquaint the student with the universally applicable method and underlying principles in the identification of the more common cations by use of drop reactions on spot plate and filter paper, and separation by use of the centrifuge. Prereq.: Anal.Chem. 1-2. Cred. ar. Barber.
- 103f*-104w*-105s.* Advanced Inorganic Chemistry. A discussion of selected topics in theoretical inorganic chemistry. 103f. Atomic Structure and the Properties of the Elements Based Thereon; 104w. The Chemistry of the More Familiar Elements Based upon Structural and Periodic Relationships; 105s. Co-ordination Compounds. Prereq.: Anal.Chem. 1-2, Org.Chem. 156 and 159. 3 cred. per quarter. Maynard, O'Brien, Brasted.
- 106w*-107s.* Chemistry of Less Familiar Elements. Prereq.: Anal.Chem. 1-2, Course 62. 3 cred. per quarter. O'Brien.
- 108s. Nonaqueous Systems. A study of the principal nonaqueous systems—both protonic and aprotic. The theories of Bronsted, Lewis, and Usanovich are considered in detail. Prereq.: Anal.Chem. 1-2, 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.: Course 13 or permission of instructor. 3 to 5 cred. per quarter. Heisig.
- 111su. Elements of Group IV A. 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, Course 62. 3 cred. Johnson.
- 134f-135w-136s. Seminar. Modern Problems in Inorganic Chemistry. Prereq.: Anal. Chem. 1-2, Phys.Chem. 103. 1 cred. per quarter. Sneed and others.
- 301f,su-302w-303s. Research in Inorganic Chemistry. Cred. ar. Sneed, Reyerson, Barber, Heisig, Maynard, O'Brien, Brasted.

CHEMISTRY, ORGANIC

Professors Lee I. Smith, Richard T. Arnold,§ C. Frederick Koelsch, Walter M. Lauer; Associate Professor Ralph Mozingo; Assistant Professors Raymond M. Dodson, William E. Parham.

Prerequisite—For major work: Bachelor's degree, with minimum average of B, from an approved course 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 are required.

Language requirements—German is required for any advanced degree and is the only language requirement for the M.S. degree. For the Ph.D. degree, German and French are required, although some other language may, by petition and with the approval

† A fee of \$3 per quarter is charged for this course. The student should purchase a \$5 chemistry deposit card from the bursar in the Administration Building. No student will be assigned a desk in the laboratory until he presents this card. The \$3 course fee, laboratory material, and breakage will be charged against the deposit.

§ On leave 1948-49.

of the division, be substituted for French. Native languages, unless they be German or French are in general not acceptable substitutes.

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

Doctor's degree—In order to merit admission to candidacy for this degree, a student must meet the prerequisites outlined above and must maintain an average grade considerably above B in addition to meeting 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 in which are considered important modern topics, such as unusual types of aliphatic, aromatic, and heterocyclic compounds, natural products, and industrial processes. Prereq.: Courses 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.: Courses 63, 64 or equiv. 3 cred. Lauer.
- 105f-106w-107s.* Advanced Organic Chemistry. An advanced descriptive course covering the field of organic chemistry, together with an introduction to the literature of organic chemistry. Prereq.: Courses 63, 64 or equiv. 3 cred. per quarter. Smith.
- 110f.‡ Organic Qualitative Analysis, Advanced Course. Identification of pure organic compounds, separation and identification of constituents of mixture. Prereq.: Course 102 or equiv. Registration limited to 20. 3 cred. Koelsch.
- 116w. Heterocyclic Compounds. A discussion of the typical classes of heterocyclic compounds, ring-closures, and the like. Prereq.: Courses 63, 64. 3 cred. Parham. (Offered in alternate years. Offered in 1948-49.)
- 130s.‡‡ Organic Quantitative Analysis. Methods of proximate and ultimate analysis of organic compounds, with special attention to semimicro methods. Prereq.: Courses 63, 64, Anal.Chem. 1-2. Registration limited to 15. 3 cred. Lauer.
- 139f,w,s.‡ Advanced Organic Chemistry Laboratory Work. Selected laboratory problems of an advanced nature, 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.: Courses 63, 64, 156. Registration limited to 20. 2 to 5 cred. Arnold, Mozingo.
- 140f.* 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.: Courses 63, 64. 3 cred. Koelsch. (Offered in alternate years. Not offered in 1948-49.)
- 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.: Courses 63, 64. 3 cred. Koelsch. (Offered in alternate years. Offered in 1948-49.)
- 142w-143s.* The Chemistry of Natural Products. Discussion of the organic chemistry of important classes of natural products. Prereq.: Courses 63, 64. 3 cred. per quarter. 142w, Parham; 143s, Dodson. (Offered in alternate years. Not offered in 1948-49.)

‡ A charge of \$10 per quarter is made for this course.

‡‡ A charge of \$2 per quarter is made for this course.

- 201f-202w-203s.* Organic Chemistry Seminar. One hour per week. One cred. per quarter. Required of all students taking major work in organic chemistry. Smith, Arnold, Koelsch, Lauer, Mozingo, Dodson, Parham.
- 205f-206w.* Theoretical Organic Chemistry. Structure, reaction mechanisms, relation of physical properties to constitution, and other topics of a theoretical nature. Prereq.: Course 107. 3 cred. per quarter. Lauer. (Offered in alternate years. Offered in 1948-49.)
- 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.: Course 107, Phys.Chem. 103, and calculus, or permission of instructor. 4 cred. Dodson. (Offered in alternate years. Offered in 1948-49.)
- 301f-302w-303s. Research in Organic Chemistry. Prereq.: Course 110, permission of the division. Cred. ar. Smith, Arnold, Koelsch, Lauer, Mozingo, Dodson, Parham.

CHEMISTRY, PHYSICAL

Professors Frank H. MacDougall, Bryce L. Crawford, Jr., Izaac M. Kolthoff, Robert S. Livingston, Lloyd H. Reyerson; Assistant Professor William N. Lipscomb.

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.: 2 years of college chemistry, 1 year of college physics, and differential and integral calculus. 3 cred. per quarter. Crawford, Lipscomb.
- 104f,su‡-105w,su‡-106s,su.*‡ Physical Chemistry Laboratory. To accompany or follow Course 101-102-103. 1 or 2 cred. per quarter. Livingston, Lipscomb.
- 107f,su‡-108w,su.‡ Elementary Physical Chemistry (Premed.). Prereq.: 2 years of college chemistry and 1 year of college physics, Math. 15-16 or 6-7. 3 cred. per quarter. Lipscomb.
- 113f.* Fundamentals of Reaction Kinetics. Empirical analysis of rate measurements; collision theory, transition state theory; chain reactions. Prereq.: Course 103. 3 cred. Livingston. (Not offered in 1948-49.)
- 114w.* 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.: Course 113. 3 cred. Livingston. (Not offered in 1948-49.)
- 116f.* Advanced Physical Chemistry. Thermodynamics. Designed to cover the fundamentals with applications to chemical problems. Prereq.: Course 103. 3 cred. Crawford.
- 117w.* Advanced Physical Chemistry. Phase Rule. Thermodynamics of electrolytic solutions. Elements of reaction kinetics. Prereq.: Course 116. 3 cred. Livingston.
- 118s.* Advanced Physical Chemistry. Electrical conductance and other non-equilibrium properties of electrolytic solutions. Physical properties and chemical structure. Prereq.: Course 117. 3 cred. Lipscomb.

‡ A fee of \$3 per quarter is charged for this course. The student should purchase a \$5 chemistry deposit card from the bursar in the Administration Building. No student will be assigned a desk in the laboratory until he presents this card. The \$3 course fee, laboratory material, and breakage will be charged against the deposit.

- 120w-121s. Introduction to Molecular Structure. Elementary quantum mechanics and statistical mechanics will be discussed and applied to the problem of the chemical bond. Prereq.: Course 103. 3 cred. per quarter. Crawford.
- 122w. Crystal Chemistry. Elementary survey of crystal chemistry. Crystals containing ionic, covalent, and metallic bonds. Relation between crystal structures and chemical and physical properties. Glasses, fibers, and liquids. Prereq.: Course 103. 3 cred. Lipscomb. (Not offered in 1948-49.)
- 123w-124s.* Crystal Analysis. Theory and practice of x-ray crystallography. Methods and examples of structure determination. Prereq.: Course 103. 3 cred. per quarter. Lipscomb.
- 128f.* Colloid Chemistry. The fundamental principles of colloid chemistry, surface chemistry, electrokinetic phenomena, lyophobic and lyophilic colloids. Prereq.: Course 103. 3 cred. Reyerson.
- 129w.* Adsorption and Catalysis. The fundamental principles of adsorption at the different interfaces and the application of these principles to heterogeneous catalysis. Prereq.: Course 128. 3 cred. Reyerson.
- 130s.* Colloids in Industry. The important applications of colloid chemistry to many of the fields of chemical industry. Prereq.: Course 128. 3 cred. Reyerson.
- 131s.*‡ Colloidal Processes. A survey of the important colloidal processes: coagulation, sol-gel transformation, thixotropy, and dilatancy. Prereq.: Course 128. 3 cred. Reyerson. (Not offered in 1948-49.)
- 132f-133w-134s. Colloid Chemistry Laboratory. Prereq.: Course 128. 1 or 2 cred. per quarter. Reyerson.
- 161f-162w.* Nuclear Chemistry and Radioactivity. The properties of nuclei, disintegration, properties of radiations; natural and artificial radioactivity; modern views of nuclear structure. Prereq.: Course 103. 3 cred. per quarter. O'Connor.
- 175s.* Photochemistry. A general survey, including a discussion of spectroscopy, with particular reference to the visible and ultraviolet absorption spectra of molecular gases. Prereq.: Course 103, Phys. 9. 3 cred. Livingston.
- 201f-202w-203s. Thermodynamics and Chemistry. A detailed study of the principles of thermodynamics and their application to physical and chemical phenomena. Prereq.: Course 103, calculus. 4 cred. per quarter. MacDougall. (Not offered in 1948-49.)
- 204f-205w-206s. Kinetic Theory and Atomistics. Kinetic theory of gases and liquids, atomic structure, quantum theory. Prereq.: Course 103, calculus. 4 cred. per quarter. MacDougall.
- 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.: Course 103. 3 cred. Lipscomb. (Not offered in 1948-49.)
- 211f-212w-213s. Advanced Physical Chemistry Laboratory. To accompany or follow any of the advanced courses in physical chemistry. Prereq.: Course 103. Cred. ar. MacDougall and staff.
- 221f-222w-223s. Colloid Seminar. 1 cred. per quarter. Reyerson.
- 231f,w,s.¶ Radioactivity Laboratory. Use and standardization of electroscopes and Geiger-Muller tubes; radioactive measurements; chemistry of trace quantities. Prereq.: must be preceded or accompanied by Course 161. 1 or 2 cred. O'Connor.
- 250f-251w-252s. Physical Chemistry Seminar. Required of all students majoring in physical chemistry. 1 cred. per quarter. Livingston.

‡ A fee of \$3 per quarter is charged for this course. The student should purchase a \$5 chemistry deposit card from the bursar in the Administration Building. No student will be assigned a desk in the laboratory until he presents this card. The \$3 course fee, laboratory material, and breakage will be charged against the deposit.

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

301f-302w-303s. Research in Physical Chemistry. Thermodynamics, electrochemistry, photo- and radiochemistry, reaction kinetics, molecular structure, colloids, adsorption, crystal structure. Cred. ar. MacDougall, Crawford, Kolthoff, Livingston, Reyerson, Lipscomb, O'Connor.

Seminars or courses on the following topics may be offered when there is sufficient demand.

254. Quantitative Theory of Valence.

255. Group Theory Applied to Molecular Vibrations.

256. Ions in Solution.

CHEMICAL ENGINEERING

Professors Charles A. Mann, Norman H. Ceaglske, Edgar L. Piret; Associate Professors Neal R. Amundson, Arthur E. Stoppel; Assistant Professors George W. Preckshot, Richard Stephenson.

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

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

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.

For the requirements for the professional degree of chemical engineering, see pages 18-20.

Language requirement—Candidates for the Master's degree must have a reading knowledge of German. In special cases approved by the department, French or another language may be substituted. For the Doctor's degree, both French and German are required. Substitution of another language for French may be allowed, subject to approval by the Graduate School.

Examinations—The written and oral preliminary examinations in chemical engineering for the Doctor's degree will be given at least twice 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—The Division of Chemical Engineering offers work leading to the Ph.D. degree.

COURSES

100s. Stoichiometry. Prereq.: quantitative chemistry. 3 cred. Ceaglske.

101f.*¶ Unit Operations. Principles and methods of operation, and uses of the unit operation equipment. Crushing, grinding, size separation, fluid flow. Lect. and prob. Prereq.: Completion of two years' work in the Institute of Technology or equiv. 3 cred. Ceaglske, Stoppel, Stephenson.

102w.*¶ Unit Operations. Continuation of Course 101. Discussions and problems on filtration, heat transfer, evaporation, humidification, and air conditioning. Lect., recitations, and lab. Prereq.: Course 101. 5 cred. Ceaglske, Stoppel, Stephenson.

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

- 103s.*¶ Unit Operations. Continuation of Courses 101 and 102. Drying, distillation, absorption, extraction, and crystallization, etc. Prereq.: Course 102. 5 cred. Ceaglske, Stoppel, Stephenson.
- 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, Preckshot.
- 106s.*‡ Petroleum and Petroleum Products. Technology and testing of petroleum products, principally gasoline, illuminating, fuel, and lubricating oils. Prereq.: Org.Chem. 63, 64. 3 cred. Stoppel. (Offered in alternate years with Course 107. Offered in 1948-49.)
- 107s. Petroleum Refinery Engineering. Unit operations and chemical engineering design principles and calculations involved in the manufacture of the principal petroleum products. Prereq.: Course 103 or permission of instructor. 3 cred. Amundson. (Offered in alternate years with Course 106. Offered in 1949-50.)
- 111f.‡ Unit Operations Laboratory. Prereq.: Course 101. 1 cred.
- 112w.‡ Unit Operations Laboratory. Prereq.: Course 102. 1 cred.
- 113s.‡ Unit Operations Laboratory. Prereq.: Course 103. 1 cred.
- 117f,118w.¶ Chemical Engineering Equipment Design. Fundamental principles in the design of chemical engineering equipment. Drawing lab. Prereq.: Course 103. 3 cred. per quarter. Stephenson, Bancroft.
- 119f-120w. Chemical Engineering Thermodynamics. A study of the principles of the fundamental laws of energy as applied to chemical engineering problems. Prereq.: Course 103. 3 cred. Ceaglske, Amundson.
- 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.: Courses 131, 132. 3 cred. Stephenson.
- 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. Topics: industrial waters, acids and alkalies, salts, chlorine, ammonia, glass, pigments, etc. Lect. and recitations. Prereq.: for chem. engrs., Course 103. 4 cred. Mann.
- 132w.*§¶ Organic Technology. Similar to 131 but covering organic field. Destructive distillation of coal and wood, petroleum and products, pulp and paper, organic processes, synthetic industrial organic products. Lect. and recitations. Prereq.: for chem. engrs., Courses 103, 131. 3 cred. Mann.
- 134f.* Intermediates and Dyestuffs. Their technical chemistry and manufacture. Processes, purification, uses, etc. Lect. and recitations. May be accompanied by laboratory work in 160. Prereq.: Org.Chem. 63. 3 cred. Mann.
- 136w.* Chemistry and Technology of Cellulose. Discussion of the chemistry, processes, and industries based on the use of cellulosic materials including the technological considerations. Pulp and paper, plastics, esters, rayon, etc. Lect. and recitations. Prereq.: Org.Chem. 156 or equiv. 3 cred. Mann.
- 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 semi-works equipment. Technical trade journals used.

‡ A fee of \$3 per quarter is charged for this course. The student should purchase a \$5 chemistry deposit card from the bursar in the Administration Building. No student will be assigned a desk in the laboratory until he presents this card. The \$3 course fee, laboratory material, and breakage will be charged against the deposit.

§ Chemists receive 4 credits in Organic Technology as they do not take Unit Operations.

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

- Lab. Prereq.: Courses 103, 132. 3 or more cred. Mann, Ceaglske, Stoppel, Stephenson.
- 152w,su.*‡ Chemical Manufacture (Organic). Similar to 151 but covering the organic unit processes. Lab. Prereq.: Courses 103, 131. 3 or more cred. Mann, Ceaglske, Stoppel, Stephenson.
- 153f-154w-155s-156su.* Special Laboratory Problems. Investigations on chemical engineering equipment and its use in the manufacture of special chemical products on a semi-works scale. Prereq.: Courses 151, 152. 3 or more cred. per quarter. Mann and staff.
- 160s.*‡ Intermediates and Dyestuffs Laboratory. Manufacture of intermediates and dyestuffs using semi-works equipment. Operations on sulphonation, hydroxylation, nitration, reduction, alkylation, diazotization, coupling, etc. Lab. Prereq.: Courses 132, 152, 134 or registration in 134. 3 or more cred. Stoppel.
- 171f-172w. 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 of instructor. 3 cred. per quarter. Ceaglske.
- 176f-177w.*‡ Applied Electrochemistry. Application of the electric current to chemical processes. Laws and phenomena of electrochemistry, batteries, electroplating, electric furnace construction and operation, and electrochemical products. Class and lab. work. Prereq.: Phys.Chem. 103, permission of instructor. 4 cred. per quarter. Mann, Madden.
- 179s.*‡ Applied Electro-Organic Chemistry. The more recent developments in the manufacture of organic products by electrochemical methods. Lect. and recitations; lab. optional. Prereq.: Course 176-177, permission of instructor. 3 or more cred. Mann.
- 201f-202w-203s.* Seminar. Presentation and discussion of papers concerning the newer developments in chemical engineering. 1 cred. per quarter. Mann.
- 205f-206w-207s. Advanced Problems in Unit Operations. A study of new developments in the unit operations. Theory and practical applications to equipment and plant process design including economic balance problems. Prereq.: Course 103. 3 cred. per quarter. Ceaglske, Piret. (Offered in alternate years with Course 208-209-210. Offered in 1948-49.)
- 208f-209w-210s. Advanced Chemical Engineering. Prereq.: Course 103. 3 cred. per quarter. Ceaglske, Piret. (Offered in alternate years with Course 205-206-207. Offered in 1949-50.)
- 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.: Course 103. 3 cred. per quarter. Piret.
- 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 quarter. Amundson.
- 301f-302w-303s.* Research in Chemical Engineering. Unit operations, applied electrochemistry and electric furnace work, chemical manufacture, unit processes, and others. Cred. ar. Mann, Ceaglske, Piret, Amundson, Stoppel, Stephenson.

‡ A fee of \$3 per quarter is charged for this course. The student should purchase a \$5 chemistry deposit card from the bursar in the Administration Building. No student will be assigned a desk in the laboratory until he presents this card. The \$3 course fee, laboratory material, and breakage will be charged against the deposit.

CHILD WELFARE

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

Prerequisites—For graduate work in the Institute of Child Welfare, students are normally expected to have had the equivalent of an undergraduate major in either psychology, sociology, education, or home economics. Aside from or including the major, the student normally is expected to have had at least 10 hours in psychology, 8 hours in sociology, and 3 hours in statistics. In special cases where the background lies in other fields, such as nursing or medicine, adjustments may be made.

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

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

NOTE: For information on work in Psychometrics, see page 22.

COURSES

- 130f. Motor, Linguistic, and Intellectual Development of the Child. Lect., readings, and reports. Prereq.: 12 cred. in psychology or equiv. 3 cred. Templin.
- 131w. Personality, Emotional, and Social Development of the Child. Lect., readings, and reports. Prereq.: 12 cred. in psychology or equiv. 3 cred. Harris.
- 132s. Later Childhood and Adolescence. Lect., readings, and reports. Prereq.: 12 cred. in psychology or equiv. 3 cred. Harris.
- 133f-134w-135s. Research Methods. Developmental records, ratings, controlled observations, etc., used in the study of children. Practical exercises on institute records and data. Prereq.: 10 cred. in psychology or educational psychology, including statistics. 2 cred. per quarter. Anderson.
- 140f,w. Behavior Problems in Younger Children. Nature and origin of behavior difficulties in younger children and the relation between early behavior and later maladjustment. Prereq.: 12 cred. in psychology, educational psychology, or sociology. 2 cred. Blodgett.
- 141w,s. Behavior Problems in Older Children. Nature and origin of behavior difficulties in older children, with particular reference to readjustment at adolescence. Prereq.: 12 cred. in psychology, educational psychology, or sociology. 2 cred. Blodgett.
- 142s. The Psychology of Atypical Children. A survey of the scientific literature on children with physical and mental handicaps. Emphasis upon personal-social and vocational adjustment. Prereq.: 12 cred. in psychology. 2 cred. Blodgett.
- 143f. Problems of Mental Deficiency. The psychology of the mentally deficient; training, institutional and home care, social and vocational adjustment. Special problems in the clinical diagnosis and appraisal of mental deficiency. Prereq.: 12 cred. in psychology or equiv. 3 cred. Blodgett.
- 150f-151w-152s. Childhood Education. Lectures and readings on the philosophy, organization, administration, methods, and materials of early childhood education. Prereq.: 12 cred. in psychology or equiv. 2 cred. per quarter. Fuller.
- 160s. Physical Growth and Development. The growth of the human body and its systems from early fetal life to maturity. Prereq.: 12 cred. in psychology or equiv. 3 cred. Burklund.
- 166f. Maturity and Aging: Developmental Changes and Adjustment. Survey of scientific literature on changes in ability with advancing age. Prereq.: 15 cred. in psychology, education, or sociology. 3 cred. Harris.

- 170f. Parent Education. History and survey of programs. Materials and methods. Administration and organization. Lect., discussions, and reports. Prereq.: 15 cred. in child welfare, home economics, psychology, education, public health, or sociology. 3 cred. Cummings.
- 185s. Children in a Changing World. Effect of social change and social stress upon children. Some emphasis upon war, depression, and catastrophe. Problems of reconstruction and rehabilitation. Prereq.: 12 cred. in psychology, education, or sociology. 3 cred. Templin.
- 190f. Use and Interpretation of Tests for Children. Mental test methods and their interpretation. Lect., demonstrations, readings, and reports. Prereq.: 12 cred. in psychology, educational psychology, or sociology. 2 cred. Roff.
- 220f-221w-222s. Seminar in Current Research. Reports on completed research or research in progress. 1 cred. per quarter. Staff.
- 225s. Seminar in Developmental Theory. Developmental theories and their efficacy in interpreting developmental material. 2 cred. Anderson.
- 226w. Seminar in Projective Methods with Children and Adolescents. Demonstrations and discussions of doll play, drawing, painting, thematic methods, the Rorschach and other projective techniques used with children. Consideration of their possibilities and limitations as research tools and as clinical devices. Prereq.: permission of instructor. 2 cred. Harris.
- 227s. Multiple Factor Analysis. The principles of factor analysis as applied to psychometric problems. Considerations of mathematical rationale and of concrete psychological results. Practical work on specific projects to illustrate the logic of the procedures used. Prereq.: 3 quarters of statistics and mental measurement. 2 cred. Roff.
- 230f-231w-232s. Seminar in Recent Literature. Reviews of current literature, and research. Meetings in alternate weeks. Attendance of graduate students who are candidates for degrees is required. 1 cred. per quarter. Anderson.
- 240f-241w-242s. Practicum in Behavior Problems. Qualified students are given experience in the Parent Consultation Service of the Institute—parent counseling and application of diagnostic and remedial procedures in children's behavior problems. Prereq.: Course 140-141, permission of instructor. Cred. ar. Harris, Blodgett.
- 250f,w,s. Internship in Professional Work with Children. Experience under qualified supervision. Open under special conditions to graduate students with permission of department. Cred. ar. Anderson.
- 270f-271w-272s.* Readings and Research in Child Development. This course can be taken for credit by any qualified student parallel to or after any of the sequences in Development (C.W. 130, 131, 132), Research Methods (C.W. 133-134-135), Atypical Children (C.W. 140, 141, 142), Childhood Education (C.W. 150-151-152), Mental Testing (C.W. 190, 290-291), or Parent Education (C.W. 166, 170, and 274 or 275), with the permission of the instructor. Cred. ar. Staff.
- 274w-275s. Technique and Field Work in Parent Education. Methods of teaching adults. Organization and administration of study groups. Lesson plans, observations, and field work. Prereq.: Courses 166, 170, permission of instructor. Cred. ar. Cummings.
- 290w-291s. Mental Examination of Preschool Children. A study of the methods used in testing young children, together with practice in such testing and specific training in the interpretation of test results. Registration limited. 290w. Minnesota, Merrill-Palmer, Arthur, and Primary Group Tests; 291s. Stanford-Binet Test. Prereq.: Ed.Psy. 142, 150 or equiv., permission of instructor. 4 cred. per quarter. Blodgett.

CIVIL ENGINEERING

Professors Lorenz G. Straub, Paul Andersen, George J. Schroeffer, Joseph A. Wise; Associate Professors Miles S. Kersten, John F. Ripken, Theodor W. Thomas; Instructor Alvin G. Anderson.

Master's degree—The Master's degree is offered under Plan A; in special cases, Plan B may be accepted when approved by the Civil Engineering Department graduate faculty. Petitions requesting Plan B should be submitted the first quarter of the student's residence.

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

COURSES

SURVEYING

109. Cadastral Surveying. Study of the newer methods of accurate surveys of property with geodetic control and co-ordinates of property monuments. Prereq.: Course 16. 2 cred. (Not offered in 1948-49.)
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.: Course 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. Operating costs governing grade revision. Prereq.: Course 22. 3 cred. Klingel.
- 122.* Railway Engineering. Lectures, office work, and field inspection. Design and operation of various types of yards and terminals and terminal facilities, including the hump, engine house, coal and water station. Prereq.: Course 22. 3 cred. (Not offered in 1948-49.)
123. Railway Engineering. Design and construction of railroad buildings and structures: culverts, wooden trestles, switches, crossovers, crossing frogs, etc. Prereq.: Course 22. 3 cred. (Not offered in 1948-49.)
124. Transportation. Development of railway, inland waterway, highway, and airline transport; federal regulation and control with special reference to the 1920, 1935, 1940 Transportation Acts. Interstate Commerce Commission geographical, financial, and rate grouping of railways; method of accounting, valuation, and cost and value of service. Prereq.: Course 22. 3 cred. (Not offered in 1948-49.)

STRUCTURAL ENGINEERING

130. Statically Indeterminate Structures. Method of moment area. Williot Diagram. Slope-deflection method. Prereq.: Course 33, M.&M. 128. 3 cred. Ar.
131. Structural Analysis. Moment distribution method. Prereq.: Course 130. 2 cred. Ar.
132. Structural Design. Continuous structures of steel and concrete. Prereq.: Course 131. 2 cred. Ar.
137. Structural Laboratory. Theoretical and experimental analysis of structural members and models. Prereq.: Courses 130, 141. 2 cred. Ar.
140. Advanced Structural Laboratory. A continuation of Course 137. Calculated and experimental influence lines for framed structures including gabled bents. Secondary stresses for trusses. Prereq.: Course 137. 3 cred. Ar.

141. Reinforced Concrete. Principles of reinforced concrete. Theory of beams, slabs, and columns and the application to ordinary structures. Prereq.: Course 33. 3 cred. Ar.
142. Reinforced Concrete Design. Continuation of 141 with special emphasis on the practical features of the design of buildings, bridges, retaining walls, etc. Prereq.: Courses 130, 141. 3 cred. Ar.
143. Arch Analysis and Design. Analysis and design of reinforced concrete arches. Prereq.: Courses 131, 142. 3 cred. Ar.
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.: Course 33. 2 cred. Ar.
232. Advanced Structural Problems in Sanitary Engineering. Theory of domes, tanks, dams, culverts, and elliptical sewer sections. Prereq.: Course 132. 3 cred. Ar.
- 233.* Advanced Problems in Foundations. Lateral earth pressure theories. Design of sheet piling. Bearing piles and cofferdams. Prereq.: Courses 132, 147. 3 cred. Ar.
- 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.: Courses 132, 142. 3 to 5 cred. per quarter. Ar.
236. Advanced Structural Design. Effects of shrinkage and plastic flow. Eccentrically loaded concrete sections. Non-symmetrical bending. Torsion. Prereq.: Course 132 or 235. 3 to 5 cred. Ar.
- 237-238-239. Structural Model Analysis. Development and use of structural models for the solution of specific problems. Prereq.: Course 137. 3 cred. per quarter. Ar.
- 240-241-242. Advanced Structural Laboratory. Experimental determination of principal strains by use of three or four intersecting gages; plastic flow and shrinkage; pre-stressed reinforced concrete; moment redistribution; theory of limit design; theory of similitude; statistical data. Vierendell trusses. Prereq.: Course 140. 3 to 5 cred. per quarter. Ar.
- 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.: Course 132. 3 cred. Ar.
- 247*-248-249. Seminar in Structures. Special topics in the higher theory of structures. Prereq.: Courses 132, 142. 3 to 6 cred. per quarter.

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. and lab. work. Prereq.: M.&M. 141. 3 cred. Ar.
- 148-149-150. Advanced Concrete. Short research problems in concrete. Prereq.: Course 146. 2 cred. per quarter. Ar.
- 151.* Advanced Highway Laboratory. Special experimental studies of highway materials. Prereq.: Course 52. 3 to 5 cred. Thomas.
- 152.* Highway Design. Preparation of a plan and specifications for short sections of highway and city streets, also making estimates of materials and cost. Prereq.: Course 52. 3 to 5 cred. Thomas. (Not offered in 1948-49.)
153. Soils in Highway Engineering. Classification, soil maps, physical tests, design of graded mixes, and soil stabilization. Prereq.: Course 52. 3 cred. Kersten.
155. Field Soil Studies. Soil classification and mapping, analysis of soil conditions where road failures have occurred. Prereq.: Course 52. 2 cred. Kersten.

156. Highway Traffic Engineering. Traffic surveys, highway safety, highway commercial transportation as related to other forms of transportation. Prereq.: Course 52. 3 cred. (Not offered in 1948-49.)
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 in 1948-49.)
158. Airport Design. Field layout, drainage, and studies of sub-bases, bases, and surfaces for aprons, runways, and taxiways. Prereq.: Course 52. 3 cred. Kersten.
159. Soil Mechanics. Consolidation, shearing resistance. Stability of foundations, embankments, and retaining walls; settlement of structures; soil sampling. 3 lect. per week. Prereq.: Course 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.: Course 159 or registration in 159. 3 cred. per quarter. Kersten.

HYDRAULIC ENGINEERING

160. Applied Hydraulics. Pipes and pipe systems, control of water in open channels. Automatic control devices, hydraulic turbines, pumping machinery, hydraulic transmission and storage of energy, hydroelectric applications. Prereq.: M.&M. 129, 143. 3 cred. Ar.
161. Hydrology. A study of the fundamental aspects of hydrology as the natural basis for hydraulic engineering work. Laws, influences, variations in hydrological phenomena and their relation to engineering. Studies of the atmosphere, wind and storm movement, hydrography, precipitation, evaporation, water storage, and stream run-off. Geology, flood flows. Prereq.: M.&M. 129. 3 cred. Cornell.
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.: Course 161 or equiv. 3 cred. Ar.
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.: Course 161. 3 cred. Cornell.

MUNICIPAL ENGINEERING

172. 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. Cornell. (Not offered in 1948-49.)
176. 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 in 1948-49.)

SANITARY ENGINEERING

135. Structural Problems in Sanitary Engineering. Earth pressures; retaining walls; reservoirs and tanks of steel and reinforced concrete; filters and settling basins, pipes and culverts; footings and raft foundations; shells, arches, and domes. 2 cred. Andersen. (Not offered in 1948-49.)

162. 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.: Course 161, M.&M. 129. 3 cred. Schroepfer, Cornell, Seidel.
163. 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.: Course 162. 3 cred. Schroepfer, Cornell, Seidel.
165. 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. Pierce.
169. Hydraulic Problems (Sanitary Engineering). Advanced problems having special reference to the hydraulic features of sanitary works. Flow through pipes, open channel flow, backwater and drawdown computations. Pumps, mechanical and electrical equipment governing hydraulic installations. 3 cred. Schroepfer.
- 173.* Sanitary Engineering Problems (Water). Investigations of problems in water supply to supplement Course 162. Collection, distribution, and purification. Economic studies. Hours ar. Prereq.: Course 162. 3 cred. Schroepfer.
- 174.* Sanitary Engineering Problems (Sewage and Industrial Wastes). Investigations of problems in sewage treatment and industrial wastes disposal to supplement Course 163. Stream pollution, stream standards, economic studies of various types and degrees of treatment. Hours ar. Prereq.: Course 163. 3 cred. Schroepfer.
- 175.* Industrial Waste Disposal. Investigation of various types of industrial wastes and methods of disposal. Economic studies. Hours ar. Prereq.: Course 174. 3 cred. Schroepfer.
179. Sanitary Laboratory. The biological, bacteriological, physical, and chemical analyses of water, sewage, air, coagulant chemicals, disinfectants, sewage sludge, etc. 3 cred. Ar.
- 180-181-182. Sanitary Engineering Seminar. Required of sr. and grad. 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 quarter. Schroepfer.
- 261*-262.* Water and Sewage Plant Design. Design of water purification and sewage disposal works. Prereq.: Course 163. 3 to 5 cred. per quarter. 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.: Course 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.: Course 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 of instructor. 5 cred. per quarter. Ar.

HYDRAULICS, HYDRODYNAMICS, AND FLUID MECHANICS

183f.* Open Channel Flow. Theory of uniform and varied flow in open channels, with practical applications to the design of hydraulic structures, computations of draw-down curves, backwater curves, hydraulic jump, measuring flumes, submerged weirs, etc. Prereq.: M.&M. 86 or 129 or 130 and 143. 3 cred. Ar.

184f-185w-186s.* Advanced Hydraulic Problems. Special problems in hydraulic design. Prereq.: Course 183 or registration in 183, permission of instructor. 2 cred. per quarter. Ar.

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.: M.&M. 86 or 129 or 130 and 143. 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.: M.&M. 127, 128, and 86 or 129 or 130, or permission of instructor. 3 cred. Ar.

191w. Hydraulic Motors and Pumps. Study of the mechanics of turbo-machines, including impulse, reaction, and propeller turbines and radial, mixed, and axial flow pumps. Hydraulic transmissions. Torque converters. Miscellaneous pumping devices. Prereq.: Course 187 or permission of instructor. 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.: Course 183 or permission of instructor. 3 cred. Ar.

193s. Hydraulic Measurements. Detailed study of laboratory and field, methods and instruments for measurement of hydraulic pressure, velocity and discharge. Prereq.: Course 187 or permission of instructor. 3 cred. Ar.

194f-195w-196s.* Advanced Hydraulic Laboratory. Special experimental studies concerning the characteristics of turbines, pumps, etc. Hydraulic models. Prereq.: M.&M. 86 or 129, or 130 and 143. 2 cred. per quarter. Ar.

197f-198w-199s. Mechanics of Soils. Prereq.: M.&M. 129, 143. 2 cred. per quarter. Ar.

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.: basic training in fluid mechanics and permission of instructor. 3 cred. Ar.

290f-291w-292s. Advanced Fluid Mechanics. Prereq.: Course 190. 3 cred. per quarter. Ar.

293f-294w-295s. Hydrodynamics. Equations of motion, irrotational flow, potential theory, two-dimensional motion, complex potentials, three-dimensional motion, solids in a fluid, vortex motion, waves, compressibility, viscous flow. Prereq.: Course 187 and differential equations or advanced calculus, or permission of instructor. 3 cred. per quarter. Ar.

296f-297w-298s. Advanced Hydrodynamics. Prereq.: Course 295. 3 cred. per quarter. Ar.

CLASSICS

Professor John L. Heller; Assistant Professors William A. McDonald, Donald C. Swanson.

Language requirement—For the Master's degree, a reading knowledge of one foreign language, preferably German, is required.

For the Ph.D. degree, a reading knowledge of two foreign languages, preferably German and French, is required.

Master's degree—Work for the Master's degree is offered under both Plan A and Plan B, in either Greek or Latin (see below).

Doctor's degree—Work for the Doctor's degree will ordinarily be concentrated in either Greek or Latin, with a minor in Latin or Greek respectively. 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 and the history of Greek and Latin literature.

GREEK

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

Major—The degree of master of arts with a major in Greek requires a nine-credit sequence in the 200 series and either one course each quarter from the 100 series or a second nine-credit sequence in the 200 series.

Minor—For a minor in Greek either the Seminar in Greek Literary Bibliography or one course each quarter from the 100 series is required.

COURSES

121f-122w-123s.† Advanced Composition. Prereq.: 24 cred. in Greek. 3 cred. per quarter. Heller. (Not offered in 1948-49.)

171f,§172w,§173s.*§ Independent Reading Course. Prereq.: open to students of exceptional ability with permission of the department. 3 cred. per quarter. 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 quarter. Heller.

211f-212w-213s. Seminar: Greek Epic. 3 cred. per quarter. Ar. (Not offered in 1948-49.)

221f-222w-223s. Seminar: Greek Drama. 3 cred. per quarter. Ar. (Not offered in 1948-49.)

231f-232w-233s. Seminar: Greek Philosophy. 3 cred. per quarter. Ar. (Not offered in 1948-49.)

LATIN

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

Major—For the degree of master of arts, any nine-credit sequence in the 200 series, and in addition one course each quarter selected from Courses 111 to 173 or 241-242-243; ordinarily this latter will be required in addition to the other 200 sequence.

Minor—For the degree of master of arts, any nine-credit sequence in the 200 series or one course each quarter selected from Courses 111 to 173.

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

COURSES

- 111f-112w-113s.† Advanced Prose Composition. Prereq.: Course 73. 2 cred. per quarter. Ar.
- 133s. Vulgar Latin. Development of Latin into Romance. Prereq.: for advanced students of either Latin or Romance, permission of instructor. 3 cred. Swanson.
- 171f,§22w,§173s.*§ Independent Reading Course. Prereq.: open to students of exceptional ability with the permission of the department. 3 cred. per quarter. Ar.

Courses for Which No Latin or Greek Is Required

- Classics 106f-107w. Introduction to the Study of Language. Prereq.: any 2 courses numbered above 50 in a foreign language. 3 cred. per quarter. Swanson.
- Classics 108s. Cultural Aspects of Language. Prereq.: any 2 courses numbered above 50 in a foreign language. 3 cred. Swanson.
- Classics 191f,192w,193s. Classical Literary Traditions. Prereq.: 9 cred. in literature, English or foreign. 3 cred. per quarter. Heller.

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

- 201f,202w,203s.* Seminar: Cicero. 3 cred. per quarter. Ar. (Not offered in 1948-49.)
- 211f,212w,213s.* Seminar: Latin Epic. 3 cred. per quarter. Ar. (Not offered in 1948-49.)
- 221f,222w,223s.* Seminar: Lyric Poetry. 3 cred. per quarter. Ar. (Not offered in 1948-49.)
- 231f,232w,233s.* Seminar: Latin Historiography. 3 cred. per quarter. McDonald.
- 241f,242w,243s.* Seminar: Introduction to Classical Philology. 3 cred. per quarter. Ar. (Not offered in 1948-49.)

DAIRY HUSBANDRY

Professors James B. Fitch, Willes B. Combs, Samuel T. Coulter, Harold Macy, William E. Petersen; Associate Professors Lester O. Gilmore, Thor W. Gullickson, Joseph C. Olson, Jr.; Assistant Professor James J. Jezeski.

Prerequisites—For a major in dairy production the adviser must be satisfied that the student has had 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 the adviser may require that additional courses be taken to make up the deficiencies.

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—Students taking major work in dairy husbandry for a Master's degree may petition for exemption from the language requirement, with the exception of students majoring in dairy bacteriology.

Master's degree—Work for the Master's degree is 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.

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

COURSES

- 101f. Milk Production. Problems of the dairy farmer, such as characteristics and adaptation of dairy breeds; selection and management of dairy herd and sires; calf raising, dairy barns. 3 cred. Fitch.
- 102w. Dairy Bacteriology. Relation of bacteria and other micro-organisms to production, processing and handling of milk and its products, and to public health; the microbiology of dairy products. Lect., assignments, lab. work. 3 cred. Macy, Olson.
- 103w. Dairy Stock Feeding. Application of principles of nutrition to feeding dairy animals. Feeding standards; characteristics of various feeding stuffs; formulation of rations. Prereq.: Course 101. 3 cred. Fitch, Gullickson.
- 104f. Dairy Stock Selection. An evaluation of inherited characters in dairy cattle from an economic standpoint. Prereq.: Courses 9, 101 or parallel. 3 cred. Gilmore.
- 105f-106w.* Seminar. Bibliographical methods and study of dairy literature. Reports on assigned subjects and reviews of recent scientific investigations. 1 cred. per quarter. Petersen.
- 110w. Dairy Products: Ice Cream and Frozen Desserts. The manufacture of ice cream with special reference to the chemical and physical processes involved. Organization, construction, equipment, and operation of such factories. Lab. exercises and lect. Prereq.: Courses 1, 3. 3 cred. Combs, Thomas.
111. Dairy Products: Butter. The manufacture of butter with special reference to the chemical and bacteriological processes involved. Organization, construction, equipment, and operation in such factories. Laboratory exercises to illustrate these processes. Prereq.: Courses 1, 2, 3. 3 cred. Coulter, Thomas.
- 112s. Dairy Products: Cheese. The manufacture of cheese, with special reference to the chemical, bacteriological, and physical processes involved. Organization, construction, equipment, operation of such factories. Lab. exercises and lect. Prereq.: Courses 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. Use of Monjonner tester, cryoscope, and bacteriological control methods. Prereq.: Course 110, 111, or 112. 3 cred. Coulter.
- 114w. Milk By-Products. The manufacture of condensed milk, dry milk, casein, and other milk by-products with special reference to the physical processes involved. Lab. exercises and lect. 3 cred. Coulter.
- 115s. Advanced Dairy Bacteriology. Investigation of specific problems in the bacteriology and mycology of milk and dairy products. Prereq.: Course 2 or equiv., Course 111, or 112. 3 cred. Macy, Jezeski, Olson.
- 116s. Milk Secretion. Lecture assignments covering the anatomy and physiology of milk secretion and factors influencing the quality and quantity of milk. Prereq.: physiology, 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. Evaluation of breeding animals and formulation of breeding plans. Prereq.: Courses 101, 104, Agron. 31. 3 cred. Gilmore.
- 202f,*203w,*204s,*208su,210su. Research in Dairy Production. Facilities offered for study and investigation of subjects pertaining to dairy cattle. Students are allowed to assist at times with investigations under way in the experiment station. Arranged to meet the needs of the individual student. Open in the Summer Session only to those who have had preliminary graduate work. Cred. ar. Fitch, Petersen, Gilmore, Gullickson.
- 205f,*206w,*207s,*209su,211su. Research in Dairy Manufacturing. Opportunity and facilities are offered for study and investigation of problems concerning dairy products. The work is arranged to meet the needs of the individual student. Open in the

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 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 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, George Filipetti, Frederic B. Garver, Ernest A. Heilman, Bruce D. Mudgett, John J. Reighard, J. Warren Stehman, Arthur R. Upgren, Roland S. Vaile, Dale Yoder; Associate Professors Arthur M. Borak, Helen G. Canoyer, Richard K. Gaumnitz, Walter W. Heller, Edwin H. Lewis, Walter R. Myers, Carl L. Nelson, Edmund A. Nightingale, Harry J. Ostlund, Andreas G. Papandreou, Clare L. Rotzel; Assistant Professors John R. Immer, John T. Wheeler.

NOTE—For information on work in International Relations, see page 21; for work in Statistics, see pages 23-24.

ECONOMICS

GENERAL REGULATIONS

Prerequisites—A minimum of nine 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. It is expected that all candidates will 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 will be expected to meet both requirements (a) and (b) above.

Majors—The programs of study of all majors must receive the approval of the Graduate Committee of the School of Business Administration.

Master of Arts

PLAN A

1. For a major in Economics the candidate must present a minimum of 18 quarter credits in courses numbered 100 or above, including Economics 103-104, unless this course or its equivalent has been completed in the undergraduate program.

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

3. A reading knowledge of a foreign language is required only if the thesis is written in one of the following fields: economic history, economic theory, money and banking, public finance, or statistics.

4. Candidates for the Master's degree must pass a final written examination in the major, and after acceptance of the thesis, a final oral examination covering all work submitted for the degree.

5. Apart from these points the candidate must meet the normal requirements for the degree as described in the preliminary pages of this bulletin.

PLAN B

1. A minimum of 45 quarter credits in courses numbered 100 or above is required, including Economics 103-104 unless this course or its equivalent has been completed in the undergraduate program.

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. Subject to the recommendation of an adviser and the approval of the Graduate Committee of the School of Business Administration, however, all 45 credits may be taken in these fields, provided that not less than 21 credit hours shall be in some one of these fields and not more than 27 shall be in any one of them.

2. Of the total of 45 quarter credits at least 9 quarter credits must be earned in courses requiring independent work and the preparation of written reports. These courses are as follows: Economics, all courses numbered 200 or above, 122-123, 124, 149, 164, 192; Business Administration 139, 156, 165, 184, not more than three quarter credits from 180-181-182C, and not more than 3 quarter credits from 180-181-182D; and such other courses as may be recommended by the adviser and approved by the Graduate Committee of the School of Business Administration.

3. A reading knowledge of a foreign language is not required.

4. A final oral examination is required, covering all work submitted for the degree.

Doctor of Philosophy

1. It is recommended that those who wish to become candidates for this degree should first obtain the Master's degree under Plan A.

2. Thirty of the credits presented in the major field shall include 6 credits in Economics 203-204, 6 credits in Economics 207, 208, and 18 credits to be chosen from any three of the following groups:

Group	Course	Credits
A	Economics 105, 106	6
	Economics 206	3
B	Economics 121-122-123	9
C	Economics 233-234	6
D	Economics 243-244	6

The remaining credits in the total major program may be selected from economics and business administration courses numbered 100 and over, or, with the approval of the Graduate Committee of the School of Business Administration, from courses in agricultural economics and economic history.

3. The student's program will be arranged by consultation with his adviser, subject to the approval of the Graduate Committee of the School of Business Administration, and the Social Science Group Committee of the Graduate School.

4. Candidates who are majors in other departments and who wish to minor in this department should consult Professor Frederic B. Garver.

5. A reading knowledge of two foreign languages, usually French and German, is required. With the approval of the Executive Committee of the Graduate School, another appropriate language may be substituted for French.

6. The written examination in the major field will cover all course work done in the major, as specified in the general regulations of the Graduate School.

7. The preliminary oral examination will cover all graduate work taken by the student except the thesis and the special field reserved for the final examination. The final oral examination will cover the field of specialization and the thesis.

BUSINESS ADMINISTRATION

Master of Business Administration

This degree is offered for students who desire postgraduate 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.

A special program of courses leading to this degree for Engineering graduates may be found in the *Bulletin of the Institute of Technology*.

Prerequisites—1. Candidates must meet the prebusiness requirements of the School of Business Administration in accounting, money and banking, principles of economics, and statistics. General Psychology (Psy. 1-2) is a prerequisite for specialization in advertising, foreign trade, merchandising, and personnel administration; and Mathematics of Investment (Math. 20) 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, Scientific Management in Industry (B.A. 184) 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. Of the total of 45 quarter credits required under Plan B a minimum of 9 quarter credits must be obtained from courses requiring independent work and the preparation of written reports. These courses are as follows: Economics, all courses numbered 200 and above, 122-123, 124, 149, 164, 192; Business Administration 139, 156, 165, 184, not more than 3 quarter credits from 180-181-182C, not more than 3 quarter credits from 180-181-182D, and such other courses as may be recommended by the adviser and approved by the Graduate Committee of the School of Business Administration.

3. A reading knowledge of a foreign language is not required under Plan B.

4. The examination requirements for Plan A are the same as those for the master of arts degree, Plan A. For Plan B there is no written examination, but a final oral examination is required covering all work submitted for the degree.

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.

- 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 social science, including Course 6-7 or equiv. 3 cred. per quarter. Garver.
105. History of Economic Ideas: The Classical Economists. The development of the doctrines of classical economics by English and French writers from 1750 to 1850. Economic and political influences giving rise to doctrines of population, distribution, governmental interference. Prereq.: Course 80-81 or 103-104 or permission of instructor. 3 cred. Garver.
106. History of Economic Ideas: The Critics of the Classical Economists. The contribution of the German Romantic and French Socialist schools is examined, followed by an extensive consideration of Marxian criticism and analysis. The Neoclassical synthesis and methodology are contrasted to classical economics on the one hand, and the Keynesian system on the other. Finally, detailed and systematic presentation of the Keynesian system and an appraisal of its contribution to economic thought is undertaken. Prereq.: Course 80-81 or 103-104 or permission of instructor. 3 cred. (Not offered in 1948-49.)
110. Industrial Price Control. The 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.: Course 6-7 or equiv., 15 additional cred. in economics and/or business administration; Course 155 is a desirable preceding course. 3 cred. Garver.
- 121-122*†-123.* Theory of Statistics. An advanced course in statistical analysis. The first quarter is designed to acquaint the student with modern statistical tools and their uses in the analysis and interpretation of data and does not stress mathematical developments. Emphasis is upon basic logic of procedures. Later quarters add consideration of origins and derivations, and more mathematical preparation is then desirable. Prereq.: Course 5 or equiv. 3 cred. per quarter. Mudgett.
- 124.* Comparative Banking: British Systems. A study of the existing financial institutions of the various members of the British Empire with regard to development, functions, methods, and problems. Constant comparison is made with the American system. Prereq.: Course 142. 3 cred. (Not offered.)
126. Economic Problems of Latin America. The 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.: Course 6-7 or equiv. 3 cred. Myers.
127. Comparative Banking: South American Systems. A study of the financial institutions of the principal countries of South America with regard to development, functions, methods, and problems. Constant comparison is made with the system in the United States. Prereq.: Course 142. 3 cred. Myers.
140. The Co-operative Movement. The history and philosophy of various co-operative developments. Similarities and contrasts between such movements as agricultural

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

- marketing co-operatives, consumer co-operatives, trade unions, and others. Consumer co-operation as a medium for economic control. Prereq.: Course 6-7 or equiv. 3 cred. Canoyer.
142. Monetary and Banking Policy. An advanced course in money and banking policy viewed from the social standpoint with primary reference to the problems of the Federal Reserve system. Selected problems in monetary policy; monetary reconstruction and monetary reform. Prereq.: Courses 3, 6-7 or equiv. 3 cred. Upgren, Myers, 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.: Course 142 or permission of instructor. 3 cred. Upgren, Myers.
155. Corporation Finance. Incorporation. The 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.: Courses 3, 6-7 or equiv. 3 cred. Stehman, Borak, and others.
161. Labor Problems and Trade Unionism. An introduction to the economic problems involved in the allocation, utilization, and conservation of human resources with particular attention to wage determination, unemployment, and the role of labor organization and government in the labor market processes. Prereq.: Course 6-7 or equiv. 3 cred. Yoder and others.
162. Labor and Socialist Movements. Analysis of structure and operation of American labor unions. An interpretation of leading labor movements in Europe and the United States during the last century. Prereq.: Course 161. 3 cred. Yoder and others.
- 164.* Labor Legislation and Social Insurance. A course dealing with the economic aspects of labor legislation, including minimum wage laws; hours legislation; factory acts; accident, health, old age, and unemployment compensation; mothers' pensions. Prereq.: Course 161. 3 cred. Yoder and others.
172. Economics of Transportation. An 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, co-ordination of services. Prereq.: Course 6-7 or equiv. 3 cred. Nightingale.
175. Government Regulation of Business. A general course on the economic aspects of legislation affecting the pricing process and the distribution of the national income. Topics studied include economic origins of modern business limitations on free competition; regulation of public utilities, trusts and combinations, and "unfair competitive practices"; positive assistance to industrial groups. Prereq.: 20 cred. in social science, including Course 6-7 or equiv. 3 cred. Boddy, Garver, Papandreou, and others.
176. International Commercial Policies. Theory of international commerce; protective tariffs, free trade, reciprocity, subsidies, preferential treatment, the open door, international finance, commercial treaties, foreign politics, and other governmental and organized efforts to affect trade. American problems emphasized. Prereq.: Course 6-7 or equiv. 3 cred. Upgren.
178. Economics of Consumption. A descriptive and analytical survey of the price-making process; the origins and the personal distribution of money income and purchasing power; planes of living in the United States; "ideal" standards of living; possibilities for improvement in the plane of consumption. Not open to majors in economics or business administration. Prereq.: Course 6-7 or equiv. 3 cred. Canoyer.

179. Economic Problems of the Far East. A survey of recent economic developments in the Far East, especially in China and Japan. The ways in which these developments illustrate and are governed by economic principles are examined. Economic regionalism, problems of population and migration, the control of raw materials, industrial efficiency, internal economic institutions, and international commercial policies as they occur in the Far East are among the topics discussed. Prereq.: Course 6-7 or equiv. 3 cred. Vaile.
185. § Economics of Marketing. A course dealing with (1) the role of market distribution in our total economy; (2) the costs of market distribution; (3) regional specialization and market distribution; (4) public, quasi-public, and corporate control of market distribution; (5) the role of the consumer in market distribution. Prereq.: Course 6-7 or equiv. 3 cred. Vaile.
186. International Economic Relations. Survey of foreign economic interests of the United States, policies to promote world recovery, and study of the 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.: Course 176. 3 cred. Upgren.
189. ¶§ Principles of Public Finance. A condensed presentation of Course 191-192. Public expenditures, revenues, debts, fiscal policy, and financial administration. Special attention is given to tax principles, practices, and burdens. Prereq.: Course 6-7 or equiv. 3 cred. Borak.
190. National Income Analysis. Review of the whole body of national income statistics as a related and integrated system of national economic accounting. "Clinical" investigation into the structure, morphology, and pathology of the national out-turn of goods and services. Central emphasis on capital formation. Short laboratory problems required. Prereq.: 20 cred. in economics and/or business administration. 3 cred. (Not offered.)
- 191-192.* ¶§ Public Finance. Public expenditures, revenues, debts, fiscal policy, and financial administration. Special attention is given to tax principles, practices, and burdens. Prereq.: Course 6-7 or equiv. 3 cred. per quarter. Heller.
193. State and Local Taxation. Main problems of state and local finance and proposed solutions, including co-ordination of national, state, and local fiscal policy and administration. Prereq.: Courses 189, 191-192 or B.A. 58. 3 cred. Borak.
195. Fiscal Policy. An analysis of fiscal policy theory as developed by Keynes and his followers; the use of economic models in the formulation of fiscal policy; the potential role of taxes, expenditures, and debt management in stabilizing the economy; and the administrative, legislative, and political barriers to the working out of a consistent national fiscal policy. Prereq.: 20 cred. in social science, including B.A. 58 and Course 142 or equiv. 3 cred. Heller.
- 203*-204.* Seminar in Economic Theory. 3 cred. per quarter. Garyer.
- 206.* Seminar in Market Prices. 3 cred. Vaile.
- 207.* Theory of Demand. 3 cred. (Not offered.)
- 208.* Production and Distribution. 3 cred. (Not offered.)
- 209.* Seminar in Theory of Monopolistic Competition. 3 cred. (Not offered in 1948-49.)
- 233-234.* Seminar in Public Finance. 3 cred. per quarter. Heller.
- 243-244.* Seminar in Money and Banking. 3 cred. per quarter. Upgren.
- 251*-252.* Seminar in Industrial Relations. 3 cred. per quarter. Yoder.

§ 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.

- 257.* Seminar in Accounting Theory. 3 cred. (Not offered in 1948-49.)
 258.* Seminar in Accounting. 3 cred. Ostlund.
 281.* Seminar in Industrial Management. 3 cred. Filipetti.

BUSINESS ADMINISTRATION

109. Business Policy. This course is devoted to the study of problems of a general administrative character. It deals with the integration of management, the 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.
- 112.‡ Business Statistics. Explanation and criticism of statistical techniques for dealing with time series; measurements of trend, seasonals, cycles; business index numbers. Statistical control of quality in manufacturing operations. Prereq.: Econ. 5 or equiv. 3 cred. Mudgett, Gaumnitz, and others.
118. Auditing Procedure. A laboratory course in auditing procedure. Class instruction in auditing technique and the preparation of a complete set of working papers and an audit report. Prereq.: Course 150 or permission of instructor. 3 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. (Not offered.)
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. (Not offered.)
- 130.‡§ Cost Accounting Survey. A general survey of cost accounting from the point of view of the executive who must use cost information in the conduct of his business. Prereq.: Econ. 22-23 or equiv. 3 cred. Wheeler, Anderson.
133. Standard Costs. The methods of standard costs. The meaning of standards. The setting of standards for materials, labor, and overhead. The analysis of and accounting for variations. The development and application of standards to distribution as well as to production activities. Prereq.: Course 130 or 153. 3 cred. Ostlund.
134. Income Tax Accounting. The principles involved in determining taxable net income and the computation of federal and state income taxes for corporations and individuals. Prereq.: Course 150. 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 of professional practice. Organization and writing of audit reports and study of case and problem material. Prereq.: Course 118. 3 cred. Reighard.
136. Internal Auditing and Accounting Control. Accounting systems and methods as related to internal check and audit control of routine transactions and the establishment of administrative and budgetary control. Prereq.: Course 150. 3 cred. Reighard.
- 139.*‡ Analysis of Financial Statements. Interpretation and analysis of financial statements, credit, investment, and managerial analysis of financial statements. Final analysis and consolidated statements. Industrial, public utility, railroad statements. Prereq.: Econ. 22-23 or equiv. 3 cred. Heilman and others.
143. Tax Accounting Problems. Special tax problems of corporation; administration of income taxes, amended returns; court appeals, state income taxes and allocation of income; social security, estate and gift taxes. Prereq.: Course 134. 3 cred. Nelson.

‡ A fee of \$1 is charged for this course.

§ Credit may not be received for both Course 130 and 152.

145. Foreign Exchange. The drawing and handling of international bills of exchange of all kinds; relations of correspondent banks; acceptance accounts; calculation of bankers' buying and selling prices; investment, speculation, and arbitrage in exchange; exchange and the money market; exchange control. Prereq.: Econ. 142. 3 cred. Myers.
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 is placed upon objective analysis from source materials of factors explaining price differentiation. Prereq.: Econ. 155. 3 cred. Stehman.
147. Bank Administration. Designed for students intending to enter the field of commercial banking. Less emphasis is placed upon the routine of bank operation than upon the problems of the bank executive. Prereq.: Econ. 142. 3 cred. (Not offered.)
148. The Securities Market. Consideration of behavior over time or "longitudinal" analysis of prices of individual and groups of securities. Emphasis is placed upon the relationship of economic conditions to security values, particularly the effects of cyclical fluctuations. Prereq.: Course 146, Econ. 149. 3 cred. Upgren.
- 150.‡ Intermediate Accounting I. Principles involved in valuation of assets, liabilities, and stockholders' interest; determination of periodic income. Prereq.: Course 139, Math. 20. 3 cred. Heilman and others.
- 151.‡ Intermediate Accounting II. Partnership liquidation, concerns in financial difficulties, estates and trusts, consolidated statements, and other specialized problems. Prereq.: Course 150. 3 cred. Heilman and others.
- 152§-153. Cost Accounting. Cost accounting practices and procedures. Prereq.: Econ. 22-23 or equiv. 3 cred. per quarter. Ostlund, Wheeler.
- 156.* Finance Management. The duties of the financial manager of a modern business. The various sources from which capital may be secured, the best use of a company's funds, and special financial problems which arise in the typical business. Prereq.: Econ. 155. 3 cred. Stehman.
157. C.P.A. Problems. This course will give attention to suggested methods and scope of preparation for all sections of the C.P.A. examination. Primary emphasis directed at the problems section. Problems will be analyzed or solved and cover costs, estates, municipals, bankruptcy, consolidations, and other common topics in the examination. Occasionally entire sections from recent examinations will be worked under examination conditions. Prereq.: Courses 151, 153 or permission of instructor. 4 cred. Nelson.
158. Governmental, Railroad, and Utility Accounting. Governmental budgets, and fund accounting. Study of accounting requirements of the Interstate Commerce Commission, the Federal Power Commission, and of the state commissions for public utilities. Prereq.: Course 150. 3 cred. Heilman.
- 165.* Economics of Public Utilities. A general course on the economic aspects of government regulation of the finances, rates, and services of municipal public utilities. Economic characteristics, legal positions, regulation, valuation, and government ownership are the principal topics covered. Prereq.: Econ. 3, 6-7. 3 cred. (Not offered.)
167. Introduction to Industrial Relations. An elementary survey of policy and practice in the management of manpower. Personnel management functions of assessing manpower needs, selection, training, and rating of workers are included as well as labor relations problems of collective bargaining, wage and salary administration, and employment stabilization. Prereq.: Econ. 161. 3 cred. Yoder and others.

‡ A fee of \$1 per quarter is charged for this course.

§ Credit may not be received for both Course 130 and 152.

- 170.‡ Motion Economy. Fundamental principles and techniques of motion economy, workplace layout, motion picture applications, operation analysis, output standards, stopwatch procedure, and cost-savings estimates. Materials: text, readings, motion picture films. Prereq.: Course 184. 3 cred. Immer.
- 171.‡ Production Standards. 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.: Course 170. 3 cred. Immer.
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.: Econ. 5, Course 77 or equiv. 3 cred. Vaile.
177. Foreign Trade. Theories of international trade; character of United States foreign trade and the world market. Commercial organization and foreign trade financing, foreign shipments—export and import. Transportation and shipping problems; governmental regulation; and individual markets. Prereq.: Econ. 6-7 or equiv. 3 cred. Lewis.
- 180-181-182. Senior Topics Courses. Intensive study of problems in respective fields of specialization.
- 180-181A. Accounting. Selected topics in practices and theory. Course 180A is currently devoted to budgetary control procedures; Course 181A to development of financial reporting standards under S.E.C. and A.I.A. releases. Term reports and reference reading. 3 cred. per quarter. Reighard.
- 181-182B. Business Finance. Individual research and discussion of important current financial developments. 3 cred. per quarter. Stehman.
- 180*-181*-182C.* Marketing. Selected topics in management problems. Course 180C is currently devoted to market price and price policies; 181C to the marketing of industrial goods and the analysis of distribution costs; 182C to retail store management. Prereq.: for 180-181C, Course 77; for 182C, Course 69. 3 cred. per quarter. Canoyer, Lewis.
- 180*-181*-182D.*¶ Industrial Relations. This series of topics courses is designed to develop a familiarity with an evaluation of professional procedures and techniques employed in each of the major functions of manpower management. Class procedure involves individual and group projects and is designed to prepare the student for employment in industrial relations at the staff level. Admission is limited to majors in industrial relations, and others who have satisfactorily completed Course 167 or its equivalent. Prereq.: Course 167. 3 cred. per quarter. 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. 3 cred. per quarter. Mudgett.
- 180-181-182G.§ Production Management. Selected problems in management; studies in the technique of executive control in manufacturing enterprises; field research and surveys in the organization and methods of management of Northwest industrial concerns. 3 cred. per quarter. Filipetti.
- 180-181-182I. Transportation. Course 180I offers study of selected topics in traffic management, including transportation rates and practices and the individual firm; 181I, motor and air transportation; 182I, regulation and management of transporta-

‡ A fee of \$1 is charged for this course.

§ Credit may not be received for both B.A. 180G and B.A. 184.

¶ 180-181-182D must be taken in sequential order.

tion agencies with intensive analysis of recent leading decisions of the Interstate Commerce Commission and Civil Aeronautics Board. Prereq.: Course 72 or permission of instructor. 3 cred. per quarter. Nightingale.

- 184.*§ Scientific Management in Industry. A study of the origin and development of the movement to apply the methods of science to the management of industrial enterprises; the effects upon individual plant management and the influence upon "rationalization" in industrial society. Prereq.: Econ. 6-7 and Course 89 or equiv. 3 cred. Filipetti.
194. Advanced Advertising Procedure. Problems and case work in advertising research. Preparation and criticism of advertisements and of advertising campaigns. Prereq.: Econ. 5 and Course 88. 3 cred. Longstaff.

EDUCATION

Professors Wesley E. Peik, G. Lester Anderson, John E. Anderson, Clara B. Arny, Charles W. Boardman, Guy L. Bond, Nelson L. Bossing, Leo J. Brueckner, Walter W. Cook, John G. Darley, Ruth Eckert, Marcia Edwards, Clifton Gayne, Jr., Harriet Goldstein, Palmer O. Johnson, Louis F. Keller, Wylie B. McNeal, Mervin G. Neale, Julius M. Nolte, Carl F. Nordly, Paul M. Oberg, Raymond G. Price, Ella Rose, Dora V. Smith, Homer J. Smith, Edgar B. Wesley, C. Gilbert Wrenn; Associate Professors Clifford P. Archer, Robert H. Beck, Miles E. Cary, Willis E. Dugan, M. Elizabeth Fuller, Paul R. Grim, Ruth Grout, Edwin L. Haislet, George W. Hauser, Marie Lien, William J. Micheels, Milo J. Peterson, Ralph A. Piper, Helen M. Starr, Tracy F. Tyler, Marvin J. Van Wagenen, Harold T. Widdowson; Assistant Professors Jean H. Alexander, Warren G. Meyer; Instructor Paul R. Wendt.

Prerequisites—For major work in education at least 6 quarter credits in psychology and in addition to this a total of not less than 18 quarter credits of undergraduate work in education which shall include Ed. 51A-B-C or Ed. 55A-B or the equivalent. For minor work at least 6 quarter credits in psychology and in addition to this a total of not less than 18 credits of undergraduate work in education.

Language requirement—Candidates for the Master's degree majoring in any of the fields of education are exempted from the foreign language requirement without petition. Candidates for the Doctor's degree will meet the requirements of the Graduate School. (See page 13.)

Master's degree—Under 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	Physical Education for Men
Educational Psychology	

Minors may be chosen as follows:

1. From any of the groupings 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.

§ Credit may not be received for both B.A. 180G and B.A. 184.

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 be expected to select a field of concentration in which he will attain from 21 to 27 credit hours. The field of concentration differs from a major in that it encourages the choice of a somewhat wider range of courses related to the student's interest. As in the case of the major, however, the student will be expected to indicate his field of concentration according to the general arrangement of courses that prevails for the requirement of 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	Physical Education for Men
Educational Psychology	

Additional courses—The student may elect the additional courses required to complete the total of 45 credits from areas of education not included in the field of concentration and from any other fields of study offered at the University of Minnesota in which satisfactory courses of graduate character are available and which are obviously related to the student's interest. Further work in subject-matter areas is encouraged.

Candidates for the Master's degree under Plan B are expected to earn 9 credits in advanced courses involving papers prepared in independent study. This requirement is satisfied in starred courses.

Doctor's degree—Major work will be chosen in the field of education 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 representing the major:

Education	History and Philosophy of Education
Agricultural Education	Home Economics Education
Curriculum and Instruction	Industrial Education
Educational Administration	Physical Education for Men
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 Education in the following fields: 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—For major or minor work, 18 credits in agricultural education and preparation in agricultural subjects satisfactory to the Division of Agricultural Education.

- Agr.Ed.101f,w. Adult Education in Agriculture. Instructional programs for rural young men not regularly enrolled in school. Analysis of rural youth situations and placement problems. Courses of instruction for adult farm men and women. Prereq.: Course 81. 3 cred. Peterson.
- Agr.Ed.103f,w. Facilities and Materials. A study of the physical arrangements for departments of vocational agriculture. Building facilities, room fixtures, references, equipment, visual aids, illustrative materials. Prereq.: Course 81. 3 cred. Ar.
- Agr.Ed.104f,w,s. Planning Programs. Long-time and annual plans for departments of vocational agriculture. Schedule of activities, analysis of results. Prereq.: Course 82. 2 cred. Ar.
- Agr.Ed.121su. Enterprise Analysis. Experience in analyzing enterprises in agriculture as a basis for identifying problems and distributing them in the horizontal setup for a course of study in agriculture. Prereq.: Ed.51A. 2 cred. (Not offered in 1948-49.)
- Agr.Ed.154f,w. Rural Education and Community Leadership. The rural school as a community center. Ways and means of organizing educational and recreational activities, such as clubs, festivals, fairs, and other desirable features of rural community life. Prereq.: 10 cred. in education. 2 cred. Ar.
- Agr.Ed.221f,w,s. Field Problems. Making investigations, gathering data, and formulating plans regarding agricultural education. 3 cred. per quarter. Field, Peterson, and staff.
- 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 education. 3 to 9 cred. Field, Peterson, and staff.
- Agr.Ed.286f,w,s. Current Problems in Agricultural Education. Analysis and discussion of special problems of individual teachers. Opportunity for intensive study of specific problems related to local school programs. Prereq.: permission of instructor. 3 to 6 cred. Peterson and staff.
- Agr.Ed.291f,w,s. Seminar in Agricultural Education. Presentation and discussion of recent developments in technical agriculture and agricultural education as these developments affect the work of the teacher. Cred. ar. Peterson and staff.

ART EDUCATION

- ArtEd.151f-152w-153s. Curriculum Building in Art Education. These courses emphasize the analysis of the functions of art in society for educational potentialities toward social improvement. Exercises in selection, evaluation, and organization of subject matter for the purpose of creating original teaching units, projects, etc., to enrich the curriculum through the adaptation of general art materials not available in convenient form for school purposes. Utilization of research materials and procedures developed on the Owatonna Art Education Project and related research testing the hypothesis, "Art a Way of Life." For advanced students and teachers in service. 3 cred. per quarter. Lien.
- ArtEd.156w. Intercultural Education through Art. A course designed to foster national unity and international understanding through recognition of the cultural contributions of diverse peoples to world-wide development and experience with special emphasis on twentieth-century exchange. Timely approaches toward understanding the

fundamental problems arising out of current ethnic and racial conflicts will be considered in the light of specific needs of teacher, community worker, layman. 3 cred. Lien.

ArtEd.157s. Art Movements of Twentieth-Century Scandinavia. 3 cred. Lien.

ArtEd.184.‡ Advanced Course in the Teaching and Supervision of Art in the Elementary School. For teachers in service and advanced students. Analysis of the elementary school as the most critical institution for the dissemination of art education in society. Emphasis on improving current practices through critical evaluation and utilization of research findings and introduction of new materials. The role of the supervisor and opportunities to develop closer co-operative relationships between room teachers and art education specialists. 3 cred. (Not offered in 1948-49.)

ArtEd.185f.‡ Advanced Course in the Teaching of Art in the Secondary School. For experienced teachers and advanced students who are planning to teach in the secondary school. Emphasis on significant general research and critical examination of high school art programs as they function in the lives of adolescent youth in a democratic society. Exercises in evaluating, planning, and administering art education programs at the secondary level. 3 cred. Lien.

ArtEd.189. Application of Esthetic Theory in Education. Examination of contemporary theories of art, their psychological and philosophical foundations as revealed through experimental evidence. Application of tested principles of art education to improving programs of general education at all levels. Open to teachers, supervisors, and administrators with or without previous experience in art who are concerned with making art function in general education. 3 cred. (Not offered in 1948-49.)

ArtEd.284f. Research in Art Education. Basically a course for systematic class training in research techniques including construction and use of tests and measurements in art education. 3 cred. Gayne and staff.

ArtEd.295w,s. Problems in Art Education. The content of this course is 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 of instructor. Cred ar. Gayne and staff.

ArtEd.296f,w,s. Seminar in Art Education. Required with or without credit for one to three quarters of all advanced degree students in art education. Reports, evaluation of problems, recent literature. Participation by entire art education staff and guest specialists from related departments and from off campus. Cred. ar. Gayne and staff.

CURRICULUM AND INSTRUCTION

General Courses

Ed.C.I.104s.‡ Adult Education. This is a survey course of the field of adult education. It deals with agencies, programs, philosophies, history, and trends. Each student will be given opportunity to devote a part of his time to the field of his special interest. 2 cred. Ar.

Ed.C.I.105f,s.‡ Visual Aids in Teaching. A study of the characteristics, advantages, limitations, and practical schoolroom use of visual aids of non-projection and projection types. Specific laboratory practice in operation of usual projection machines. Sources of materials available for all grade levels and illustrations of practical uses of visual aids in various school subjects. 3 cred. Wendt.

‡ A fee of \$1.50 per quarter is charged for this course.

- Ed.C.I.106w.‡ Co-ordinating a Visual Aids Program. A course for those individuals who have a part-time or full-time responsibility for running an audio-visual program. Covers criteria of equipment, facilities, and materials, sources of materials, in-service training of teachers, and special problems encountered in small and large systems. Prereq.: Course 105 or permission of instructor. 3 cred. Wendt.
- Ed.C.I.107f,w,s.‡ Radio in Education. The major purpose of the course is to assist teachers and prospective teachers in making the most effective use of radio in the classroom. This necessitates consideration of such aspects as production, techniques of classroom use, selection of equipment, teaching appreciation, and the administration of radio in the schools. Field trips, demonstrations, activities, and concrete examples are used wherever possible. Each individual's interests and needs are met by permitting him to select for intensive study one of the several units into which the course is divided. Prereq.: 9 cred. in education. 3 cred. Tyler.
- Ed.C.I.114s.‡ The School Health Education Program. Study of various health organizations in city and state in relation to the school health program; organization of the health education programs with the school; construction of the curriculum in school health; evaluation of the school health education program; preparation and requirements for teaching school health education. Health supervision and guidance. Prereq.: P.H. 50, Ed.T. 83. 3 cred. Starr.
- Ed.C.I.117s.‡ Rural Education for Administrators and Teachers. Prereq.: consult instructor. 3 cred. Archer.
- Ed.C.I.129s.‡ Principles and Problems of Teaching Social Hygiene. Course deals with social hygiene or sex education in its broadest aspects, physical, sociological, and psychological. Emphasis will be placed on methods of teaching sex education at elementary levels and integration of material with total health curriculum. Primarily for teachers. Prereq.: 9 cred. in education. 2 or 3 cred. Ar.
- Ed.C.I.145s.‡ Remedial Reading. A study of the remedial practices in reading that are useful to both the classroom teacher and the reading specialist in the light of contributions of research, projects, and observations of remedial techniques. Prereq.: Course 143 or 144 or equiv. 3 cred. Bond.
- Ed.C.I.151w.‡ Diagnosis and Remedial Instruction. Objective evaluation of the results of teaching; diagnosis of pupil difficulty; remedial work; tests as aids to teaching; following up a testing program. Prereq.: Course 150 or equiv. 3 cred. Brueckner.
- Ed.C.I.171f,w,s.‡ Curriculum Laboratory Practice. A practice course in the analysis and construction of units, courses of study, and curricula; class projects and individual projects according to needs, interests, level, and specialization. Prereq.: Course 170A or 170B or permission of instructor. 2 cred. per quarter. Bossing, Cook, Archer.
- Ed.C.I.174f-175w-176s.‡ 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 with children in the public schools and with adults in the University Speech Clinic. Prereq.: Sp. 1, 2, 3, 61, 67, 162, and Ed.Psy. 142. 3 cred. per quarter. Bryngelson and staff.
- Ed.C.I.205f,w,s.*‡ Problems in Visual Education. Cred. ar. Wendt.
- Ed.C.I.207f,w,s.*‡ Problems in Radio Education. Individual problems for graduate students whose work in Ed.C.I.107 has indicated a special aptitude and interest in the field. Each student selects a problem, studies it intensively, outlines the proposed procedure, and carries it through to completion under the guidance of the instructor. Meetings may be arranged from time to time for discussion and criticism of individual projects. Prereq.: Course 107. 1 to 3 cred. per quarter. Tyler.

‡ A fee of \$1.50 per credit is charged for this course.

- 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 of instructor. 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 of the students. Prereq.: permission of instructor. 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 of instructor. Cred. ar. Grout.
- Ed.C.I.227f,w,s.*‡ Problems in Rural Education. Cred. ar. Archer.
- Ed.C.I.271f,w,s.*‡ Problems in Curriculum Construction. Special problems in the field of the student's individual choice. Prereq.: completion or current enrolment in one of the following: Courses 113 or 119, 170 or permission of instructor. 2 to 3 cred. per quarter. Bossing, Cook, Archer.
- Ed.C.I.273f,w,s.*‡ Problems in Reading. Recent problems, issues, studies, and findings. Intended for those who have had previous training in reading and have a special problem or who wish to survey the most recent literature. Prereq.: previous training in reading such as Course 143 or 144 or equiv. 2 or 3 cred. per quarter with a maximum of 9. Bond.

Elementary Education

- Ed.C.I.102f.‡ The Teaching of the Social Studies in the Elementary School. Prereq.: Ed. 71A-B-C or equiv. 3 cred. Wesley. (Not offered in 1948-49.)
- Ed.C.I.119w.‡ Elementary School Curriculum. A study of curriculum issues, viewpoints, and a survey of the methods, problems, and findings of research by subject and skill areas. Principles of curriculum development are derived from: psychology of individual and trait differences, social control, and learning; the nature of the biological, physical, and social heritage; and philosophy. Prereq.: Ed. 71C or equiv. 3 cred. Cook.
- Ed.C.I.121w.‡ Physical Education in the Elementary School. (The same as Phys.Ed. 113E.) This course is concerned with the determination and suggested solutions of outstanding current problems in physical education at the elementary school level. Emphasis is placed upon understanding the child and those of his problems with which this field should be concerned, understanding the role of the classroom teacher, and the common problems in organization, planning, instruction, and evaluation at the elementary level. Prereq.: Phys.Ed. 60, 82, or teaching experience in elementary grades. 3 cred. Baker.
- Ed.C.I.130w,s.‡ Problems in Childhood Education. (The same as Child Welfare 150.) Prereq.: 9 cred. in education including Ed.T. 55 or equiv. 2 cred. Fuller.
- Ed.C.I.143f.‡ Teaching and Supervision of Reading in the Elementary School. A study of the objectives, the materials, and the teaching procedures in lower and intermediate grades in the light of the contributions of research; survey of current practices and curricula; class and individual projects; observation of reading techniques and materials in the demonstration school. Prereq.: 9 cred. in education including Ed. 51A or 71A. 3 cred. Cook.
- Ed.C.I.146.‡ Current Developments in Language Expression in the Elementary School. A general course in the function and development of power in connection with all experiences of the school day. Materials, methods, and current philosophies of language instruction in the elementary school. Prereq.: Ed. 71A-B-C or equiv. Not open to students who have had Course 64. 2 cred. Smith. (Not offered 1948-49.)

‡ A fee of \$1.50 per credit is charged for this course.

- Ed.C.I.147f.‡ Workshop in the Language Arts. (Primarily for teachers in service.) The first hour will be given over to a series of lectures on methods and curriculum in reading, writing, speaking, and listening, with different lectures each week. At the second hour, group and individual conferences will be held on problems pursued by individual teachers in relationship to their own teaching. Lectures may be registered for without credit. Prereq.: Ed. 71A-B-C or equiv. 2 cred. Smith, Bond. (Not offered in 1948-49.)
- Ed.C.I.149w.‡ The Teaching and Supervising 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. 71A-B-C or equiv. Not open to students who have had Course 62A or B. 2 cred. Brueckner.
- Ed.C.I.150f.‡ Supervision and Improvement of Instruction. An analysis of the 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; the results of scientific investigation; use of standardized and informal tests; remedial work. Prereq.: Ed. 71C or equiv. 2 or 3 cred. Archer.
- Ed.C.I.157f,w,s.‡ Practice in Supervision. Individual research on special supervisory problems, especially intended for supervisors in service. Prereq.: permission of instructor. 3 cred. per quarter. Brueckner.
- Ed.C.I.170A.‡ Curriculum and Course of Study Construction. A study of the principles and methods for the selection and organization of units, courses of study, and curricula at the elementary school level. Prereq.: Course 119 or permission of instructor. 3 cred. (Not offered in 1948-49.)
- Ed.C.I.173As.‡ Organizing Units of Instruction in the Elementary School. A consideration of the principles and procedures involved in the development and organization of units (center of interest units, activity units, experience units, etc.) utilizing natural science, social studies, and literary content in the development of skills in reading and study, oral and written composition, arithmetic, and the arts. Prereq.: Course 119 or teaching experience. 3 cred. Cook.
- Ed.C.I.181w.‡ Foundations of Elementary School Methods. A survey of the current philosophy and research which form the bases for improvement of elementary school instruction. Observation in the demonstration school. 3 cred. Brueckner.
- Ed.C.I.190w.‡ Principles of Selection of Materials for Reading in the Elementary School. An advanced course in reading and selection of materials suitable for the elementary school with emphasis upon curriculum needs, principles of child development, and scientific determination of reading difficulty. Prereq.: Course 63 or 122 or equiv. 2 cred. (Not offered in 1948-49.)
- 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 School Supervision. Intended primarily for graduate 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 for measuring the extent to which objectives are achieved; spring, problems in the evaluation of teaching. Prereq.: 10 cred. in education, including Ed. 71A or equiv. 3 cred. per quarter. Brueckner.

‡ A fee of \$1.50 per credit is charged for this course.

- Ed.C.I.263s.*‡ Research in Arithmetic Instruction. A study of recent research in curriculum, gradation of subject matter, methods, materials, and supervision of arithmetic. Prereq.: Course 149 or equiv. 3 cred. Brueckner.
- Ed.C.I.264f.*‡ Research in Educational Diagnosis. A study of recent research in the methods of diagnosis in education, and the techniques of preventive and remedial teaching. Prereq.: Course 151 or equiv. 3 cred. Brueckner.

Secondary Education

- Ed.C.I.113f,w.‡ High School Curriculum. A study of viewpoints and curriculum issues, organization trends, typical research findings by subjects, and the analysis of state and local curricula. Prereq.: Ed. 51A-B-C or equiv. 3 cred. Bossing.
- Ed.C.I.122s.‡ Literature for Adolescents. A background for pupil guidance in extensive reading in junior and senior high schools; analysis of studies of adolescent choices in literature; principles of selection; critical reading in broad fields of literary, biographical, historical, scientific, and vocational interests of boys and girls. Prereq.: Ed. 51C or junior-senior high school teaching experience. 2 cred. Smith.
- Ed.C.I.125s.‡ 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 of instructor. 1 cred. per quarter. Dugan.
- Ed.C.I.131.‡ Advanced Course in Teaching Technical Business Subjects. Recent research and trends in teaching the technical business subjects of typewriting, shorthand, transcription, office and secretarial practice. Prereq.: permission of instructor. 3 cred. Price. (Not offered in 1948-49.)
- Ed.C.I.132f.‡ Teaching the Basic Business Subjects. Recent trends and developments in teaching junior business training, economic geography, marketing, business law, consumer education, and bookkeeping. Prereq.: permission of instructor. 3 cred. Price.
- Ed.C.I.133w.‡ Consumer Education in Secondary Schools. Need for consumer education, organizing a program in the school, contribution of various subject-matter areas. Prereq.: permission of instructor. 3 cred. Price.
- Ed.C.I.134s.‡ Materials and Methods in Consumer Education. Significant areas in consumer education, choosing and buying goods and services, financial problems, economic status of consumer, aids and protection. Development of teaching units. Emphasis on teaching methods and recent aids and materials. Prereq.: permission of instructor. 3 cred. Price.
- Ed.C.I.135w.‡ 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.: Ed.Psy. 133 or permission of instructor. 2 or 3 cred. Dugan.
- Ed.C.I.136w.‡ Organization and Supervision of Distributive Education Programs. Principles and practices followed in developing co-operative part-time, extension part-time, and evening school programs under the George-Barden Act, and non-reimbursable programs. A basic course for teachers, co-ordinators, and administrators of distributive education programs. Prereq.: permission of instructor. 3 cred. Meyer.
- Ed.C.I.137f.‡ Materials and Methods in Distributive Education Programs. Methods of teaching distributive education subjects in high schools and junior colleges with emphasis on individual instruction and correlation of classroom work with on-the-job experience. Prereq.: permission of instructor. 3 cred. Meyer.

‡ A fee of \$1.50 per credit is charged for this course.

- Ed.C.I.138su.‡ Supervisory Training in Distributive Education. Supervisory training problems and elementary training techniques used in stores and offices designed to improve the on-the-job experience of co-operative part-time students, and to enable co-ordinator to conduct short unit courses for store and office supervisors. Prereq.: permission of instructor. 3 cred. Meyer.
- Ed.C.I.139s.‡ Co-ordination Techniques in Business Education. Practical problems encountered by the co-ordinator in his daily work concerning the co-operative part-time program. Guidance and selection; placing of students in work stations; assisting job adjustments; developing the training program; correlating school work and job experience. Prereq.: permission of instructor. 3 cred. Meyer.
- Ed.C.I.141f.‡ Co-operative Part-time Distributive Education Classes. A study of the co-operative part-time program including planning a program, curriculum building, promoting the program, plant and equipment, program evaluation. Prereq.: permission of instructor. 3 cred. Meyer.
- Ed.C.I.142su.‡ Evening School Distributive Education Classes. Selection and training of evening school instructors; planning and promoting evening school distributive education classes; sources of teaching materials; teaching methods adapted to the evening school programs. Prereq.: permission of instructor. 3 cred. Meyer.
- Ed.C.I.144w.‡ Teaching of Reading in Junior and Senior High Schools. A study of the teaching procedures, objectives, and materials, with special consideration for the teaching of reading in the various subject-matter fields. Prereq.: 9 cred. in education including Ed. 51A or 55A or equiv. 3 cred. Bond.
- Ed.C.I.168w.‡ Current Developments in the Social Studies. A survey of contemporary literature, curricular trends, the Commission Report, and recent developments in integration. 2 cred. Wesley.
- 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.: 9 cred. in education, including Ed. 51A or 55A or equiv. 2 cred. Bossing.
- Ed.C.I.170Bs.‡ Curriculum and Course of Study Construction. A study of the principles and methods for the selection and organization of units, courses of study, and curricula at the secondary school level. Prereq.: Course 113 or 119, 170 or permission of instructor. 3 cred. Bossing.
- Ed.C.I.173Bs.‡ Organizing Units of Instruction in the Secondary School. Philosophical and psychological basis of the unit. Development of principles and procedures for construction and teaching of units of instruction at the secondary level. Prereq.: Course 113 or permission of instructor. 2 or 3 cred. Bossing.
- Ed.C.I.191s.‡ Advanced Course in the Teaching and Supervision of Secondary School Mathematics. Evaluation of present practices in methods, curriculum materials, and administration of junior and senior high school mathematics. Prereq.: Ed. 51C or permission of instructor. 2 cred. D. Johnson.
- Ed.C.I.198.‡ Recent Literature in Methods and Curriculum in Secondary School English. (Students should not register for this course in the same year with Ed.C.I. 294.) Prereq.: Ed.T. 66A-B-C or equiv. 2 cred. (Not offered in 1948-49.)
- Ed.C.I.201f,w,s.*‡ Problems in Teaching the Social Studies. Prereq.: permission of the instructor. 3 cred. per quarter. Wesley.
- Ed.C.I.204f.‡ Social Studies Curriculum. A review of the techniques and practices of curriculum-making in the social studies at all grade levels. 2 cred. Wesley.

‡ A fee of \$1.50 per credit is charged for this course.

- Ed.C.I.222f,w,s.‡ Seminar—Current Problems in the Techniques of High School Instruction. Required of students working on theses. Prereq.: Course 113 and Ed. 51B or equiv. With or without cred. Bossing, Johnson, Smith, Wesley.
- Ed.C.I.225f,w,s.*‡ Special Problems in Supervision of Instruction in Secondary Schools. Study of special problems in supervision primarily for graduate students and supervisors in schools who are qualified to make intensive studies. Prereq.: consult instructor before registering. Cred. ar. Boardman.
- Ed.C.I.238f,w,s.*‡ Problems in Distributive Education. Investigation of particular problems in the field of distributive education. Intended for those qualified to make intensive studies. Prereq.: permission of instructor. Cred. ar. Meyer.
- Ed.C.I.239f,w,s.*‡ Problems in Business Education. Special investigations in the field of the student's interest. Prereq.: consult instructor before registering. Cred. ar. Price.
- Ed.C.I.254.‡ Supervision of the Social Studies. The scientific work being done on the course of study in geography, history, science, and related fields; improvement of instruction in social sciences. 2 cred. (Usually offered in alternate years. Not offered in 1948-49.)
- Ed.C.I.266s.‡ Supervision of High School Instruction. The present status of high school supervision; its proper scope and function. A course combining consideration of principles and their application to improving high school instruction in the academic and special subjects. This is part of the major sequence for the administration of secondary schools. 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. 2 or 3 cred. Johnson.
- Ed.C.I.293s.*‡ Foundations of Secondary School Methods. A study of the investigations which form the bases of the technique of high school instruction and the application of their results to subject matter and to classroom procedure. Each member will work primarily in the field of his teaching choice, with a final synthesis by the class as a whole. 3 cred. Johnson.
- Ed.C.I.294f.*‡ Advanced Course in Methods of Teaching English. Evaluation of present practices in methods and content of junior and senior high school English courses in the light of the known results of scientific investigations in that field. Prereq.: Ed.T. 66A-B-C or equiv. 2 cred. 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. A course primarily for teachers engaged in the direction of student teachers in elementary and secondary education. 2 cred. Grim.
- Ed.C.I.228f,w,s.*‡ Problems of Higher Education and Teacher Training. Problems of student personnel, of curricula and instruction, and of organization and administration in both liberal arts and professional schools. Programs of individual study and research on any of the above topics may be supplemented by seminar attendance during the winter and spring quarters. Problems of general or liberal education will be discussed during the winter quarter, while spring quarter sessions will be devoted to questions of professional education, with special emphasis on the field of teacher education. Prereq.: Course 250 or 285 or permission of instructors. Cred. ar. Peik, Cooper, Eckert.

‡ A fee of \$1.50 per credit is charged for this course.

- Ed.C.I.250f.‡ Higher Education in the United States. A survey of the historical development of institutions of higher education and a consideration of the following topics: the functions of higher education in a democracy; types of higher institutions; the articulation of secondary and higher education; educational principles and theories underlying present curriculum practices—the curriculum for general education and for advanced and special education, the improvement of instruction, the administration and control of higher education, the evaluation of programs of higher education by accrediting agencies and by individual faculty groups. This course is designed as an introduction to the sequence of courses in higher education and is also designed for graduate students in academic fields who wish a survey of the problems of colleges and universities. Prereq.: 18 cred. in education or permission of instructor. 3 cred. Eckert.
- Ed.C.I.251w.‡ Curriculum Trends in American Colleges. A study of basic principles underlying the derivation of content of college curricula and the organization of these materials into units, courses, and sequences. The functional relationship of curriculum and aims will be stressed, as well as promising means of orienting the curriculum to known characteristics of students. After examination of the curriculum as a whole and the relative emphasis placed on general and special education in selected college plans, critical study will be given to problems and issues involved in the development of general education sequences. 3 cred. Eckert.
- Ed.C.I.252s.‡ Effective College Teaching. A review of the philosophical and psychological bases of instruction, with particular attention to their meaning for the guidance and encouragement of student learning at the college level. Various methods of teaching will be studied with a view to discovering their contributions toward attainment of important educational objectives. In this connection a number of investigations dealing with various teaching methods and administrative devices (such as sectioning and changes in class size) will be critically analyzed. Some observation of college classes will be expected. 3 cred. Eckert.
- Ed.C.I.284f,w,s.*‡ Problems in Student Teaching. Special research problems in the supervision, organization, and administration of student teaching on the elementary and secondary levels in various types of teacher education institutions. Cred. ar. Grim.
- Ed.C.I.285f.‡ The Professional Education of Teachers. A study of the present status of teacher education and of the problems that relate to the institutional training of teachers for public schools and higher education. Prereq.: 15 cred. in education. 3 cred. G. L. Anderson.

EDUCATIONAL ADMINISTRATION

General Courses

- Ed.Ad.124f. Public School Administration. The organization, administration, and general support of public schools in state and local school districts. Prereq.: 10 cred. in education. 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.: Courses 124, 225. 3 cred. Domian.
- Ed.Ad.225f.* Pupil Personnel Administration. Standard practices regarding child accounting problems, records, and reports; procedures having to do with pupil personnel. Standard office practices, including textbook and supply management. Prereq.: Course 124. 3 cred. Domian.

‡ A fee of \$1.50 per credit is charged for this course.

- Ed.Ad.226s.* School Plant Planning and Management. Plant program planning and financing, including operation and maintenance of public school buildings. Prereq.: Courses 124, 125. 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.: Course 124. 3 cred. Domian.
- Ed.Ad.228f,w,s.* Special Problems in Educational Administration. This course is designed primarily for superintendents and principals qualified to make intensive studies of specific problems related to the administration of a school system. Prereq.: Courses 124, 125. 1 or 3 cred. per quarter. Neale.
- Ed.Ad.230f.* Public Relations for Schools. Theory and practice of educational interpretation. Principles involved; machinery and personnel; the teacher's contacts with the community; the role of the pupil; professional and lay organization. 3 cred. Domian.
- 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.
- Ed.Ad.280w. School Surveys. Prereq.: permission of instructor. 3 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 education. 3 cred. Grim.

Secondary Education

- Ed.Ad.133f. Introduction to Student Personnel Work. Basic principles and current practices in the development and operation of a student personnel program. Emphasis on broad areas of guidance services and related techniques. 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. 3 cred. Bossing.
- Ed.Ad.218f,w,s. Recent Literature in Secondary Education. A seminar concerned with current problems and literature in secondary education. Cred. ar. Boardman, Bossing.
- Ed.Ad.263f. Organization of the Secondary School. This course is concerned with the organization of secondary school units, vertical and horizontal organization for administration, and organization for instructional purposes. 3 cred. Boardman.
- Ed.Ad.264w. Administration of the Instructional Activities in the Secondary School. Problems relating to curriculum, teacher selection, schedule making, extra-curricular activities, guidance, pupil control. 3 cred. Boardman.
- Ed.Ad.265s. Administration of the Noninstructional Activities of the Secondary School. Problems relating to housing, forms and records, marks, finance, public relations. 3 cred. Boardman.
- Ed.Ad.270f,w,s.* Special Problems in Secondary Education. Primarily for those qualified to undertake individual research and to write research reports. Cred. ar.; maximum 9 cred. Boardman, Bossing.

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 of instructor. 3 cred. Neale.

- Ed.Ad.274w. The Junior College. The present status of the junior college, its development, purposes and functions, organization, curriculum, and probable trends. 3 cred. Boardman.
- Ed.Ad.290w. Financing Higher Education. Prereq.: permission of instructor. 3 cred. Neale.
- Ed.Ad.291s. Public Relations for Colleges and Universities. Prereq.: permission of instructor. 3 cred. Neale.

EDUCATIONAL PSYCHOLOGY

NOTE—For information on work in Psychometrics, see page 22.

General Courses

- Ed.Psy.120f,w,s. Basic Principles of Measurement. Principles applied to the construction and use of tests and to the interpretation and evaluation of scores. Illustrations from mental and other aptitude tests, education, personality, and character tests. Prereq.: Course 60 or equiv. 3 cred. Cook.
- Ed.Psy.133f. Introduction to 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 the measurement of intelligence, interests, personality, and achievement. Attention is given to underlying hypotheses, techniques of test construction, research devoted to establishing the validity of the tests, and the interpretation of test scores. Prereq.: Course 120 or equiv. 3 cred. Cook.
- Ed.Psy.141w. Group Aptitude Testing. A study of group aptitude tests for all school levels with special emphasis on reliability and validity as instruments for educational and vocational guidance. Prereq.: Course 120 or equiv. 3 cred. Ar.
- Ed.Psy.142f,w,s. Individual Aptitude Testing. Application of basic principles of measurement to individual diagnosis. Demonstration and practice. Stanford-Binet, Wechsler-Bellevue, and performance tests. Consideration of other clinical methods. Prereq.: Course 120 or equiv. 3 cred. Bond.
- Ed.Psy.143s. Individual Mental Testing Laboratory. Prereq.: Course 142. 2 cred. Bond.
- Ed.Psy.150f,w,s. Psycho-educational Clinic. Conducted in co-operation with existing clinics and agencies in the Twin Cities. Students will receive practice in giving psychological examinations, in case study, and in scientific interpretation of data. Prereq.: Courses 120, 140, and 141 or 142, permission of instructor. 2 or 3 cred. per quarter. Bond.
- Ed.Psy.159f,s. Personality Development and Mental Hygiene. A survey course for educational workers, particularly teachers and counselors. Emphasis on an understanding of the factors involved in personality development and on the preventive rather than the remedial phases of mental hygiene. Attention is given to the various types of maladjustments as well as to the conditions under which a teacher or counselor can safely attempt remedy or treatment. Prereq.: 9 cred. in education including one recent course in psychology. 3 cred. Wrenn.
- Ed.Psy.208w.* Methods in Educational Research. A study of the methods and techniques employed in the investigation and report of educational problems. Designed to aid students in the preparation of theses. Suggested for all candidates for degrees. 2 or 3 cred. Johnson.
- Ed.Psy.216f-217w-218s. Statistical Methods in Education. A course 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 quarter. 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 and tables than is obtained from the lecture course 216-217-218. The lecture course may be taken with or without laboratory work. 2 cred. per quarter. 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.: Course 218 or permission of instructor. 3 cred. P. O. Johnson.
- Ed.Psy.220w-221s. Advanced Theory of Measurement. An examination of the principles underlying construction and use of psychological and educational measuring instruments and of the limitations of tests for purposes of measurement in experimentation and in evaluation of students' work. Prereq.: Courses 60 or 120, 216 or equiv. 2 cred. per quarter. Van Wagenen.
- Ed.Psy.225w,226s.* Diagnosis and Counseling in a Student Personnel Program. An advanced course requiring recent background in both psychological measurement and principles of guidance. Attention is given to the techniques for collecting information regarding a student, the making of a diagnosis, and the techniques of counseling and interviewing. Prereq.: Course 120, Ed.Ad. 133 or equiv. 3 cred. per quarter. 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. Cred. ar. Edwards, Wrenn, Dugan.
- Ed.Psy.240f,w,s.* Problems of Measurement. Intensive study and individual research in problems of educational and vocational measurement. Cred. ar. P. O. Johnson.
- Ed.Psy.243f,w,s. Problems in Statistics for Students in Education and Psychology. A seminar devoted to recent developments in statistical science with special reference to their application to educational and psychological problems. Cred. ar.; or may be taken without credit. P. O. Johnson.
- Ed.Psy.253f,w,s.* Research Problems. Prereq.: consult instructor. Cred. ar. G. L. Anderson, Bond, Cook, Van Wagenen, Wrenn.
- Ed.Psy.260f,w,s. Educational Psychology Seminar. For all Ph.D. majors in educational psychology. This seminar meets at least five times a quarter for the purpose of integrating course work in all areas of educational psychology, analyzing new developments, and presenting Ph.D. dissertation outlines. No cred. Wrenn and Educational Psychology staff.
- Ed.Psy.290f-291w. Individual Differences. A study of group and individual differences and their relations to educational practice. Prereq.: Course 60 or equiv., permission of instructor. 3 cred. per quarter. Ar.
- Ed.Psy.292s.* Recent Literature in Educational Psychology. Readings and reports on problems in educational psychology. Prereq.: permission of instructor. 3 cred. Ar.
- Ed.Psy.293w.* Psychology of Learning. A systematic study of theories and research in human learning and their implications for curriculum and instruction. Prereq.: 12 cred. in psychology and educational psychology. 3 cred. G. L. Anderson.
- Ed.Psy.294s.* Recent Theory and Research in Human Learning. Prereq.: consult instructor. 3 cred. G. L. Anderson.

Elementary Education

- Ed.Psy.113f-114w-115s. Psychology of Elementary School Subjects. A discussion of the research studies in the field of psychology of elementary school subjects. Prereq.: 10 cred. in education and psychology. 2 cred. per quarter. Van Wagenen.
- Ed.Psy.182f. Education of Handicapped Children. Prereq.: Ed. 51A or 55A or 71A or equiv. 2 cred. Ar.
- Ed.Psy.183f. Education of Gifted Children. A study of the abilities and characteristics of intellectually gifted children and adults. Prereq.: Ed. 51A or 55A or 71A or equiv. 2 cred. Van Wagenen.

Ed.Psy.184s. Education of the Slow-Learning Child. A study of physical and mental traits of intellectually subnormal children and adults; social problems of feeble-mindedness. Prereq.: Ed. 51A or 55A or 71A or equiv. 2 cred. Ar.

See also courses under Child Welfare.

Secondary Education

Ed.Psy.158s. Psychology of Adolescence. A study of the physical and mental changes that characterize the transition from childhood to adult life. Implications for educational guidance during the period of secondary education. Prereq.: Ed. 51A or 55A or equiv. 3 cred. Edwards.

Ed.Psy.282w,s. Practice in High School Personnel Work. Experience in counseling, testing, and related personnel work procedures in the high school program. Weekly case study conferences with staff. Consult instructor. Cred. ar. Dugan.

See also courses 182 and 183 under Elementary Education.

Higher Education

Ed.Psy.250f. College Student Personnel Work. Development and administration. For advanced students planning to become college personnel workers, teachers, or administrators. Attention given to place of student personnel program in the institution and the administration of that program. 3 cred. Wrenn.

Ed.Psy.251f,w,s. College Student Personnel Work. Weekly seminar discussions of specialized phases of college student personnel and non-educational personnel work. Fall, Student Activities; winter, Personnel Services; spring, Co-ordination with Non-academic Personnel Procedures. 3 cred. per quarter. 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 instruction at the college level; the design of investigations and the critical evaluations of investigations in higher education. Prereq.: 15 cred. in education. 3 cred. P. O. Johnson.

Ed.Psy.281f,w,s. Practice in Personnel Work. Designed to give properly qualified students experience in the use of psychological and related methods in dealing with individuals at college and adult levels. Prereq.: Course 225, or to be taken concurrently, and permission of instructor. 2 to 3 cred. per quarter. Berdie, Edwards, Wrenn, Dugan, Hagenah.

HISTORY AND PHILOSOPHY OF EDUCATION

General Courses

H.Ed.101f. Historical Foundations of Modern Education. Historical analysis and interpretation of the more 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. A historical study of the origin, aims, growth, and existing types of European and American secondary schools. 3 cred. Alexander.

H.Ed.103s. History of Modern Elementary Education. The institutions, theories, and problems of modern elementary education in the light of their history. Emphasis upon the rise of state systems and upon the history of modern educational reform. Not open to students who have had H.Ed. 71. 3 cred. (Not offered in 1948-49.)

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. Cary.

- H.Ed.131w. Comparative Education. This course compares European, Asiatic, and American systems and philosophies of education. Emphasis will be placed on exploring the possibilities of international education. 3 cred. Beck.
- H.Ed.141f. Critical Issues in Contemporary Education. Primarily intended for graduate students who have a meager background in educational philosophy. Designed to introduce the student to the basic subject matter of educational philosophy; centered on problems of teachers and administrators. Not open to those who have completed Course 176. 3 cred. Beck, Cary.
- H.Ed.155s. History of Public Education in the United States. A survey of the development of elementary and secondary schools in the United States with special emphasis on the nineteenth century. 3 cred. Alexander.
- H.Ed.178w. Education and Problems of American Democracy. An exploration of the need and possibilities of building a coherent view concerning the basic meanings of democracy. Particular emphasis will be given to the idea and means of developing a positive democratic discipline both in the school and through community undertakings. 3 cred. Cary.
- H.Ed.180f,w,s. The School and the Social Order. This course considers the cultural and social setting within which schools function today. Such problems as the relation of education and the state, etc. will be weighed. 3 cred. Cary, Beck.
- H.Ed.182s. Comparative Philosophies of Education. A study of issues in educational philosophy. The major works of contemporary educational philosophers will be critically reviewed in an attempt to understand conflicting viewpoints. Prereq.: Course 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 of instructor. Cred. ar. Wesley, Beck, Cary, 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 of instructor. 3 cred. Beck, Cary.

Elementary Education

- H.Ed.103s. History of Modern Elementary Education. See above under General Courses. 3 cred. Alexander. (Not offered in 1948-49.)

Secondary Education

- H.Ed.102w. History of Modern Secondary and Higher Education. See above under General Courses. 3 cred. Alexander.

HOME ECONOMICS EDUCATION

Prerequisites—For a major or a minor in Home Economics Education, adequate preparation in psychology, educational psychology, education, and home economics must be presented. The prerequisites must be satisfactory to the major adviser.

Requirements for advanced degrees—All students who expect to major in home economics education must pass the battery of tests required of education majors before they are accepted as candidates for an advanced degree.

Master's degree—Under Plan A: The general requirements listed on pp. 9-11 of this bulletin must be met except that candidates may be exempted from the foreign language requirement.

A minimum of 18 credits in home economics education and education and 9 credits in the minor is required; the thesis accounts for the remainder of the credits. The candidate must pass a written examination in the major field and an oral examination in both course work and thesis.

Under Plan B: The requirements listed on page 11 of this bulletin must be met. Courses in home economics may be included either with courses in home economics education to meet the requirements in the field of concentration or with those from one or more other areas in the related fields. Students must pass both a written and an oral examination.

Doctor's degree—The requirements listed on pages 13-16 in this bulletin must be met. 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 economic education courses. The student's work will be directed by a major adviser of the graduate faculty in home economics education.

COURSES

- 192f. Evaluation in Home Economics Education. Evaluation as a means of measuring progress toward important goals in personal and family life; review of published tests and other evaluation materials; construction of tests and rating devices and methods used to improve them. Prereq.: Ed.51A or equiv., permission of instructor. 3 cred. Army, Rose.
- 193Aw,s. Home Economics Curriculum (secondary level). A study of the contributions of home economics at elementary and secondary levels; evaluation of curriculum practices and techniques employed in curriculum planning and reconstruction. Prereq.: Course 94 or parallel or permission of instructor. 6 cred., fall; 2 cred., winter, spring. Army, Rose.
- 193Bs. Home Economics Curriculum (college level). The place of home economics in higher education; problems facing home economics in small colleges; curriculum offerings; teaching schedules and load; appropriate reference materials. Prereq.; permission of instructor. 3 cred. McNeal, Army.
- 194Af,w,s. Adult Education Problems. Objectives of adult education; planning an adult program; teaching procedures; discussion of special problems. This course is planned for high school and extension teachers and supervisors of home economics classes. Prereq.: Courses 91, 93 or equiv. 3 cred. Ford.
- 194Bs. Adult Education Problems. Development of unit outlines, illustrative material, and bibliography for use in adult classes. This course is planned for teachers and supervisors of local leader groups or adult classes. Prereq.: Courses 91, 93 or equiv., 194A or permission of instructor. 3 cred. Ford.
- 197f,w,s,‡ Organization and Methods for Related Art Teaching. Organization of a related art course and methods of teaching art as applied to familiar objects and processes. The course is planned on an individual basis. Prereq.: Course 91, H.E. 180 or parallel. 1 to 3 cred. H. Goldstein.
- 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 of instructor. 3 cred. Rose.
- 292s.* Problems in Evaluation. Special emphasis upon individual problems. Prereq.: permission of instructor. 3 cred. Army. (Not offered in 1948-49.)
- 293f,w,s.* Problems in Home Economics Education. Designed to meet the needs of advanced students for independent study. Prereq.: Course 294 recommended, permission of instructor. 1 to 3 cred. per quarter. Army, Rose.
- 294f,w,s.* Research Methods. A study of the methods used in collection, treatment, and interpretation of data in areas of home economics; the writing of a technical report. Prereq.: Course 192, permission of instructor. 3 to 6 cred. Army, Rose.
- 295f,w,s.* Seminar in Home Economics Education. Discussion and reports on problems in the field of home economics education. 1 cred. per quarter. Army, Rose.

‡ A fee of \$1.50 per credit is charged for this course.

INDUSTRIAL EDUCATION

- Ind.100s. Industrial Education. Concepts and techniques of instruction in three phases of industrial teaching—industrial arts, trade and industrial schools and classes, and training-within-industry programs. For graduate students who have not had Course 70. 3 cred. Smith.
- Ind.101s. Tests in Industrial Subjects. Study and application of principles of achievement test construction to shop and drawing subjects; evaluation of results. 3 cred. Micheels.
- Ind.102s. The General Shop (not a shop course). Purpose of the new general shop organization; current practice as to types of shops, equipments, instructional materials and procedures, pupil personnel plans, etc. Prereq.: Course 80 or equiv. 2 cred. Micheels.
- Ind.103w. Instructional Aids. Analysis of various instructional aids; preparation and plans for their use. Prereq.: permission of instructor. 3 cred. Micheels.
- Ind.105w. Administration of Industrial Education. Open to superintendents, principals, and teachers not specializing in the field named; general and vocational phases considered; objectives, programs, and practices; laws, rulings, and standards for aid; significant literature. 3 cred. Smith.
- Ind.107f. Co-ordination. Province and duties of co-ordinators in trade schools, part-time programs, and cosmopolitan high schools offering training opportunities. Informational for school administrators and in the nature of guidance and training for those having interest in this new type of school work. Prereq.: Courses 60, 61, or 105 or permission of instructor. 2 cred. Widdowson.
- Ind.108. Apprenticeship. History and recent development of apprenticeship in the United States: trends, practices, organization, laws, and rulings; state plans for vocational education in their varying relationships to apprenticeship. Prereq.: permission of instructor. 2 cred. Widdowson. (Not offered in 1948-49.)
- Ind.109w. Conference Leading for Industry. Purposes, advantages, limitations, and types of conference method. Characteristics of conference situations and of good leadership. Initial planning, sequential steps, techniques and devices, problems and tensions, summaries. Evaluation of group and individual attainment. Writing of reports. Practice sessions and criticism. Prereq.: permission of instructor. 2 cred. Widdowson.
- Ind.110w. Vocational Guidance. History of the educational and vocational guidance movement; typical public school means and methods; collection and use of occupational information; duties of the counselor; organization and relationships. 3 cred. Smith.
- Ind.115s. Supervision of Industrial Education. Principles of creative supervision applied in industrial teaching; analysis of duties, organization for supervision; functional analysis of modern concepts of industrial education. Prereq.: Courses 60, 61, or 105. 3 cred. Micheels.
- Ind.125s. Philosophy and Practice of Industrial Education. History, objectives, development, and current practices in the field. Three phases considered—industrial arts as general education, school preparation and upgrading for trade pursuits, induction and adjustment of workers by employers. 3 cred. Smith.
- Ind.135w. Industrial Course Construction. Principles and techniques of course construction and unit development; exercises in planning, organizing, and building a course of study. Prereq.: permission of instructor. Not open to those who have had Courses 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.: permission of instructor. 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; 9 cred. required. Smith, Micheels.
- Ind.250f-251f. 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 of instructor. 6 cred. Smith.

NOTE—In addition to the master of arts degree (Plans A and B) in the Graduate School, those with major interest in industrial education may well consider the master of education degree (Plans X and Y) offered by the College of Education. Professor Homer J. Smith, 101 Temporary West Pattee, will be pleased to confer or to correspond regarding the entrance requirements and program patterns for such a degree. A mimeographed explanation is available.

PHYSICAL EDUCATION FOR MEN

- Phys.Ed.101w. Principles of Physical Education. A study of the aims, scope, and biological aspects of physical education with special treatment of its place in education. Prereq.: Course 53-54-55. 3 cred. Osell.
- Phys.Ed.103s. Physical Examination. The responsibility of the physical education instructor in the examination of pupils, assisting the physician, follow-up procedures, and keeping of records. Prereq.: Course 51, Anat. 57, Phys.Hyg. 91, 92. 3 cred. Hauser, Osell.
- Phys.Ed.135s. Tests and Measurements in Physical Education. Critical analysis of existing testing methods in physical education. Study of current tests from both practical and theoretical standpoints. Use of tests in the administration of physical activity programs. Application of the principles of test construction to specific problems in physical education. Prereq.: 10 cred. in physical education courses and Ed.Psy. 60 or equiv. 3 cred. Keller.
- Phys.Ed.233w. Special Administration Problems in Physical Education in Secondary Schools. Staff organization, supervision; current required and adopted physical education programs; interscholastic athletic problems; legal aspects; professional and public relations. Prereq.: Course 63 or equiv. 3 cred. Nordly.
- Phys.Ed.234s. The Secondary School and College Curriculum in Physical Education. Theory and principles of curriculum construction applied to physical education. Evaluation of activities and critical analysis of existing programs. Practical application of principles in the development of physical education curriculum for a specific situation. Prereq.: Courses 63, 101, or equiv. 3 cred. Nordly.
- Phys.Ed.236f. Recent Literature and Research in Physical Education and Recreation. Directed readings and class discussions of recent literature; critical analysis of research in physical education and recreation; current research problems; steps involved in solving selected problems. Prereq.: permission of instructor. 3 cred. Nordly.
- Phys.Ed.238f. Administration of Physical Education in Colleges and Universities. A study of the problems connected with the administration of the facilities and programs in physical education and athletics in institutions of higher education. Prereq.: Courses 63, 233, or equiv. 3 cred. Keller.

- Phys.Ed.241w. The Administration and Supervision of Public Recreation. Basic principles of administration of public recreation programs. Of special interest for all persons dealing in the area of public welfare work and for administrators, leaders, and workers in the field of social group work, physical education, and general education as well as public recreation. Includes organization for recreation, policies and procedures relating to recreation finance, program, facilities, office management, legislation, and public relations. Prereq.: permission of instructor. 3 cred. Fitzgerald.
- Phys.Ed.242s. Community Organization for Recreation. The course is designed to inquire into the 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 of instructor. 3 cred. Fitzgerald.
- Phys.Ed.247f,w,s.* Problems in Health Education, Physical Education, and Recreation. An independent study course in which students conduct research on chosen problems. Individual conferences are arranged with the instructor. Cred. ar. Keller and staff.
- Phys.Ed.250s. The Administration of Health Education, Physical Education, and Recreation. Current problems of school administrators. A course for school principals, superintendents, and others not majoring in physical education. 3 cred. Nordly.
- Phys.Ed.261s. Seminar in Contemporary Problems in Physical Education and Recreation. Presentation of problems by class members; suggestions presented by local and national leaders in the field; assigned readings and discussions; problems selected for individual study. Cred. ar. Keller and staff.

ELECTRICAL ENGINEERING

Professors Henry E. Hartig, Loyst C. Caverley, Elmer W. Johnson, John H. Kuhlmann, William G. Shepherd; Associate Professors Sidney C. Larson, James S. Webb.

Prerequisites—For work in Electrical Communication, Industrial Electronics, or Power Engineering, completion of the corresponding work required for each of these options by the current *Institute of Technology Bulletin* of candidates for the B.E.E. degree.

Master's degree—Work for the Master's degree is offered under Plan A. Plan B will be accepted only on petition to, and favorable action by, the Electrical Engineering Graduate Committee.

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

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.: Courses 15, 16. 3 cred. per quarter. Staff.
111. Electrical Engineering. Alternating current circuits. Prereq.: Courses 15, 16 or equiv. 3 cred. Staff.
- 112.‡ Electrical Engineering Laboratory. Experimental study of alternating current circuits. Prereq.: registration in Course 111. 1 cred. Staff.
- 113-115. Electrical Engineering. Alternating current circuits. Prereq.: Courses 111, 112 for 113; and Courses 113, 114 for 115. 3 cred. per quarter. Staff.
- 114‡-116.‡ Electrical Engineering Laboratory. Experimental study of alternating current circuits and machinery. Prereq.: registration in Course 113-115. 1 cred. per quarter. Staff.

‡ A fee of \$1 per credit is charged for this course.

- 117-119. Engineering Electronics. Fundamental theory of electronic devices. Prereq.: Courses 111, 112 for 117, and Course 117 for 119. 3 cred. per quarter. Staff.
- 118‡-120‡ Electronics Laboratory. Prereq.: registration in Course 117-119. 1 cred. per quarter. Staff.
- 121-123-125. Electrical Engineering. Theory of alternating current machinery. Prereq.: Courses 115, 116, 119. 3 cred. per quarter. Staff.
- 122‡-124‡-126‡ Electrical Engineering Laboratory. Operating characteristics of alternating current machinery. Prereq.: Course 116 and registration in Courses 121-123-125. 2 cred. per quarter. Staff.
- 127‡-128‡-129‡ Transient Electrical Phenomena. Mathematical study of electric circuits during sudden changes of conditions. Classical and operational methods of analysis applied to electric circuits and machines, and use of the oscillograph in the analysis of these problems. Prereq.: registration in Course 121-123-125. 3 cred. per quarter. Staff.
- 131-133-135. Electronic Circuit Design. Study of practical circuits and components for design of industrial electronic applications, amplifiers, oscillators, power rectifiers, etc. Prereq.: Course 161-162-163. 3 cred. per quarter. Larson.
- 132-134-136. Electrical Design. Design of direct current generators and motors, alternating current transformers, generators, and synchronous motors. Prereq.: for 132, registration in Course 121; for 134, registration in Course 123; for 136, registration in Course 125. 3 cred. per quarter. Kuhlmann.
- 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 relay, oil circuit breakers, and lightning arresters to power systems for protection of apparatus and service. Prereq.: registration in Course 121, 123, or 125. 3 cred. per quarter. Staff.
141. Central Stations. Electric power generating stations and distribution systems. Economic considerations. Costs, load curves, plant location, selection of prime movers, station equipment. Prereq.: registration in Course 121. 3 cred. Staff.
142. Electrical Transmission. Considerations involved in the designing and building of transmission lines. Mechanical, electrical, and economic considerations. Lightning protection, underground lines, high-voltage D.C. transmission. Prereq.: registration in Course 123. 3 cred. Staff.
- 157-158-159. Industrial Electronics. Theoretical and laboratory study; applications to X ray, dielectric heating, precipitation, servo-mechanisms, etc. Prereq.: Course 161-162-163. 3 cred. per quarter. Larson.
- 161-162-163.§ Fundamentals of Radio. Fundamental principles of radio communications receivers and transmitters. Theoretical and laboratory studies of amplifiers, detectors, oscillators, for amplitude and frequency modulation transmission and reception. Prereq.: Course 119. 3 cred. per quarter. Staff.
- 164‡-165‡-166‡ Electric Communication. Communication circuits at audio and carrier frequencies. Theoretical and laboratory study of circuits and transmission lines, wave filters, balancing networks, equalizers, repeaters. Prereq.: Course 119. 4 cred. per quarter. Staff.
- 167-168-169.§ Generation and Propagation of Electromagnetic Radiation. Theoretical and laboratory studies of free space and guided transmission of electromagnetic waves; antennas, coaxial lines, wave guides. Vacuum tubes for generation and amplification of micro-waves. Prereq.: Course 161-162. 3 cred. per quarter. Staff.

‡ A fee of \$1 per credit is charged for this course.

§ During the years 1948-1950 Courses 163 and 167 will be given as a combined course carrying 6 credits. 4 recitations and 3 laboratory hours per week.

ADVANCED COURSES IN ELECTRICAL ENGINEERING

- 187-188-189.* Communication Seminar. Study and discussion of current articles on communication or allied topics. Prereq.: permission of instructor. 1 cred. per quarter. Hartig.
- 191-192-193.* Graduate Seminar. Discussions of problems in power circuits and machinery. Prereq.: permission of instructor. 1 cred. per quarter. Caverley.
- 197-198-199. Advanced Electrical Design. A study of the methods and procedures for the design of standard equipment for specific performance characteristics and for the design of special apparatus. Special problems in rotating machinery design including study of harmonics in air gap flux wave and their effect upon performance; study of starting of synchronous motors. Transformers for control and electronic applications including audio-transformers. Prereq.: Course 132-134-136. 3 cred. per quarter. Kuhlmann.
- 201-202-203. Advanced Industrial Electronics. Continuation of Course 157-158-159. 3 cred. per quarter. Staff.
- 211-212-213. Advanced Network Analysis. The study of networks by advanced methods. Particular emphasis is placed on active networks, feedback, stability, and physical realizability, topics in design of impedance functions. Applications of general theorems to design of equalizers, input and output circuits and interstage networks, applications to servo-mechanisms. Prereq.: M.&M. 150, 152-153. 3 cred. per quarter. Hartig. (Alternates with 272-273-274. Not offered in 1949-50.)
- 227-228-229. Stability of A.C. Power Systems. A study of A.C. power systems, including the system design factors which affect the problem of stability. The relation of both steady state and transient conditions to stable operation of power distribution systems. Prereq.: Course 138-139-140. 3 cred per quarter. Caverley.
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.: Course 121-123-125. 2 or 3 cred. per quarter. Caverley.
- 255-256-257. Analysis of A.C. Power-Systems Circuits. Application of specialized network theorems and equivalent circuits to the study of A.C. generators, motors, transformers, and transmission lines. The study of the behavior of A.C. equipment under unbalanced conditions by the use of symmetrical components. Transients in machines and associated circuits analyzed by the application of the Heaviside operational calculus and the Laplace transform. Prereq.: Course 138-139-140. 3 cred. per quarter. Caverley.
- 261-263-265. Advanced Communication. Applications of basic electromagnetic theory to problems in electrical engineering. Studies of antennas, free space transmission including refraction and diffraction phenomena, wave guides, and circuits. Static electric and magnetic fields with applications to the motions of charged particles. Interaction of electromagnetic fields with electron streams. Prereq.: Phys. 101-103-105 or equiv. 3 cred. per quarter. Shepherd.
- 262-264-266.* Communications Seminar. Study and discussion of current literature. Prereq.: permission of instructor. 1 cred. per quarter. Shepherd.
- 267-268-269. Theory of Communication. Theory of communication with special reference to 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 of instructor. 3 cred. per quarter. Ar. (Offered whenever demand warrants.)

- 272-273-274. Electromechanical Vibrating Systems and Engineering Acoustics. Theoretical discussion of the production of sound by electrically driven vibrating systems, sound transmission, reflection, absorption. Laboratory study of vibrating systems, pipes, horns, absorbing materials, sound pressure, articulation, reverberation, resonance, sound filters. Prereq.: M.&M. 151; grad. by permission. 3 cred. per quarter. Hartig. (Alternates with 211-212-213. Not offered in 1948-49.)
- 275-276-277. Advanced Electrical Design. Special problems. Prereq.: Course 132-134-136. 3 cred. per quarter. Kuhlmann.
- 287-288-289. Advanced Vacuum Tube Analysis. Theoretical and laboratory investigations of vacuum tubes used for communication purposes with particular 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 of instructor. 3 cred. per quarter. Shepherd. (Alternates with 261-263-265. Not offered in 1948-49.)
- 291-292-293.* Electronics Seminar. Study and discussion of current literature. Prereq.: permission of instructor. 1 cred. per quarter. Larson.

ENGLISH

Professors Samuel H. Monk, Huntington Brown, James T. Hillhouse, Theodore Hornberger, Tremaine McDowell, Henry Nash Smith, Robert P. Warren; Associate Professors Eric R. Bentley, William P. Dunn, Elizabeth Jackson; Assistant Professors Harold B. Allen, Elizabeth Atkins, Saul Bellow, Bernard R. Bowron, Frank Buckley, John W. Clark, David V. Erdman, Lewis B. Hessler, Franz J. Montgomery, Robert E. Moore, William V. O'Connor, Anna H. Phelan, Mary C. Turpie, Leonard H. Unger.

NOTE—Students interested in major work in American Studies will find a description of this work on pages 17-18.

Before the acceptance of his subject for a thesis, a candidate for the degree of M.A. or Ph.D. must have given evidence to the department that he speaks and writes English with propriety.

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 27 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 graduate courses, students should consult with the director of graduate work for the department, Mr. Brown.

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

REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS

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 subjects listed 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.

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 no lack of opportunity for the display of scholarship and critical judgment.

Under Plan B, nine credits must be in a seminar (all courses numbered above 200). With the permission of the director of graduate work, courses numbered above 100 in which research papers are required may be substituted for a seminar.

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

Linguistics and Comparative Philology, including 100 (Old English), 102 (Old English Poetry), 103 (Beowulf), 171-172-173 (The Rise and Development of Standard English), 174 (American English), and certain related courses.

Comparative Literature, including Italian 159-160 (Dante in English), English 152 (Medieval and Early Elizabethan Drama), 147-148-149 (The Literature of England in the Middle Ages Exclusive of Chaucer), 234-235-236 (Medieval Seminar), and similar courses in English and foreign language departments.

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

1. The field of English is divided for convenience into seven parts: the English language or Old English language and literature, Middle English literature, Renaissance, seventeenth century, eighteenth century, nineteenth and twentieth centuries, American literature. Of these the candidate shall, in consultation with his adviser, elect five, exclusive of his special field (see below), in which to present himself at his preliminary examination, and his choice shall be noted on his three-year program at the time this is filed (see page 13). The preliminary examination will be devoted to the five divisions of the field designated by the candidate, and to the minor subject (see page 14).

2. The part of the field within which the subject of the candidate's dissertation falls, or to which it is most closely related, shall be designated as his special field, and his knowledge of this shall be thoroughly tested at the final examination.

3. The candidate must have completed, before the preliminary examination, advanced courses of at least one quarter each in Chaucer and Shakespeare, English 100, and either English 102 and 103 (Old English Poetry and Prose, and Beowulf) or English 171-172-173 (The Rise and Development of Standard English).

4. The candidate is required to have a reading knowledge of two of the following foreign languages: French, German, Latin, Greek. A good reading knowledge of Latin is in all cases desirable, and in some cases may be indicated by the candidate's adviser as indispensable.

5. Candidates who have not already taken the comprehensive written examination given to M.A. candidates must take it, not later than their third quarter of residence. This requirement will be waived if the candidate's record contains satisfactory evidence of attainments equivalent to those it is designed to test.

COURSES

100f. Old English (Anglo-Saxon). An introduction to the sounds and grammar, with some prose reading. The relation to modern English is stressed. Prereq.: 6 cred. in English literature above Course A-B-C. 4 cred. Clark.

102w. Old English Prose and Verse. Introduction to Old English versification, and critical reading of poems. Prereq.: Course 100. 3 cred. Clark.

- 103s. Beowulf. An introduction to the Old English poem, with reading of considerable portions of the text. Prereq.: Course 100. 3 cred. Clark.
- 109w-110s. The Romantic Poets of the Nineteenth Century. From Wordsworth to Keats. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. per quarter. Erdman.
- 113s. American Short Story. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. McDowell.
114. The Midwest in Literature. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. (Not offered in 1948-49.)
- 115-116. The Development of English Prose Style. 115. Definition of six broad types of prose style on historical principles; sketch of the history of English prose styles from the earliest times to 1700. 116. Studies in the styles of selected writers since 1700. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. per quarter. (Not offered in 1948-49.)
117. American Essay. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. (Not offered in 1948-49.)
- 118w-119s. Nineteenth-Century Prose. 118w. The literature of social criticism—Carlyle, Ruskin, Arnold, and others. 119s. Literature concerned largely with science and religion—Newman, Huxley, Spencer, Butler, and others. Prereq.: 6 cred. above Course 50 or permission of instructor. 3 cred. per quarter. Erdman.
- 120f-121w. The Interpretation of Poetry. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. per quarter. Warren.
- 123f-124w. The Technique of the Novel. Special studies in novels of the late nineteenth and twentieth centuries, with particular regard to structure. Prereq.: 6 cred. in English literature above Course A-B-C, permission of instructor. 3 cred. per quarter. Warren.
- 126f-127w. Drama, 1660-1880. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. per quarter. Hillhouse.
- 129s. Modern Drama, 1880 to the Present. A survey of the chief dramatists, English, American, and Continental, from the time of Ibsen. Prereq.: Course 55-56 or 126-127. 3 cred. Hillhouse.
- 130w-131s. English Poetry, 1832-1914. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. per quarter. Erdman.
133. Ballads. A study of a large number of traditional ballads, English and foreign, and of ballad style and origins. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. (Not offered in 1948-49.)
- 134f. The Origins of American Naturalism. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. Bowron.
135. Spenser. Selections from the minor poems; *The Faerie Queene*; attention to classical and foreign influence on Spenser and his influence on later English poets. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. (Not offered in 1948-49.)
- 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.: Course 55-56. 3 cred. Brown.
- 137f-138w-139s. The Nineteenth Century in English Literature. Prose and poetry, but mostly prose, and read chiefly as illustrating the history of ideas. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. per quarter. (Not offered in 1948-49.)
- 140w. Advanced Chaucer. The more important poems apart from the *Canterbury Tales*. The treatment will be primarily literary and historical, linguistic proficiency being presumed. Prereq.: Course 75. 4 cred. Clark.

- 143f-144w-145s. American Folklore (The same as History 143-144-145). 3 cred. per quarter. Jordan.
- 147f-148w-149s. The Literature of England in the Middle Ages Exclusive of Chaucer. Reading includes Anglo-French and Latin documents in translation. Special attention to the period from the Norman Conquest to 1500. Prereq.: Course 75. 3 cred. per quarter. (Not offered in 1948-49.)
- 151s. Recent Poetry. Poetry in England and America since the death of Queen Victoria. The main tradition and tendencies now prevailing. Prereq.: 6 cred. in English literature above Course A-B-C. 4 cred. Jackson.
- 152f. Medieval and Early Elizabethan Drama. Selected mystery and morality plays and farces; *Ralph Roister Doister*, *Gammer Gurtons Neddle*; Kyd, Marlowe, Lyly, Greene, Peele. Prereq.: Course 55-56. 3 cred. (Not offered in 1948-49.)
- 154w-155s. § The American Novel. The history of the American novel from the beginning to the present. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. per quarter. Bowron.
- 156s. The American Drama. Survey of American drama in the eighteenth and nineteenth centuries. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. Hornberger.
- 157f-158w. § Elizabethan Non-Dramatic Literature. 157f. Tudor prose: "courtesy-books," voyages, criticism, fiction, history, tracts, and essays. 158w. Tudor lyric and narrative poetry. Prereq.: 6 cred. above Course 50, including 55-56 or 152 or 170. 3 cred. per quarter. Brown.
- 159f-160w. § Colonial Literature in America. Covers the period from 1608 to 1783. Prereq.: Course 73-74 or permission of instructor. 3 cred. per quarter. Hornberger.
161. Scientific Thought in American Literature. A study of the influence of science on the thought and writing of major American authors, including Franklin, Jefferson, Cooper, Poe, Emerson, Whitman, Holmes, Henry Adams, and Dreiser. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. (Not offered in 1948-49.)
- 163f-164w. Restoration Drama. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. per quarter. (Not offered in 1948-49.)
- 165f,w. Introduction to Modern English. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. Allen.
- 166s. Historical Backgrounds of Modern English. A study of those distinctive aspects of the sounds of Early Modern, Middle, and Old English which are significant for the language of the present day. Prereq.: Course 165. 3 cred. Allen.
- 167f-168w. English Literary Criticism. A historical sketch, with special attention to Sir Philip Sidney, Dryden, Dr. Johnson, Coleridge, Arnold, T. S. Eliot. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. per quarter. O'Connor.
- 169s. Browning and Tennyson. Most of the time will be spent on Browning. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. Ar.
- 170f. Shakespeare's Later Contemporaries. Selected plays of Chapman, Jonson, Dekker, Marston, Webster, Heywood, Beaumont and Fletcher, Middleton, Ford, and Shirley. Prereq.: Course 55-56. 3 cred. Brown.
- 171f-172w-173s. The Rise and Development of Standard English. An inductive study of English historical phonology, morphology, and syntax, with some attention to the lexicon and to the history of attitudes toward usage. Prereq.: Course 100. 3 cred. per quarter. Allen.
- 174s. American English. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. Allen.

§ Students may enter either quarter.

- 175f-176w. § The History of English Verse. Origin and development of standard forms—ballad stanza, heroic couplet, blank verse, sonnet, etc. Discussion of metrical technique. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. per quarter. Jackson.
- 179-180. Social and Intellectual Backgrounds of American Literature. Prereq.: 6 cred. of American history, philosophy, political science, or literature. 3 cred. per quarter. (Not offered in 1948-49.)
- 181s. Recent Trends in Literary Criticism. Criticism and scholarship; criticism and esthetics; science and literature; imagination and myth; tradition and regionalism; isolation of the artist; debt to the metaphysicals, symbolists, and earlier American writers; political emphasis; experiments with language and form; re-examination of major critical terms; etc. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. O'Connor.
- 182s. 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. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. H. N. Smith.
- 183f. The Poetry of T. S. Eliot. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. Unger.
- 184f-185w-186s. The Interpretation of the Drama. Critical analysis of plays: modern, renaissance, and ancient. (The same as Speech 184-185-186.) Prereq.: 6 cred. above Course A-B-C; 55-56 recommended. 3 cred. per quarter. Reisman.
- 187f-188w-189s. § Eighteenth-Century Literature. Survey of English literature from 1700 to 1790. Parallel readings and critical essays. Graduate students will submit a term paper each quarter. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. per quarter. Monk.
- 191f. Imagery and Symbolism in English and American Literature. Prereq.: 6 cred. in English literature above A-B-C. 3 cred. Atkins.
194. Dr. Johnson and His Circle. Particular attention to Boswell and to Johnson's influence on his contemporaries. Prereq.: 6 cred. above Course A-B-C. 3 cred. (Not offered in 1948-49.)
- 197f-198w-199s. Seventeenth-Century Literature. 197f-198w. A survey of the prose of the century down to 1660, with some consideration of the metaphysical and cavalier poets, Monk. 199s. Dryden and his contemporaries, Moore. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. per quarter.
- 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 sakes than for the light they shed upon him. 3 cred. per quarter. (Not offered in 1948-49.)
- 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 quarter. (Not offered in 1948-49.)
- 231f-232w-233s. Shakespeare's Tragic and Comic Art. 3 cred. per quarter. Brown. (Not offered in 1948-49.)
- 234f-235w-236s. Medieval Seminar. A literary and linguistic study of selected Middle English texts. 3 cred. per quarter. (Not offered in 1948-49.)
- 237f-238w-239s. Chaucer. A study of some of the important problems in the Chaucer canon and in the works of Chaucer. 3 cred. per quarter. (Not offered in 1948-49.)
- 240f-241w-242s. The Canterbury Tales. 3 cred. per quarter. (Not offered in 1948-49.)

§ Students may enter either quarter.

- 243f-244w-245s. Non-Dramatic Literature of the Sixteenth Century. The Renaissance in England; prose and poetry, with special attention to Spenser and his contemporaries. 3 cred. per quarter. Brown. (Not offered in 1948-49.)
- 253f-254w-255s. American Romanticism I: New England. 3 cred. per quarter. (Not offered in 1948-49.)
- 256f-257w-258s. Spenser and Milton. Prereq.: 3 cred. above Course 50 in medieval or Elizabethan literature and 3 cred., 1600-1660. 3 cred. per quarter. Brown.
- 259f-260w-261s. The Romantic Period of the English Novel. The Gothic romances and the Revolutionary novel, the realistic novel of national manners, and Jane Austen, Sir Walter Scott and the more important later romancers. 3 cred. per quarter. Hillhouse. (Not offered in 1948-49.)
- 262f-263w-264s. Nineteenth-Century Novel. The chief novelists of the period, Dickens, Thackeray, and George Eliot as well as several of the minor novelists. Emphasis on social theories in the novels and reflection of the life of the times. 3 cred. per quarter. Hillhouse.
- 265f-266w-267s. American Romanticism II: Poe, Whitman, and Melville. 3 cred. per quarter. 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. Research topics and bibliographical problems will be assigned. Some familiarity with the period and a reading knowledge of French are desirable. 3 cred. per quarter. Monk.
- 277f-278w-279s. American Realism. Prereq.: permission of instructor. 3 cred. per quarter. 277f, H. N. Smith; 278w, 279s, Hornberger.
- 281f-282w-283s. The Nineteenth Century. 3 cred. per quarter. (Not offered in 1948-49.)

COMPOSITION

- 101f-102w-103s. Seminar in Writing. 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. Students who wish to write poetry should consult Mr. Unger. Credits may be counted toward the distribution requirement under Plan B for the M.A. or as the minor under Plan A. Prereq.: permission of instructor. 3 cred. per quarter. Sec. 1, Phelan; Sec. 2, Unger.
- 104s. The Writing of Poetry. Prereq.: English 120-121 or 6 cred. above Course 50 in Composition, permission of instructor. 3 cred. (Not offered in 1948-49.)
- 200f-201w. Graduate Seminar in Writing. Credits may be counted toward the distribution requirement under Plan B for the M.A. or toward the minor under Plan A. Prereq.: permission of instructor. 3 cred. per quarter. Warren.

ENTOMOLOGY AND ECONOMIC ZOOLOGY

Professors Clarence E. Mickel, Alexander A. Granovsky, Alexander C. Hodson; Associate Professors Mykola H. Haydak, William H. Marshall, A. Glenn Richards, Lloyd L. Smith, Jr.; Assistant Professors Torfine L. Aamodt, Albert L. Burroughs, Laurence K. Cutkomp.

Prerequisites—27 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 requirements—Candidates for the Master's degree must have a reading knowledge of German or French. In special cases, where other languages are needed for the development of the thesis, Russian, Italian, or the Scandinavian languages may be substituted by petition.

Of candidates for the Ph.D. degree, a reading knowledge of two foreign languages, usually German and French, is required. Substitutions may be made for one of these in accordance with the statement in the preceding paragraph.

Master's degree—Work for the Master's degree is offered in general under Plan A. In exceptional cases Plan B may be followed by petition approved by a special committee composed of 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, Seminar, is required of all majors throughout the period of resident studies.

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

Doctor's degree—It is recommended that those who wish to become candidates for the Ph.D. degree should first obtain the Master's degree under Plan A.

Course 200, Seminar, 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 will be required for deposit in the divisional library.

COURSES

- 114s.‡ Apiculture. Problems of bee management, disease control, wintering, bee breeding, processing and marketing bee products. Lect., lab., and field practice. Prereq.: 9 cred. in entomology. 3 cred. Haydak.
- 117f.‡ Animal Ecology. General ecology stressing ecological principles and land communities. Prereq.: 15 cred. in zoology or entomology. 3 cred. Eddy, Hodson.
- 118w.‡ Animal Ecology. Experimental approach to the study of environmental factors affecting animal populations. Prereq.: 15 cred. in zoology or entomology. 3 cred. Hodson.
- 119s.‡ Animal Ecology. A study of the conditions for life in the water and distribution of aquatic animals. Prereq.: 15 cred. in zoology or entomology. 3 cred. Eddy.
- 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.: Courses 117, 118. 3 cred. Hodson.
- 121f.‡ Ichthyology. A study of the taxonomy and habits of North American fishes with special reference to those of upper Mississippi drainage. Lect. and lab. Prereq.: 15 cred. in zoology. 3 cred. Eddy.
- 125f‡-126w‡-127s.*‡ Advanced General Entomology. Morphology, biology, and classification of insects. Lect. and lab. Frequent field trips in 127s. Prereq.: Course 52 or equiv. or permission of instructor. 3 cred. per quarter. Mickel.
- 128f‡‡-129w.‡‡ Insect Physiology. General and comparative physiology of insects, a survey of the organ systems and their functioning in various insects. Special emphasis is placed on research methods and evaluation of data. Lect., lab., and reading. Prereq.: 15 cred. in zoology or entomology and permission of instructor. Zool. 50 or equiv. recommended. 4 cred. per quarter. Richards.
- 140s.‡‡ Histology and Embryology of Insects. Primarily histology and histochemistry, but with a brief resumé of the special features of insect embryology. Prereq.: Course 125-126-127, or equiv. 4 cred. (Given in alternate years. Not given in 1948-49.) Richards.

‡ A fee of \$1.50 per quarter is charged for this course.

‡‡ A fee of \$5 per quarter is charged for this course.

- 141f‡-142w.‡ Insects in Relation to Plant Diseases. A study of the principal insect vectors and their habits; types of insect injuries affecting the health of plants; modes of insect transmission and dissemination of plant diseases; the methods of rearing and handling the carriers. Of interest to students in entomology, plant pathology, horticulture, forestry, and agronomy. Prereq.: 8 cred. in entomology or plant pathology. 3 cred. per quarter. J. J. Christensen, Granovsky.
- 144f.‡ Medical Entomology. A study of the principal arthropods noxious to man and animals. Special emphasis is placed on those arthropods that serve as pathogenic organisms of man and animals. Lect. and lab. Prereq.: Zool. 52 or equiv. or permission of instructor. 3 cred. Burroughs.
- 145w.‡ Parasitic Protozoa. The structure, life histories, and economic relations of protozoal parasites of man and animals. Lect., lab. diagnosis. Prereq.: 15 cred. in zoology. 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 zoology. 3 cred. Wallace.
- 150s.‡ Introduction to Aphidology. The biology and taxonomy of the Aphididae. Prereq.: Course 52 or equiv. or permission of instructor. 3 cred. Granovsky.
- 162su. Ecology of Terrestrial Vertebrates. Detailed studies of the ecological relationship of northern Minnesota terrestrial vertebrates. Prereq.: Course 68 or Zool. 57-58, Course 63 or equiv., Bot. 20. 4 cred. Marshall.
- 164f‡-165w‡-166s.‡ Wildlife Management. Detailed study of the 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., and field work. Prereq.: Courses 63, 64, Zool. 57-58, Bot. 50, Pl.Path. 53. 3 cred. per quarter. 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.: Course 64. 3 cred. Marshall.
- 168f‡‡-169w.‡‡ Fishery Biology and Management. Methods and theory of fishery biology; age and rate of growth, condition factor, populations, mortality and harvest, indices of productivity, lake and stream survey methods and planning, lake and stream improvement, natural and artificial propagation, lake and stream improvement, fish pond management. Lect. and lab. Prereq.: Course 64, Zool. 53, 117, 118, 119, 121, Bot. 176 or equiv., Agr.Econ. 90 or equiv., or permission of instructor. 3 cred. per quarter. Smith.
- 170s.‡ Fisheries Resources. Fisheries resources of the United States: fisheries products; methods and description of commercial fisheries; state, federal, and international administration of fisheries; significant laws and current legislation controlling United States fisheries. Organization of fishery programs. Prereq.: Courses 168, 169 or permission of instructor. 3 cred. Smith.
- 175f.‡ Principles of Economic Entomology. Methods and principles of insect control. Lect. and demonstration labs. Prereq.: 15 cred. in entomology including Course 5 or equiv., or permission of instructor. 4 cred. Cutkomp.
- 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 Course 5 or equiv., or permission of instructor. 3 cred. Aamodt.

‡ A fee of \$1.50 per quarter is charged for this course.

‡‡ A fee of \$5 per quarter is charged for this course.

- 177s.‡‡ Insecticides and Their Action. Chemistry, physiological action, toxicology, and laboratory testing of insecticides. Lect. and lab. Prereq.: 15 cred. in entomology including Course 5 or equiv., or permission of instructor; inorganic and organic chemistry. 5 cred. (Given only in alternate years.) Cutkomp.
- 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 quarter. Mickel, systematic entomology; Granovsky, insect transmission of plant diseases, soil insects; Hodson, insect ecology, forest entomology; Richards, insect physiology, insect histology; Marshall, wildlife management; Smith, fishery biology; Haydak, apiculture; Burroughs, medical entomology; Cutkomp, insecticides.
- 200f,w. Seminar. Assigned topics dealing with some special fields of work of the division. 1 cred. per quarter. Mickel and staff members.
- 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. Burroughs.
- 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 38.

FORESTRY

Professors Frank H. Kaufert, John H. Allison, Thorwald Schantz-Hansen; Associate Professors Randolph M. Brown, Henry L. Hansen, Ralph Hossfeld, Louis W. Rees; Instructor Donald P. Duncan.

Prerequisites—For graduate work in forestry, students normally are expected to have had the equivalent of an undergraduate course in forestry. 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—Exemption from the language requirement for the Master's degree may be made by petition in individual cases of students majoring in fields in which a reading knowledge of a foreign language is not considered essential.

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

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

[**Master of forestry degree**—Work for this professional degree is done under the jurisdiction of this division. Students registering for this curriculum do so through the College of Agriculture, Forestry, and Home Economics and not through the Graduate School.]

‡ A fee of \$1.50 per quarter is charged for this course.

‡‡ A fee of \$5 per quarter is charged for this course.

COURSES

- 101w. Advanced Dendrology. A continuation of Course 3-4 with special studies in classification and distribution of some important timber species of the world. Prereq.: Course 3-4. 3 cred. Rees.
- 111f,w,s-112w,s. Advanced Forest Mensuration. Continuation of Course 9 with special emphasis on statistical methods in forest mensuration. Prereq.: Course 9 or permission of instructor. 3 cred. per quarter. Brown.
- 113w. Wood Pulp and Paper. A detailed study of production of wood pulp and paper products. Lect., reading, reports. Prereq.: Course 53-54, 8 cred. in inorganic chemistry, 10 cred. in organic chemistry. 3 cred. Hossfeld.
- 114f. Mechanical and Physical Properties of Wood. Derivation and application of the formulas used in determining stresses in wood. Lect., reading, and class problems. Prereq.: Course 53-54, Math. 7. 3 cred. Rees.
- 115w-116s. Mechanical and Physical Properties of Wood. Laboratory methods in timber testing. Use of timber connectors in wood construction. Physical and mechanical properties of plywood and various fiber-boards. Principles of fabrication of furniture and other glued wood construction. Lab., reading, and reports. Prereq.: Course 114. 3 cred. per quarter. Rees.
- 119s. Advanced Wood Structure. The microtechnique of woody tissues and study of tropical woods. Lect., reading, and lab. work. Prereq.: Course 53-54. 4 cred. Rees.
- 120s. Estimating. A general course in building cost estimating. 3 cred. Ar.
- 121f. Wood Finishing. Painting and natural finishing of wood including chemical and physical principles involved in the formulation and application of finishes, preparation of surfaces, etc. Prereq.: organic chemistry. 3 cred. Hossfeld.
- 125s. Wood Preservation. Lectures and collateral reading of the history, development, and methods of wood preservation. Different systems now in use and preservatives used. Prereq.: Course 53-54. 3 cred. Kaufert.
- 126f. Silvics. The fundamentals forming the basis of silviculture with special attention to the silvics of the important tree species. Discussion, readings, and required papers. 3 cred. Hansen.
- 127f. Silviculture. A study of the general principles underlying the art of silviculture, and a brief study of the European methods as applied to American conditions. Prereq.: Course 126. 3 cred. Hansen.
- 128s. Introduction to Silviculture. Lectures and field trips designed to introduce the student to all the silvicultural considerations involved in the management of timber stands. Includes examination of all plots established at earlier dates. 3 cred. Ar.
- 129s. Silviculture Laboratory. Cone collection, seed extraction, nursery practices, planting, timber marking, timber stand improvement. 3 cred. Ar.
- 130f. Forest Valuation. The business of forest management. A study of the different factors entering into the valuation of forest property. 5 cred. Allison.
- 131w. Forest Policy. Policy of the United States and the states toward the utilization of the public forest resources. Policy of other owners toward forest resources controlled by them. Administration of the national and state forests. 3 cred. Allison.
- 132s. Introduction to Forest Management. Basic economic and technical principles involved in the management of forest lands for the continuous production of timber crops. Given at the Cloquet Experimental Forest. 3 cred. Allison.
- 133s. Forest Management Laboratory. Includes instruction and training in type mapping, timber cruising, growth studies, and the preparation of a complete management plan for a portion of the Cloquet Experimental Forest. Given at the Cloquet Experimental Forest. 3 cred. Allison.

- 136f. Forest Economics. The place of the forest in the productive utilization of land; past and present markets and source of supply of timber and timber products, particularly with reference to the present situation in North America. Prereq.: Agr. Econ. 2. 3 cred. Allison.
- 137w. Seeding and Planting. Principles of seeding and planting and the nursery practices used in the different forest regions of the United States. 3 cred. Hansen.
- 140w. Forest Management. Forest organization and methods of regulating and allotting the cut from a forest under management. Lect. and reports. Prereq.: Courses 128, 132. 5 cred. Allison.
- 141w. Principles of Silvics. Principles underlying the silvical characteristics of trees and the reactions of trees to their environments. Prereq.: Courses 126, 127. 3 cred. Hansen.
- 142s. Wood Chemistry. Wood composition, the constitution of wood components, the reactions of wood components and derivatives, and the analysis and chemical technology of wood and wood products. Prereq.: Course 54, 8 cred. in organic chemistry. 3 cred. Hossfeld.
- 143w. Forest Recreation. The recreational use of the forest from an economic, sociological, and technical point of view. Administrative and technical problems arising from recreational use. 3 cred. Ar.
- 144s. Forage and Browse Plants. The important forage and browse plants of the United States; their identification, nutritive value, palatability, growth habits, and distribution. Includes a general study of forage types, classes of forage, carrying capacities, and methods of ecological investigation. Prereq.: Bot. 113, Pl.Path. 4. 3 cred. Ar.
- 151s. Logging. The principles and general methods of logging in the different forest regions of the United States, and the modifications required by forest management. 3 cred. Ar.
- 152s. Wood Seasoning. Theory and practice of air seasoning and kiln drying of wood. Prereq.: Course 53-54. 3 cred. Rees.
- 155f. Forest Protection. The protection of forests from fire. The causes of forest fires and their elimination, climate and fires, fire fighting and fire legislation. 3 cred. Ar.
- 180s. Aerial Photography in Forest Management. Aerial photographic interpretation and application in forest survey, timber cruising, and in the preparation of management plans. 1 cred. Ar.
- 200f-201w-202s. Research Problems in the Science and Practice of Silviculture. Cred. ar. Hansen.
- 203f-204w. Research Problems in Forest Management and Forest Management Plans. Cred. ar. Allison.
- 205f-206w. Research Problems in Forest Economics. Cred. ar. Allison.
- 207f-208w-209s. Research Problems in Wood Technology. Cred. ar. Kaufert, Hossfeld, Rees.
- 213f-214w-215s. Special Problems in Forest Utilization. Cred. ar. Kaufert, Hossfeld, Rees.
- 218f-219w. Research Problems in Forest Mensuration. Cred. ar. Brown.
- 223f-224w-225s. Literature Seminar. Assigned topics with special reference to current forestry problems. Critical and historical review of current forestry literature. 1 cred. per quarter. Schmitz, Kaufert.

GENERAL STUDIES COURSES CARRYING GRADUATE CREDIT

- Hum.132w-133s. Humanities Proseminar. Topic for course: The Place of the Humanities in an Age of Science. (Formerly Humanities 97-98-99.) 2 cred. per quarter. Castell.
- Nat.Sci.171f-172w-173s. The Development of the Sciences. Prereq.: 1 year of biological and of physical science or permission of instructor. 3 cred. per quarter. Graubard.

GEOGRAPHY

Professor Jan O. M. Broek; Associate Professor John C. Weaver.

Prerequisites—For major work, Courses 11, 41, and 5 additional credits in geography, Economics 6-7, and Geology 1 or 8. For minor work, 10 credits in the department.

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

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

COURSES

101s.* Geography of Europe. A study of the various European countries and their economic development. Prereq.: Course 11 or permission of instructor. 3 cred. Broek.

102w.* Trade Routes and Trade Centers. A study of the major land and ocean routes, ports, and interior trade centers, and the nature and significance of the traffic. Prereq.: Course 41. 3 cred. Weaver.

103w.* Geography of Africa. A study of the geographic regions and economic activities of the continent of Africa. Prereq.: Course 11 or permission of instructor. 3 cred. Ar.

104s.* Geography of Australasia. A consideration of the physical environment and economic activities of Australasia. Prereq.: Course 11 or permission of instructor. 2 cred. Weaver.

110f.* Geography of South America. A study of the major geographic regions of South America, with emphasis upon the economic activities and their geographic basis. Prereq.: Course 11 or permission of instructor. 3 cred. Ar.

120s.* Geography of Asia. Areal differentiation in the major geographic regions of Asia. Special consideration of China, Japan, and India. Prereq.: Course 11 or permission of instructor. 3 cred. Davis.

125s.* Geography of the Polar Regions. Prereq.: Course 11 or permission of instructor. 3 cred. Weaver.

133w. Climatology. A study of climates and their distribution. Prereq.: Course 11 or permission of instructor. 3 cred. Brown.

251f-252w-253s. Seminar in Geography. A survey of current literature, with reports and discussion on assigned topics. Prereq.: 18 cred. in geography or permission of instructor. Cred. ar. Broek and staff.

301f,w,s. Research Problems in Geography. Cred. ar. Broek and staff.

GEOLOGY AND MINERALOGY

Professors George A. Thiel, John W. Gruner, George M. Schwartz; Associate Professor Samuel S. Goldich; Assistant 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; Mineralogy 23-24; general chemistry, such as Inorg.Chem. 6-7, or 9-10, or equivalent and Inorg.Chem. 11 or 12. In addition, elementary physics, such as Phys. 7-8-9 or equivalent, is required for those specializing in mineralogy, petrography, and economic geology; and for those specializing in paleontology or stratigraphy, elementary zoology, such as Zool. 1-2-3 or its equivalent, is required. Students who have not had the necessary undergraduate prerequisites may take them without credit along with other work for which they are prepared.

Major and minor—A student selecting some branch of geology as a major will not be allowed to select general geology as a minor. It is always preferable that the minor be taken outside of the major department.

Language requirement—Exemptions from the language requirement for the Master's degree may be made in individual cases by petition. Students who are deficient in modern languages are advised to take a language along with their graduate work.

Master's degree—Work for the Master's degree is offered under both Plan A and Plan B. A field course or field experience is required.

Doctor's degree—Whatever field of special interest is pursued, it is expected that the student registering for the doctorate in this department will take some courses in each of the major divisions of geology. Those conducting the preliminary examination will assume that this has been done. Some field experience is required.

COURSES

- 100su.*‡ Field Work in Northern Minnesota—July 15 to 30, approximately. Students interested in this trip should consult the department. Prereq.: Course 105. 3 cred. Gruner, Thiel.
- 101f.* Sedimentation. The origin of sedimentary rocks and their primary structures; interpretation of sediments in relation to paleogeography. Lect. and assigned readings. Prereq.: Course 24. 3 cred. per quarter. Thiel.
- 102w. Methods of Study of Sediments. Techniques used in the study of sediments and sedimentary rocks. Textural and mineralogical analyses of clastic and non-clastic materials. Prereq.: Course 106. 3 cred. Thiel.
- 103w-104s. Micropaleontology. The study and classification of Foraminifera, ostracoda, and other small fossils and their use for purposes of correlation. Prereq.: Courses 105, 107. 3 cred. of lab. work per quarter. Swain.
- 105s. Rock Study. The occurrence and genesis of rocks; their mineral and chemical composition and classification; their structure, texture, and alteration. Prereq.: Course 24. 2 cred. Goldich.
- 106f. Petrography. The identification and study of minerals and rocks by optical methods; the microscopic study of igneous, sedimentary, and metamorphic rocks. Prereq.: Course 105. 2 cred. Goldich.
- 107f. Invertebrate Paleontology. Morphology and classification of some important invertebrate genera. Prereq.: Courses 2, 24. 3 cred. Bell.
- 108w-109s. Stratigraphic Paleontology. Study of representative invertebrate faunas, together with their stratigraphic and geographic distribution. Prereq.: Course 107. 3 cred. per quarter. Bell.
- 110f-111w. Economic Geology. The nature, genesis, and distribution of mineral deposits; relation of mineral deposits to structure and their surficial alteration. Prereq.: Course 105. 3 cred. per quarter. Schwartz.
- 112s. Geology of Petroleum. The nature, origin, and distribution of petroleum and the geology of the various oil fields of the world. Prereq.: Courses 125, 152. 3 cred. Swain.
- 114s. Geology of Minnesota and Adjoining Areas. The stratigraphy, structure, and lithology of the rocks and their associated mineral resources. Prereq.: Course 105. 3 cred. Thiel.
- 118f.* Principles of Geomorphology. Origin and evolution of constructional and destructional land features produced by current geological processes such as weathering, mass movements, wind, running water, waves and currents, vulcanism, and diastrophism. Prereq.: Course 2. 3 cred. Wright.

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

- 119w.* Geomorphology of the United States. Regional study by physiographic units emphasizing surface features and tracing the influence of process, structure, and geological history. Discussion of the characteristic forms and principal problems in each area. Prereq.: Courses 2, 4. 3 cred. Wright.
- 120s. Glacial Geology. Origin of glaciers, existing glaciers, glacial mechanics, topical treatment of erosional and deposition products of continental and mountain glaciations, chronology of the Pleistocene, ancient glaciations. Prereq.: Course 2. 3 cred. Wright.
- 121f. Crystallography. The symmetry relations in the thirty-two crystal classes. Crystal drawings and measurements. Projections and mathematical calculations. Prereq.: Math. 7, Inorg.Chem. 6-7 or 9-10. 3 cred. Gruner.
- 124w.* Metamorphic Geology. Conditions, processes, and results of weathering and metamorphism. Prereq.: Course 105. 3 cred. Schwartz.
- 125f.* Structural Geology. Study of the principles and applications of geologic structures. Prereq.: Course 105. 3 cred. Wright.
- 131s-132f.* Advanced Petrology. Advanced optical methods. Criteria for rapid identification of the common rock clans. Regional and genetic studies. Petrographic reports. Prereq.: Course 106. 5 cred. per quarter. Goldich.
- 137s. Principles of Chemical Geology. A study of geochemical literature. Methods in geochemical research and application of chemical and physical chemical principles to geological problems. Prereq.: Course 105. 3 cred. Gruner.
- 140w-141s.* Applied Petrography. Determination of ore and gangue minerals, microscopic studies of paragenesis of ores and other mineral associations. Practical problems in mining and geology. Prereq.: Course 131. 3 cred. per quarter. Goldich.
- 144w. Interpretation of Geological Maps. Laboratory problem study of geological maps, structure contours, and mine maps. Mathematical and geometrical treatment of geological elements pertaining to strata, veins, faults, and other bodies in three dimensions. Prereq.: Course 125. 3 cred. Wright.
- 145s. Use and Interpretation of Aerial Photographs. Elements of aerial photographs, simple photogrammetric procedures, planimetric maps from photos, normal and stereoscopic study, geological interpretation and field use. Prereq.: Course 2. 3 cred. Wright.
- 146f-147w. Soil Mineralogy. Prereq.: one year of college chemistry. 4 cred. per quarter. Gruner.
- 150su.*§ Field Geology. June 15 to July 15, approximately. Detailed, systematic work, conforming to official surveys. Prereq.: Course 125. For additional prerequisites see members of the department. Cred. ar. Gruner.
- 151f-152w.* Stratigraphy. Principles of stratigraphic interpretation and correlation, illustrated by analyses of original papers. Prereq.: Course 107. 3 cred. per quarter. Bell.
- 153f. Subsurface Stratigraphy. The application of sample logs, electrical logs, and other techniques to the detailed stratigraphy of the subsurface in selected areas. Prereq.: Course 152. 3 cred. Swain.
- 161w. Advanced Mineralogy. Use of X rays for identification of minerals. The crystalline state. Isomorphism and Polymorphism. Phase rule applied to mineralogy. Structures of silicates. Synthesis of minerals. Prereq.: Course 121. 3 cred. Gruner.
- 166w-167w,s.* Mineralography. Methods of studying opaque minerals and application of the methods to problems in ore genesis and history. Prereq.: Courses 111, 131. 3 cred. per quarter. Schwartz.
- 170f,*w,*s.* Geologic Problems. Prereq.: permission of major adviser. 3 cred. Staff.

§ A maximum of 8 credits will be granted after field report is completed.

- 211f-212w-213s.* Advanced Paleontology. Selected groups of fossils. Field work supplemented by reference reading and thesis. Prereq.: Course 104 or 108. 3 cred. per quarter. Bell, Swain.
- 214.* Seminar in Ore Deposits. Prereq.: Course 111. 3 cred. Goldich, Schwartz.
- 215.* Advanced Principles of Ore Deposits. Prereq.: Course 111. 3 cred. Schwartz.
- 216s.* Geology of the Ore Deposits of the Western Hemisphere. Prereq.: Course 111. 3 cred. Schwartz.
- 241.* Field Course in Geology. To be arranged with individual students upon application to the department. Credit will be given for field work done satisfactorily as prescribed in the joint announcement of the departments of geology of American universities.
- 243-244.* Research Course in Geology. Advanced work in geology; chiefly individual work on selected subjects. Data and collections of material gathered in the course of field work studied under instructor. Methods follow standards of federal and state surveys. As many as 10 to 15 cred. per quarter may be earned. Goldich, Gruner, Schwartz, Thiel.
- 245-246.* Research Course in Sedimentation. Methods of Course 101-102 applied to sedimentary petrography. Prereq.: Course 102. 3 cred. per quarter. Thiel.
- 251-252.* Original Mineralogical Problems. Morphology and physical measurements of minerals. Prereq.: Course 24. 3 cred. per quarter. Gruner.
- 253-254.* Research Course in Ore Deposits. Methods of Course 243-244 applied to ore deposits. Prereq.: Course 243-244. 3 cred. per quarter. Goldich, Gruner, Schwartz.
- 263-264.* Research Course in Petrology. Methods of Course 243-244 applied to petrology. 3 cred. per quarter. Goldich.
265. Seminar in Special Research Fields. Ar.

GERMAN

Professor Oscar C. Burkhard; Associate Professor Lynwood G. Downs; Assistant Professor Frederick L. Pfeiffer.

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—Work for the Master's degree is 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 subdivision, German Literature, embraces New High German literature and extends from the end of the Middle Ages to the present. The second subdivision, 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 eighteen credits in linguistics and philology.

A minor in linguistics and philology will require at least twenty-seven credits. Majors in German literature may, however, offer a combined minor by presenting eighteen credits in linguistics and philology and not less than twelve 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 eighteen credits in German literature.

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

I. GERMAN LITERATURE

COURSES

- 130f-131w-132s.* The Age of Luther. Prereq.: Course 70 and 11 cred. above Course 59 or equiv. 3 cred. per quarter. Downs. (Not offered in 1948-49.)
- 143bf-144bw-145bs.* The Classical Period: Goethe. (a) Lessing, Wieland, Herder; (b) Goethe; (c) Schiller; (d) Goethe and His Literary Relations to France, England, and the United States. Prereq.: Course 71 and 11 cred. above Course 59 or equiv. 3 cred. per quarter. (Not offered in 1948-49.)
- 150af-151aw-152as.* Studies in German Literature of the Nineteenth Century. (a) Die Novelle; (b) Austrian Drama. Prereq.: Course 72 and 11 cred. above 59 or equiv. 3 cred. per quarter. Burkhard.
- 153f-154w-155s.* The Modern Drama. From Hauptmann to the present. Prereq.: Course 72 and 11 cred. above 59 or equiv. 3 cred. per quarter. (Not offered in 1948-49.)
- 156f-157w-158s.* History of the German Drama. Prereq.: Course 70-71-72 and 6 cred. above 59 or equiv. 3 cred. per quarter. (Not offered in 1948-49.)
- 160f-161w-162s.* Lyric Poetry. 160f. From the Renaissance through *Sturm und Drang*; 161w. From Goethe through Romanticism; 162s. From Heine to Rilke. Prereq.: Course 70-71-72 or equiv. and 11 cred. above 59. 3 cred. per quarter. (Not offered in 1948-49.)
- 163f-164w-165s.* The German Novel. (a) The Development of the Novel; (b) The Nineteenth Century Novel; (c) The Modern Novel. Prereq.: Course 70-71-72 and 6 cred. above 59 or equiv. 3 cred. per quarter. Pfeiffer. (Not offered in 1948-49.)
- 173f-174w-175s.* German and English Literary Relations in the Seventeenth, Eighteenth, and Nineteenth Centuries. Prereq.: Course 70-71-72 and 6 cred. above Course 59 or equiv. 3 cred. per quarter. Pfeiffer.
- 253f-254w-255s.* Seminar: Literary Problems. (a) German Baroque Literature: from the Renaissance to the Age of Reason; (b) Goethe and the Middle-Class Tradition; (c) Romanticism; (d) Nineteenth Century Drama: Kleist, Grillparzer, and Hebbel; (e) The Problem of Tragedy in Modern Drama. Prereq.: Course 70-71-72. 3 cred. per quarter. (Not offered in 1948-49.)

II. GERMANIC LINGUISTICS AND PHILOLOGY

- 110f-111w-112s.*† Middle High German. Linguistic introduction and readings in Middle High German literature. Prereq.: Course 70 and 11 cred. above Course 59 or equiv. 3 cred. per quarter. (Not offered in 1948-49.)
- 113f-114w-115s. Gothic and Old High German. (Same as Scandinavian 113-114-115.)
- 113f. Gothic. The course is designed as an introduction to Germanic linguistics and to a comparative study of Indo-European languages. 3 cred. Downs; 114w. Gothic Texts. 3 cred. Downs; 115s. Old High German. 3 cred. (Not offered in 1948-49.) Prereq.: Course 80 and 11 cred. above Course 59 or equiv.
- 125s. History of the German Language. Prereq.: Course 80 and 11 cred. above Course 59. 3 cred. (Not offered in 1948-49.)
- 126s. Historical German Grammar. Prereq.: Course 110-111-112 or 113-114-115. 3 cred. (Not offered in 1948-49.)

- 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 in 1948-49.)
- 180w. Old Norse Literature. (The same as Scandinavian 180.) 3 cred. (Not offered in 1948-49.)
- 182s. Germanic Mythology. (The same as Scandinavian 182.) 3 cred. (Not offered in 1948-49.)
- 183s. Germanic Heroic Poetry. (The same as Scandinavian 183.) Prereq.: 8 cred. in literature. 3 cred. (Not offered in 1948-49.)
- 194s. Old Saxon. *The Heliand*. 3 cred. Downs.
- 195w. Introduction to Old Norse Language and Literature. (The same as Scandinavian 195.) Old Norse phonology and morphology. Survey of Old Icelandic history and literature. Prereq.: Course 113. 3 cred. (Not offered in 1948-49.)
- 196s. Eddic Poetry. (The same as Scandinavian 196.) Philological interpretation of Old Norse poems. 3 cred. (Not offered in 1948-49.)
- 218bf-219bw-220bs.* Seminar: Germanic Languages and Literature. (a) Problems in Middle High German Literature; (b) Texts in Germanic Dialects: Runic inscriptions; (c) Old High German. Linguistic interpretations of texts. Prereq.: at least two Germanic dialects. 3 cred. per quarter. (Not offered in 1948-49.)

GREEK

For courses and staff, see Classics, page 73.

HISTORY

Professors August C. Krey, Alfred L. Burt, Harold C. Deutsch, Herbert Heaton, Philip D. Jordan, Ernest S. Osgood, Lawrence D. Steefel, George M. Stephenson, David H. Willson; Associate Professors Tom B. Jones, Rodney C. Loehr, Faith Thompson, Alice F. Tyler, John B. Wolf; Assistant Professor George W. Anderson; Instructor William D. Beatty.

NOTE—For information on work in International Relations, see page 21; for work on American Studies, see page 17.

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 will be expected to 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. Except in very unusual cases, where the nature of the field studied calls for another language, French and German are the best tools; adequate reading knowledge of one of these must be demonstrated not later than the close of the second quarter in which the student is registered for an advanced degree.

REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS

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

Plan A—Before entering upon the work for this degree the candidate shall satisfy his adviser, by examination or otherwise, that he is sufficiently prepared to carry on graduate work in the fields of his selection; he shall also, by the end of the second term of residence, demonstrate his ability to read French or German. 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 fields and 9 in the minor will be expected; the thesis accounts for the remainder of the credits. 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.

Group A

1. The Old Orient
2. Greece
3. Rome

Group B

1. Europe, 395-1300
2. England to 1485
3. Renaissance and Reformation
4. Economic History, 1300-1700

Group C

1. England since 1485
2. Modern Europe§
3. Economic History, 1700 to Present

Group D

1. American History to 1840
2. American History since 1840
3. Economic History of the United States

Group E

1. Asia since 476
2. European Colonies and Dependencies
3. Latin America
4. Canadian History

Plan B—Candidates for the Master's degree will meet the general requirements of the Graduate School for this degree (see page 11 of this bulletin), and by the end of the second quarter of residence demonstrate ability to read French or German. 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 some attention to the supporting fields

§ The candidate, with the advice and consent of his adviser, may choose one or more fields in the modern history of Continental Europe. These fields may be arranged (a) on a regional or (b) on a topical basis, or (c) in exceptional cases may be limited to the history of a single country. *Examples* of (a) would be Western Europe with special attention to France and Spain, Central Europe, with special emphasis on Germany and Italy, Eastern Europe with special emphasis on Russia and the Near East, the Mediterranean region, or the Baltic region. *Examples* of (b) would be international relations from the end of the 15th century to the end of the 18th or from the end of the 18th century to the present, the constitutional history of Continental Europe since the beginning of the French Revolution, the history of European nationalism. *Examples* of (c) would be the history of France since the middle of the 15th century, Germany since the middle of the 16th, or Russia.

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 150-200 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. As in the case of candidates for the degree under Plan A, the candidate under Plan B must present evidence that he is prepared to pursue courses giving graduate credit (deficiencies must be made up by carrying without credit undergraduate courses which will be sufficient in scope and number to supply the necessary background). On completion of the courses presented for the degree the candidate will be given an oral examination covering the work.

REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Candidates will be expected to fulfill the general requirements as given in this bulletin, pages 13-16.

Preliminary Examination

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. The selection of these fields must be made in consultation with, and subject to, the approval of the chairman of the candidate's examination committee. These selections shall be reported by the adviser to the chairman of the History Department. In exceptional cases, the department may approve fields not included in the list.

The preliminary examination 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. The scope of this reserved field shall be indicated to the department and approved by it at the time when the candidate is certified for the preliminary examination. The preliminary examination for candidates majoring in history is both written and oral.

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, under the rules of the Graduate School, is given by the same committee that sat in the preliminary examination. This examination includes 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 shall be required to be adequately prepared in two of the listed fields and to take a written examination covering the fields selected.

GENERAL REQUIREMENT

201f-202w-203s. Historical Bibliography and Criticism. Required of candidates for advanced degrees in history who do not present evidence of similar training elsewhere. 1 cred. per quarter. Steefel and others.

Students, proposing to make history their major field or field of concentration under Plan B, who enter upon their graduate work with inadequate preparation in certain fundamental courses may, upon recommendation of their adviser, enroll for one or more

of the following courses numbered between 100 and 149. In each case the student shall attend and do all the work required in the designated course, including preparation of papers and taking tests; in addition the student shall do such supplementary reading and perform such other tasks as the instructor shall require. No major program or program of concentration will, however, be approved where the bulk of work is in such courses; the emphasis must be placed on courses numbered 150 and above.

Graduate students whose major field or field of concentration is not history may, on recommendation of their respective advisers and with the permission of the Department of History, enroll for these courses.

These courses are not open to undergraduates.

COURSES

- 101f-102w-103s.† Ancient History. Student does the work of History 50-51-52 or 50a-51a-52a or 50b-51b-52b. 3 cred. per quarter. Jones.
- 104f-105w-106s.† Medieval History. Student does the work of History 53-54-55 or History 53a-54a-55a. 3 cred. per quarter. Krey.
- 107f-108w-109s.† European History. Student does the work of History 56-57-58, 59-60-61, 62-63-64 or 65-66-67. 3 cred. per quarter. Deutsch, Steefel, Willson.
- 107af-108aw-109as.† Russian History. Student does the work of History 56af-57aw-58as. 3 cred. per quarter. Anderson.
- 107bf-108bw-109bs.† History of the Middle East. Student does the work of History 56bf-57bw-58bs. 3 cred. per quarter. Anderson.
- 108aw-109bs.† World War II. Student does the work of History 67aw-67bs. 3 cred. per quarter. Deutsch.
- 110f-111w-112s.† English History. Student does the work of History 70-71-72 or History 73-74-75. 3 cred. per quarter. Willson, Thompson.
- 110af-111aw-112as.† English History. Student does the work of History 73af-74aw-75as. 3 cred. per quarter. Willson.
- 113f-114w-115s.† Canada and Canadian-American Relations. Student does the work of History 76-77-78. 3 cred. per quarter. Burt.
- 116f-117w-118s.† American Economic History. Student does the work of History 83-84-85. 3 cred. per quarter. Loehr.
- 119f-120w-121s.† European Economic History. Student does the work of History 80-81-82. 3 cred. per quarter. Heaton.
- 122f-123w-124s.† West in American History. Student does the work of History 90-91-92. 3 cred. per quarter. Osgood.
- 125f-126w-127s.† American Diplomatic History. Student does the work of History 93-94-95. 3 cred. per quarter. Beatty.
- 128f-129w-130s.† Minnesota and the Northwest. Student does the work of History 97f-98w-99s. 3 cred. per quarter. Jordan.
- 131f-132w-133s.† The American Colonies. Student does the work of History 86-87-88. 3 cred. per quarter. Tyler.
- 134f-135w.† The Immigrant in American History and Life. Student does the work of History 68af-69aw. 3 cred. per quarter. Stephenson.
- 136w-137s.† American History since 1900. Student does the work of History 68w-69s. 3 cred. per quarter. Stephenson.
- 136af-137aw-138as.† Latin-American History. Student does the work of History 93af-94aw-95as. 3 cred. per quarter. Beatty.
- 143f-144w-145s. American Folklore (The same as English 143-144-145). 3 cred. per quarter. Jordan.

146f-147w-148s. Social and Intellectual History of the United States. Student does the work of History 86af-87aw-88as. 3 cred. per quarter. Tyler.

Courses numbered 150 to 200 are open to seniors and graduates; prerequisites are the appropriate survey courses (see courses numbered 50 to 100 in the *Class Schedule*). Graduate students who do not present the appropriate survey courses or their equivalent are required to carry such courses without credit; in cases where such procedure is feasible the student may register for the courses numbered above 149 and also attend the meetings of the appropriate survey course, being therein held responsible for class exercises and examinations if the instructor and major adviser consider it advisable.

150f-151w-152s.† Selected Readings in Ancient History. 3 cred. per quarter. Jones.

153f-154w-155s.† Selected Readings in Medieval and Renaissance History. 3 cred. per quarter. Krey, Thompson.

156f-157w-158s.† Selected Readings in Modern European History. 3 cred. per quarter. Steefel, Deutsch, Willson, Wolf.

156af-157aw-158as.† Selected Readings in Russian History. 3 cred. per quarter. Anderson.

170f-171w-172s.† Selected Readings in English History. 3 cred. per quarter. Willson, Thompson.

176f-177w-178s.† Selected Readings in Canadian History. 3 cred. per quarter. Burt.

180f-181w-182s.† Selected Readings in European Economic History since 1700. 3 cred. per quarter. Heaton.

183f-184w-185s.† Selected Readings in American Economic History. 3 cred. per quarter. Loehr.

190f-191w-192s.† Selected Readings in American History. 3 cred. per quarter. Stephenson, Osgood, Tyler, Jordan.

204f-205w-206s.*† Seminar in Medieval History. 3 cred. per quarter. Heaton, Krey.

208f-209w-210s.*† Seminar in American History. 3 cred. per quarter. Stephenson, Osgood, Jordan, Loehr, Beatty.

221f-222w-223s.*† Seminar in Economic History. 3 cred. per quarter. Heaton.

224f-225w-226s.*† Seminar in Modern European History. 3 cred. per quarter. Steefel, Deutsch, Wolf.

230f-231w-232s.*† Seminar in Ancient History. 3 cred. per quarter. Jones.

240f-241w-242s.*† Seminar in Latin-American History. 3 cred. per quarter. Jones, Beatty.

HISTORY OF SCIENCE

Richard E. Scammon, Ph.D., LL.D., Distinguished Professor in the Graduate School.

COURSES

190f-191w-192s-193su. History of Science. Course in the social history of science, open to qualified graduate and Senior College students in any field of scientific or historical specialization. Conferences, readings, and lectures. This course may count as major or minor on approval of the student's adviser in the Graduate School. Consult instructor before registering. Cred. ar. Scammon.

201f-202w-203s-204su. Problems in Human Biology. Problems in the growth and distribution of human populations, in the serial development of the individual and its parts, in human developmental geometry, in statics of the human body, and in approaches to human biology by the newer methods of graphics, iconometrography, and applied mathematics. Permission of the instructor must be obtained. No medical credits allowed unless specifically permitted in advance by the dean of the medical sciences. Cred. ar. Scammon.

HOME ECONOMICS

Professors Wylle B. McNeal, Alice Biester, Clara B. Army, Harriet Goldstein, Jane Leichsenring, Isabel Noble, Ethel L. Phelps, Ella J. Rose; Associate Professor Lucy A. Studley; Assistant Professors Roxanna Ford, Vetta Goldstein, Kathleen Jeary; Instructors Gertrude Esteros, Marguerite L. Paulsen, Lillian K. Rasmussen, Florence L. Turnbull.

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 division for the Doctor's degree must include 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.

Master's degree—Work for the Master's degree is 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. A study of textile materials with special reference to the following: nature of the raw materials; economic, chemical, and physical applications involved in their manufacture and use; methods and significance of physical testing. Prereq.: Course 50, Agr.Biochem. 1, Agr.Econ. 3 or parallel. 3 cred. Phelps.
- 107w. Textile Analysis. Problems and applications of quantitative methods in textile analysis with special reference to informative labeling and to statements concerning fiber composition of fabrics. Prereq.: Course 102, Agr.Biochem. 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, the sociological and economic aspects of fashion in dress, the ready-to-wear industry. Prereq.: Course 50, Agr.Econ. 3. 3 cred. Ar.
- 116f,su. Family Clothing Problems. The buying of clothing. The simplification of clothing, the labeling and standardization of clothing, the sizing of garments and patterns, recent developments in the choice of clothing for specific uses such as work clothing and clothing for infants and children. Prereq.: Course 50. 3 cred. Ar.
- 120f,w,s. Art History and Appreciation. The historical development of painting, sculpture, architecture, decoration, furniture, and costumes, studies with special emphasis on design and influence upon modern styles. 3 cred. Esteros, V. Goldstein.
- 121f. Textile Design. A study of historic and modern textile designs with special reference to the technique and materials employed in their production and to their adaptations for present-day use in the home and in dress. Prereq.: Courses 27, 50. 3 cred. Rasmussen.
- 122s. Advanced Interior Design. Special problems of small house decoration, involving execution of elevation drawings. Studies and reports on topics of historical and practical interest. Actual materials used as far as possible. Prereq.: Courses 120, 180 or permission of instructor. 3 cred. H. Goldstein, V. Goldstein.

- 125w. Advanced Costume Design. Study of figure construction. Relation of color and texture to dress design. Studies and reports on assigned topics. Laboratory work with fabrics. Designs in pencil and water colors. Prereq.: Course 3, or permission of instructor; 22, 25 recommended. 3 cred. Rasmussen.
140. New Developments in Food Preparation. Demonstrations, discussions, and some laboratory work illustrating recent trends in food preparation. Such topics as the following will be included: the use of pressure saucepans, the theory and practice of freezing foods, and comparisons of recently proposed quick methods of preparing cakes and yeast breads with conventional methods. Prereq.: Course 40 or equiv. 3 cred. Ar.
- 142f,w,s. Experimental Cookery. An intensive study of problems in foods and food preparation with individual laboratory problems. Prereq.: Course 40 and Agr.Biochem. 1. 3 cred. Noble, Turnbull.
- 146s. Special Food Problems. Class problems in foods and food preparation. Prereq.: Course 142. 3 cred. Noble.
- 150su. Textile Problems. Discussion and readings covering recent developments and findings in the field of textiles. Special emphasis on the 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. The fundamental principles of human nutrition and their application in the promotion and maintenance of optimal health of the family. Prereq.: Courses 31, 40, Agr.Biochem. 1, Physiol. 4. 3 cred. Biester, Leichsenring.
- 171w,s. Child Nutrition. Lectures, assigned readings, and discussions dealing with the principles of child nutrition and with the formation of desired food habits. Prereq.: Course 170, H.E.Ed. 90. 3 cred. Leichsenring.
- 172su. Current Developments in Nutrition. This course aims to provide subject matter that is fundamental in the solution of nutrition problems currently met in feeding families or larger groups of people. The course will include topics such as the place of various nutrients in good nutrition; the interrelationships among nutrients; dietary allowances; the conservation of the nutritive values of foods; and the role of amino acids and proteins in health and abnormal conditions; as well as other material essential to an understanding of modern nutrition. Prereq.: Courses 31, 40, Agr.Biochem. 1, Physiol. 4, or permission of instructor. 3 cred. Biester, Leichsenring. (Not offered in 1948-49.)
- 173s. Nutrition in Disease. A study of the fundamental principles involved in using diet in the treatment of certain diseases. Prereq.: Course 170, 35 also advised. 4 cred. Ar.
- 175w. Nutrition. A study of tissues and metabolism. Includes work on blood, milk, and urine. Prereq.: Course 33. 4 cred. Ar.
- 176w. Advanced Nutrition. Selected quantitative methods applicable to investigations relating to digestion and metabolism. Prereq.: Course 35 or parallel, Agr.Biochem. 2. 4 cred. Biester.
- 177s. Digestion and Metabolism. An intensive study of problems relating to digestion and metabolism involving lectures, assigned readings, and laboratory work. Prereq.: Course 35. 3 cred. Leichsenring.
- 178f,w,s. Clinical Problems in Nutrition. The application of nutrition information to problems in health and disease involving assigned readings, discussions, and experience in a clinic. Prereq.: Courses 170, 35 or parallel. Limited to 6. 2 cred. Ar.
- 179f,w,s. Readings in Nutrition. A course designed to give experience in the use of nutrition books and periodicals, involving assigned readings, oral and written reports. Prereq.: Course 170. 2 cred. Biester, Leichsenring.

- 180f,w. Home Planning and Furnishing. Problems in selecting a home and prolonging the life of the house and its furnishings. Stresses intelligent planning and furnishing of the home on the basis of family living. Prereq.: Course 27; 120 recommended. 5 cred. H. Goldstein, V. Goldstein, Paulsen.
- 184f,w,s. Home Management: Operation and Maintenance. Lectures. Discussion of the management aspects of homemaking with emphasis on the problems involved in the use of time, energy, and money. Prereq.: Course 40, H.E.Ed. 90 or parallel. 4 cred. Ar.
185. Family Relationships. A study of the factors that promote satisfaction within the immediate family, and the relations of the family to the community. Prereq.: Course 85 or parallel; H.E.Ed. 90. 2 cred. Studley. (Not offered in 1948-49.)
- 186s. Problems in Income Management. A study of problems relating to individual and family budgets. Readings, discussions, and field work. Prereq.: Courses 85 or parallel, 86 or parallel, 34 or equiv., Agr.Econ. 126 or parallel. 3 cred. Studley.
- 195s. Development of Home Economics. A discussion of the development of home economics with emphasis upon current problems. 2 cred. McNeal.
- 202f,w, or s. Animal Fibers. An advanced course dealing with the structure, composition, chemical and physical properties, and special problems of manufacture of wool, silk, casein, and protein-like fibers in relation to their use. Prereq.: advanced textiles, permission of instructor. 2 cred. Phelps.
- 204f,w, or s. Plant and Other Cellulosic Fibers. Study of the structure, composition, physical and chemical properties, and special problems of manufacture of cotton, flax, rayon, and certain minor fibers in relation to their use. Prereq.: botany, advanced textiles, permission of instructor. 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.: botany, zoology, advanced textiles, permission of instructor. Cred. ar. Phelps.
- 209f,w,s.* Seminar in Textiles and Clothing. Reviews and interpretations of the literature of this field, emphasizing recent advances and involving individual assignments and oral and written reports. Prereq.: permission of the instructor. 1 cred. Phelps.
- 247w.* Special Food Problems. A critical study of recent research in the field of foods and food preparation selected with consideration of the interests of individual students. Prereq.: Course 142, Agr.Biochem. 1, permission of instructor. 3 cred. Noble.
- 249s.* Seminar in Foods. Reviews and interpretations of the literature in the field of foods and experimental food preparation involving individual assignments and oral or written reports. Prereq.: permission of instructor. 1 or 2 cred. Noble.
- 270-271f. Principles of Human Nutrition. An advanced course dealing with certain aspects of digestion, metabolism, excretion, and food requirements under various conditions. Prereq.: Course 170, permission of instructor. 3 cred. per quarter. Leichsenring. (270 not offered in 1948-49.)
- 279w,s.* Seminar in Nutrition. Reviews and interpretations of the literature of this field, emphasizing recent advances and involving individual assignments and oral and written reports. Prereq.: permission of instructor. 1 cred. Biester, Leichsenring.
- 295f,w,s-296f,w,s.* Home Economics Problems. Opportunity is offered for the 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 of instructor. 1 to 5 cred. per quarter. Biester, H. Goldstein, Leichsenring, Noble, Phelps, Rose, Studley.
- 299f,w,s.* Home Economics Problems. A critical study of recent advances in the field of home economics, involving independent study, reading and oral or written reports. Prereq.: permission of instructor. Cred. ar. McNeal, H. Goldstein, Rose, Studley.

HORTICULTURE

Professors William H. Alderman, Wilfrid G. Brierley, Troy M. Currence, Fred A. Krantz; Associate Professors Arthur E. Hutchins, Arthur N. Wilcox, James D. Winter; Assistant Professors Lewis E. Longley, Robert E. Nylund.

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—The graduate committee in horticulture may, in individual cases, waive the foreign language requirement under Plan A by petition. Under Plan B a reading knowledge of a foreign language is not generally required.

Major—With the approval of the advisers, courses in closely related fields may be accepted as part of the major work.

Master's degree—Candidates for the Master's degree will be accepted 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. A detailed study of the various operations in orchards and berry fields. Operating costs and profits. Lect., lab., and individual problems. Prereq.: Course 6. 3 cred. Brierley. (Offered in 1948-49 and alternate years.)
- 110w. Horticultural Crop Breeding. The application of plant breeding methods to the principal horticultural crops, with stress on the formulation of methods of attack and on the genetic and cytogenetic background. Prereq.: Agron. 31. 3 cred. Wilcox.
- 111f. Systematic Pomology. A study of fruit varieties. Lect., lab. and a survey of the literature. Prereq.: Course 6 and 9 cred. in botany or equiv. 3 cred. Brierley. (Offered in 1949-50 and alternate years.)
- 121w. Small Fruit Culture. Cultural practices for each of the small fruits; botanic relationship; history of commercial development. Lect., problems, and survey of literature. Prereq.: Course 6, 9 cred. in botany or equiv. 3 cred. Brierley.
- 135f. Potatoes. Culture, handling, storage, seed maintenance, varieties, improvement, and physiology of the potato plant. Prereq.: 9 cred. in botany or equiv. 3 cred. Krantz.
- 136f. Adaptation and Maintenance of Vegetable Varieties. The origin and development of leading varieties and their adaptation to different vegetable producing areas. Methods of seed production and maintaining of varieties. Activities of plant breeding organizations toward further improvement of varieties for future use of growers. Prereq.: Course 32, 9 cred. in botany or equiv. 3 cred. Currence.
- 138w. Vegetable Crops I. Lectures and assigned reading on the relation of environmental factors to the growth and culture of vegetable crops. Prereq.: Course 32, 9 cred. in botany or equiv. 3 cred. Nylund. (Offered in 1948-49 and alternate years.)
- 139w. Vegetable Crops II. A continuation of Course 138w. Prereq.: Course 32, 9 cred. in botany or equiv. 3 cred. Nylund. (Offered in 1949-50 and alternate years.)
- 153w. Conservatory Plants and Florists' Flowers. A systematic study of the plants adapted to growing in conservatories and homes, and also of florists' cut flowers and potted plants. Lect., lab., and field trips to greenhouses. Prereq.: 9 cred. in botany or equiv. 3 cred. Longley. (Offered in 1948-49 and alternate years.)
- 176s. Landscape Construction and Maintenance. A survey of garden and landscape construction, materials, grading, planting, and maintenance; including plans, specifications, and computation of costs. Materials and construction of walks, walls, fences,

- steps, pools, terraces, lawns, planting areas, flower beds, etc. Lect., field trips, reports, and construction problems. Prereq.: Course 24 or 25, or permission of instructor. 3 cred. Longley, Phillips. (Offered in 1948-49 and alternate years.)
- 190f-191w-192s. Special Problems. Supervised reading or experimentation upon special horticultural problems. Written report required. Prereq.: permission of instructor. 2 to 4 cred. per quarter. Staff.
- 193f-194w. Horticultural Seminar. Reports and discussions of problems and investigational work. Required of graduate students. 1 cred. per quarter. Staff.
- 241w. Organization of Horticultural Research. A survey of the organization and administration of horticultural research in agricultural experiment stations with special emphasis on the development of the project, co-operation with other groups, and relationship of federal and state agencies. 2 cred. Alderman, Krantz.
- 243f*-244w.* Advanced Topics in Horticulture. A critical analysis of recent research in the field of horticultural crop production selected with consideration of the interests of individual students. 3 cred. per quarter. Alderman, Brierley, Krantz, Longley.
- 247f,w,s,su.* Report on Special Horticultural Topics. A review of the literature dealing with a selected topic or problem in horticulture and the preparation of a written report. Designed for students taking the Master's degree without thesis. Not to exceed 9 cred. Final approval by graduate committee in horticulture. Staff.
- 248w. Truck Crop Breeding. Survey of literature related to the improvement of vegetable garden crops. Lectures and reading on methods of controlling pollination, seed setting, maintenance of breeding material, sources of new varieties, etc. Prereq.: Course 110 or Agron. 132. 3 cred. Currence.
- 249f,w,s,su.* Research in Horticultural Crop Breeding. Cred. ar. Currence, Krantz, Hutchins, Wilcox.

The following seminars are given in co-operation with Plant Genetics. For other major courses in plant breeding see Agronomy and Plant Genetics.

- Agron.242f,s.* Plant Breeding Seminar. Plant genetics in relation to plant breeding, a discussion of research problems. 1 cred. per quarter. Horticulture and Agronomy staffs.
- 246w.* Genetics Seminar. Important contributions to genetic theory and practice. 2 cred. Horticulture, Agronomy, and Animal Husbandry staffs.

INTERNATIONAL RELATIONS AND AREA STUDIES

For general statement, see page 21.

JOURNALISM

Professors Ralph D. Casey, Thomas F. Barnhart, Mitchell V. Charnley, J. Edward Gerald, Ralph O. Nafziger; Associate Professor Edwin H. Ford; Assistant Professor W. Edwin Emery.

Prerequisites—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 including reporting, news editing, and magazine writing; and 12 credits in either political science, economics, history, sociology, or psychology, or courses in English, among them a sophomore or Senior College course in composition.

For minor work, not fewer than 12 credits in journalism courses which satisfy the journalism adviser that the student has attained some journalistic proficiency.

Minor—A candidate who meets the prerequisite may satisfy the minor requirement by electing courses from among the following: 101, 103, 109-110, 111, 112, 115, 121, 130-131, 150, 177, 205, 208, 210.

Language requirement—A reading knowledge of at least one foreign language for the Master's degree unless special exception is made upon petition. In the case of such exception, a suitable substitute shall be offered. For certain foreign students to whom English is an acquired language, a similar substitution of English may be granted on recommendation of the major adviser and with the approval of the graduate group committee.

Fees—Students registered for one or more courses are required to pay a general fee of \$1 per quarter.

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

Doctor's degree—Candidates for the Ph.D. degree in one of the several departments which have authority to offer it may elect a minor or minors in journalism by petition with the approval of the dean of the Graduate School, the candidate's major adviser, and the director of the School of Journalism. Journalism and one of the several social sciences and journalism and education may co-operate on an equal basis in offering the degree, but the candidate for the degree must have the approval of the dean of the Graduate School, the director of the School of Journalism, and the chairman of the department or the dean of the college which grants the degree co-operatively with journalism.

COURSES

- 101w,s. The Reporting of Public Affairs. Training in reporting court trials, city, county, state, federal, administrative, and legislative agencies; politics, business, and labor. Prereq.: Course 51. 3 cred. Nafziger and 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 of instructor. 3 cred. Ford.
- 109w-110s.* History of Journalism. 109w. Development of newspapers and periodicals from early beginnings in Europe through the 1860's in the United States. 110s. The emergence of modern journalism in the post-Civil War period. Prereq.: Course 13. 3 cred. per quarter. Ford, Emery.
- 111f.* International Communications. A study of the channels of international communication and the news-gathering agencies. Factors affecting the flow of news throughout the world. The role of the foreign correspondent. The relation of the press to foreign affairs. Prereq.: Course 51 and a history or political science course in international affairs, or permission of instructor. 3 cred. Nafziger.
- 112w.* Comparative Foreign Journalism. The press in the principal foreign countries. The cultural, economic, and technological influences that have shaped the foreign press systems. Newspapers abroad compared and contrasted with those in the United States. Prereq.: Course 111. 3 cred. Casey, Gerald, Nafziger.
- 115s.* Communication Media Analysis. Scientific techniques used in analyzing the content and readership or listenership of mass communications. Social stratification and attitude studies as they relate to the utilization of the media by the public. Prereq.: Course 51 or Econ. 5 or Psy. 70 or equiv., permission of instructor. 3 cred. Nafziger.
- 121w.* The Newspaper in a Dynamic Society. Economic, political, and social determinants of the character and content of the daily newspaper and other agencies of communication. Patterns of ownership—private, co-operative, monopolistic, and socialistic—and their effect on content. The newspaper of the future. Prereq.: Course 15 or permission of instructor. 3 cred. Gerald.
- 130f-131w.* Communication Agencies 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. Prereq.: for 130, 15 cred. in the social studies; for 131, Course 130. 3 cred. per quarter. Casey.
- 140f-141w. Interpretation of Contemporary Affairs. Analysis of major political, economic, and social developments that have public interest and significance, and their interpretation in the editorial, interpretative article, and commentary. A study of authoritative source materials in the backgrounding of the news. Prereq.: Course 51, 10 cred. in social studies or permission of major adviser in journalism. 3 cred. per quarter. Staff.
- 142s. Current Communications Problems. The individual project method is used for analyses of journalistic problems of contemporary importance. Prereq.: Course 51. 3 cred. Staff.
- 150s.* Public Relations in Community Service. 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 had Course 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. Legislative and administrative regulations affecting news gathering, news dissemination, publishing, and broadcasting. The problem of international freedom of press and radio. Prereq.: Course 51 or permission of instructor. 3 cred. Gerald.
- 205f,w,s.* Topics in International News Communication. Discussions and reports on the rise and development of international news communication and the news-gathering agencies. Prereq.: permission of instructor. 3 cred. Nafziger.
- 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 of adviser. 3 cred. Gerald.
- 210f,w,s.* Research in 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. Casey, Charnley, Gerald, Nafziger.

LATIN

For courses and staff, see Classics—Latin, pages 73-74.

LINGUISTICS AND COMPARATIVE PHILOLOGY

Professor John L. Heller; Associate Professors Emmert M. Brackney, Lynwood G. Downs, Raymond L. Grismer; Assistant Professors Harold B. Allen, Joseph H. Greenberg, Donald C. Swanson.

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

A reading knowledge of Latin and German and a fair knowledge of Greek are required of all candidates. The course in Sanskrit, Linguistics 131-132, is a prerequisite.

Doctor's degree—For a minor, candidates are expected to have a substantial knowledge of Latin, German, and one additional language, preferably Greek, Russian, or French. Their preparation should lead toward a comprehensive knowledge of the comparative grammar of the Indo-European languages. The language requirements for a major are Latin, Greek, German, and one additional modern language, preferably Russian or French. The candidate is expected to choose a main field of concentration and to become thoroughly acquainted not only with the linguistic, but also the cultural and literary background of that field. In order to work out a satisfactory program, candidates are to consult the adviser or the Graduate School.

GENERAL COURSES

- Linguistics 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 in 1948-49.)
- Linguistics 106f,107w. Introduction to the Study of Language. Prereq.: any two courses numbered above 50 in a foreign language. 3 cred. per quarter. Swanson.
- Linguistics 108s. Cultural Aspects of Language. Prereq.: any two courses numbered above 50 in a foreign language. 3 cred. Swanson.
- Linguistics 109s. Analysis of Language. Special attention will be directed to non-Indo-European languages. 3 cred. Greenberg.

CELTIC

- Linguistics 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 quarter. (Not offered in 1948-49.)

CLASSICS

- Classics 133s. Vulgar Latin. Development of Latin into Romance. Prereq.: permission of instructor. 3 cred. Swanson.
- Classics 242w.* Historical Latin Grammar. 3 cred. Heller. (Not offered in 1948-49.)

ENGLISH

- English 100f. Old English. Prereq.: 6 cred. above English 50. 4 cred. Ar.
- English 102w. Old English Poetry. Prereq.: English 100. 3 cred. Ar.
- English 103s. Beowulf. Prereq.: English 100. 3 cred. Ar.
- English 165f. The Historical Study of Modern English. Prereq.: 6 cred. in English literature above Course A-B-C. 3 cred. Allen.
- English 166w. Historical Backgrounds of Modern English. Prereq.: English 165. 3 cred. Allen.
- English 171f-172w-173s. The Development of Standard English. Prereq.: English 100. 3 cred. per quarter. Allen.
- English 174s. American English. Prereq.: 6 cred. above English 50. 3 cred. Allen.

FRENCH

- French 171f-172w-173s.*† History of French Language. Prereq.: one year of Latin or permission of instructor. 1 cred. per quarter. Brackney.
- French 201f-202w-203s. Old French Phonology and Morphology. 2 cred. per quarter. Brackney.
- French 204f-205w-206s. Reading in Old French Literature. 2 cred. per quarter. Brackney.

GERMAN

- German 110f-111w-112s.*† Middle High German. Linguistic introduction and readings in Middle High German literature. Prereq.: German 70 and 11 cred. above German 59. 3 cred. per quarter. (Not offered in 1948-49.)
- German 113f-114w. Gothic. Introduction to Germanic linguistics and to a comparative study of the Indo-European languages. 3 cred. per quarter. Downs.
- German 115s. Old High German. Prereq.: German 113. 3 cred. Downs. (Not offered in 1948-49.)
- German 125s. History of the German Language. Prereq.: Course 80 and 11 cred. above German 59. 3 cred. (Not offered in 1948-49.)

- German 126s. Historical German Grammar. Prereq.: German 110-111-112 or 113-114-115. 3 cred. (Not offered in 1948-49.)
- German 176f-177w. Problems and Research Trends in Germanic Philology. 3 cred. per quarter. Ar. (Not offered in 1948-49.)
- German 178s. The German Dialects. Prereq.: German 110-111-112 or 113. 3 cred. Downs. (Not offered in 1948-49.)
- German 194s. Old Saxon. 3 cred. Downs.
- German 218bf-219bw-220bs. Texts in Germanic Dialects. Prereq.: at least two medieval Germanic dialects. 3 cred. per quarter. (Not offered in 1948-49.)
- German 218cf-219cw-220cs. Old High German. 3 cred. per quarter. (Not offered in 1948-49.)

SANSKRIT

- Linguistics 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 quarter. Swanson. (Not offered in 1948-49.)
- Linguistics 131f-132w. Introduction to Sanskrit. Phonology and morphology from comparative point of view. Prereq.: at least two Senior College courses in early Indo-European languages, preferably Greek, Gothic, or Latin. 2 cred. per quarter. Swanson.

SCANDINAVIAN

- Scandinavian 185.* History of the Scandinavian Languages. Prereq.: Scand. 4-5-6 or 10-11-12 or permission of instructor. 3 cred. (Not offered in 1948-49.)
- Scandinavian 195.* Introduction to Old Norse. (The same as German 195.) Prereq.: Scand. 113 or permission of instructor. 4 cred. (Not offered in 1948-49.)
- Scandinavian 196.* Eddic Poetry. Philological interpretation. Prereq.: Scand. 195. 3 cred. (Not offered in 1948-49.)

SEMITIC

- Linguistics 121f-122w-123s. Introduction to Arabic Grammar and Reading. Prereq.: two courses above 50 in any foreign language. 3 cred. per quarter. Greenberg. (Not offered in 1948-49.)
- Linguistics 124f-125w-126s. Introduction to Biblical Hebrew. 3 cred. per quarter. Greenberg.

SPANISH

- Spanish 241f-242w-243s.* Old Spanish Philology. 2 cred. per quarter. Grismer.

MATHEMATICS AND MECHANICS

Professors Raymond W. Brink, Robert H. Cameron, Harry A. Doeringsfeld, Henry C. T. Eggers, Forrest E. Miller, William L. Hart, George C. Priester, Stefan E. Warschawski, Hugh B. Wilcox; Associate Professors Gladys E. C. Gibbens, Fulton Koehler, William R. McEwen, John M. H. Olmsted, Hugh L. Turrittin; Assistant Professors Jacob E. Bearman, Elizabeth Carlson, Charles Hatfield, Jr., Gerhard K. Kalisch, Warren S. Loud, Gayle W. McElrath, William D. Munro.

Mr. Turrittin is chairman and Mr. Olmsted 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—The substitution of one other language for French or German is sometimes permitted, on petition, by the Graduate School faculty.

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

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

For more detailed information about the courses listed below (schedule of hours and days, etc.) students should consult the program of the Department of Mathematics 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*. Footnotes in this *Graduate School Bulletin* indicate which courses are usually given by one department or the other.

NOTE—For information on work in Statistics, see pages 23-24.

COURSES

- 102f-103w.*¶ Advanced Analytic Geometry. Prereq.: differential and integral calculus. 3 cred. per quarter. Carlson.
- 105f,s.¶ Intermediate Calculus. Prereq.: differential and integral calculus. 5 cred. Ar.
- 106f,w.¶ Differential Equations. Prereq.: differential and integral calculus. 3 cred. Loud, Graves.
- 107s.¶ Advanced Calculus. Prereq.: Course 105 or Courses 50 and 51 (Differential and Integral Calculus) taken with A grades in the College of Science, Literature, and the Arts, and either some acquaintance with solid analytic geometry or permission of instructor. 5 cred. Graves.
- 109s.*¶ Theory of Numbers. Prereq.: differential and integral calculus. 3 cred. Carlson.
- 115w-116s.*¶ Differential Geometry. Prereq.: Course 136. 3 cred. per quarter. Gibbens.
- 118-119-120.*¶ Vectors and Matrices. Prereq.: differential and integral calculus. 3 cred. per quarter. Hart. (Not offered in 1948-49.)
- 121f-122w-123s.*¶ Mathematical Theory of Statistics. Prereq.: differential and integral calculus. 3 cred. per quarter. Hart, Bearman.
- 125.*¶ Theory of Geometrical Constructions. Prereq.: Course 30 (Analytic Geometry). 3 cred. (Not offered in 1948-49.)
- 127f,w,s.§ Technical Mechanics. Prereq.: Course 26 (a more elementary course in technical mathematics) or permission of instructor. 5 cred. Wilcox.
- 128f,w,s.§ Strength of Materials. Prereq.: Course 26 (a more elementary course in technical mechanics). 5 cred. Miller.
- 129f,w,s.§ Fluid Mechanics. Prereq.: Course 26 (a more elementary course in technical mechanics). 4 cred. Doeringsfeld.
- 130f,w,s.§ Fluid Mechanics. Hydrostatics, Bernoulli's theorem. Compressible and incompressible flow through orifices and pipes. Dynamic action of jets and streams. Elementary principles of turbines and pumps. Prereq.: Course 26 (a more elementary course in technical mechanics). 5 cred. Doeringsfeld.

* 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 in the College of Science, Literature, and the Arts.

§ This course is given by the Department of Mathematics and Mechanics in the Institute of Technology.

- 131.*¶ Advanced Algebraic Theory. Prereq.: Course 62 (Theory of Equations) or 105. 3 cred. (Not offered in 1948-49.)
- 132f-133w-134s.§ Industrial Statistics. Statistics as applied to engineering problems and quality control. Prereq.: differential and integral calculus. 3 cred. per quarter. McElrath.
- 136f.*¶ Solid Analytic Geometry. Prereq.: differential calculus. 3 cred. Olmsted.
- 137s.*¶ Advanced Theory of Equations. Prereq.: Courses 51 (Integral Calculus) and 62 (Theory of Equations). 3 cred. Hatfield.
- 139.*¶ Limits and Series. Prereq.: Course 51 (Integral Calculus). 3 cred. (Not offered in 1948-49.)
- 140.*¶ Projective Geometry. Prereq.: differential and integral calculus or permission of instructor. 3 cred. Gibbens. (Not offered in 1948-49.)
- 141f,w,s.§ Materials Testing Laboratory. Prereq.: Course 128 or registration in 128. 1 cred. Miller.
- 143f,w,s.§ Hydraulics Laboratory. Prereq.: Course 129 or 130 or registration in 129 or 130. 1 cred. Doeringsfeld.
- 144f-145w-146s.*¶ Topics in Analysis. Prereq.: differential and integral calculus. 3 cred. per quarter. Hatfield. (Not offered in 1948-49.)
- 149.¶ Introduction to Group Theory. Prereq.: Courses 51 (Integral Calculus), 62 (Theory of Equations). 3 cred. (Not offered in 1948-49.)
- 150f.§ Calculus III: Intermediate Calculus. Partial differentiation, multiple integrals, infinite series, and other advanced topics. Prereq.: Course 25 (Integral Calculus). 3 cred. Koehler.
- 151f,w,s.§ Differential Equations. Prereq.: Course 80 (Elementary Differential Equations) or equiv. 3 cred. Koehler.
- 152w-153s.§ Advanced Calculus with Applications. Prereq.: Course 150. 3 cred. per quarter. Koehler.
- 154f.*§ Vector Analysis. Prereq.: Course 26 (a course in technical mechanics). 3 cred. Munro.
- 155w.*§ Vector Analysis and Dyadics with Applications. Prereq.: Course 154. 3 cred. Munro.
- 156s.*§ Elements of Tensor Analysis. Prereq.: Course 154. 3 cred. Munro.
- 161f-162w-163s.*§ Advanced Technical Mechanics. Prereq.: Course 127 or permission of instructor. 3 cred. per quarter. Wilcox.
- 164f-165w-166s.*§ Operational Methods and Operational Calculus. Prereq.: Course 151 or permission of instructor. 3 cred. per quarter. Turrittin. (Not offered in 1948-49.)
- 167f-168w-169s.§ Mathematics of Modern Engineering. Prereq.: Course 26 (a course in technical mechanics). 3 cred. per quarter. Munro.
- 170f-171w-172s.¶ Introduction to Modern Algebra. Based on the text of Birkhoff and MacLane. Prereq.: differential and integral calculus or permission of instructor. 3 cred. per quarter. Kalisch.
- 173f-174w-175s.§ Elementary Partial Differential Equations with Applications. Prereq.: Courses 151, 153. 3 cred. per quarter. Turrittin.

* 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 in the College of Science, Literature, and the Arts.

§ This course is given by the Department of Mathematics and Mechanics in the Institute of Technology.

- 176w-177s.*¶ Intermediate Differential Equations. Topics in differential equations not contained in a first course but not requiring a broad background of analysis. Emphasis on linear equations of second order of interest in physics. Normal form, adjoint equations, series solutions, equations of Fuchsian type, hypergeometric, Bessel and Legendre equations. Prereq.: Course 106. 3 cred. per quarter. Loud.
- 180f.§ Advanced Strength of Materials. Prereq.: Course 128. 3 cred. Miller.
- 181f-182w-183s.*§ Applied Elasticity. Prereq.: Course 128. 3 cred. per quarter. Priester.
- 184f-185w-186s.*§ Advanced Testing Materials Laboratory. Prereq.: Course 141. 2 cred. per quarter. Priester. (Not offered in 1948-49.)
- 190f-191w-192s.§ Problem Seminar. Prereq.: permission of instructor. 3 cred. per quarter. Warschawski. (Not offered in 1948-49.)
- 206f-207w-208s.*¶ Theory of Functions. Prereq.: 5 or 6 cred. of Course 107-108 or permission of instructor. 3 cred. per quarter. Brink, Hart.
- 221s.*¶ Calculus of Variations. Prereq.: Courses 106, 107 or the old Course 107-108. 3 cred. Cameron.
- 232f-233w-234s.§ Mechanics of Continuous Media. Prereq.: Courses 127, 151, 153. 3 cred. per quarter. Wilcox.
- 241f-242w-243s.¶ Series and Integral Solutions of Differential Equations. Prereq.: Course 208. 3 cred. per quarter. Cameron. (Not offered in 1948-49.)
- 245f.*¶ Introduction to Lebesgue Integrals. Prereq.: Course 208. 3 cred. Cameron.
- 246w.*¶ Introduction to Wiener Integrals. Prereq.: Course 208, permission of instructor. 3 cred. Cameron.
- 247s.*¶ Integration in Function Space. Prereq.: Course 245, permission of instructor. 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 quarter.
- 252w-253s.*¶ Linear Spaces. Prereq.: Course 245. 3 cred. per quarter. Olmsted.
- 261f-262w-263s.§ Functions of a Complex Variable. Elliptic functions and integrals with applications. Prereq.: Course 153. 3 cred. per quarter. Warschawski. (Not offered in 1948-49.)
- 264f-265w-266s.§ Conformal Mapping. Prereq.: Course 261 or permission of instructor. 3 cred. per quarter. Warschawski.
- 271f-272w.*¶ Theory of Linear Differential and Integral Equations. Prereq.: Course 208. 3 cred. per quarter. Cameron.
- 274f-275w-276s.§ Partial Differential and Integral Equations of Applied Mathematics. Prereq.: Courses 151, 153. 3 cred. per quarter. Warschawski.
- 277f-278w-279s.§ Partial Differential Equations of the First Order with Applications to Mechanics. Prereq.: Courses 127, 151, 153. 3 cred. per quarter. Turrittin.
- 281f-282w-283s.§ Potential Theory. Prereq.: Courses 151, 153. 3 cred. per quarter. Warschawski.
- 284f-285w-286s.§ Non-linear Mechanics. Prereq.: Courses 127, 151, 153. 3 cred. per quarter. (Not offered in 1948-49.)
- 290f-291w-292s.§ Theory of Plates and Shells. Prereq.: Courses 153, 294. 3 cred. per quarter. Priester.

* 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 in the College of Science, Literature, and the Arts.

§ This course is given by the Department of Mathematics and Mechanics in the Institute of Technology.

294f-295w-296s. § Mathematical Theory of Elasticity. Prereq.: Courses 128, 153. 3 cred. per quarter. Priester.

297f-298w.* § Vibration Problems. Prereq.: Course 127. 3 cred. per quarter. Wilcox.

The following courses have been offered from time to time in the past, and similar courses or other courses of corresponding grade will be provided at any time there is sufficient demand for them.

100-101. ¶ Foundations of Geometry	138. ¶ Higher Plane Curves
111. ¶ Elliptic Functions and Integrals	142. ¶ Theory of Invariants
113. ¶ Mathematical Recreations	160. ¶ Numerical Methods in Computation
114. ¶ Mathematics of Small Vibrations	212-213. ¶ Point Set Topology
126. ¶ Calculus of Finite Differences	
135. ¶ Introduction to the Theory of Small Samples	

DRAWING AND DESCRIPTIVE GEOMETRY

111f-112w-113s. § Advanced Descriptive Geometry. Prereq.: Dr. 3, M.&M. 25. 3 cred. per quarter. Ar.

115f-116w-117s. § Curve Fittings. Prereq.: Dr. 3, M.&M. 25. 3 cred. per quarter. Eggers.

118f,w,s. § Short Course in Curve Fitting. Prereq.: Dr. 3, M.&M. 25. 3 cred. Eggers.

152f,w,s-153w-154s. § Nomography. Prereq.: Dr. 52, M.&M. 25. 3 cred. per quarter. Eggers.

157f-158w-159s. § Graphical Mathematics. Prereq.: Dr. 3, M.&M. 26. 2 cred. per quarter. Eggers.

MECHANICAL ENGINEERING

Professors Frank B. Rowley, Axel B. Algren, John R. DuPriest, Newman A. Hall, Richard C. Jordan, Burton J. Robertson; Associate Professors Fulton Holby, Mil-lard H. LaJoy, Lloyd B. Ritchey, James J. Ryan; Assistant Professors John W. Andeen, John M. MacKenzie.

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 requirements—There are no language requirements for the master of science degree. For the Ph.D. degree a reading knowledge of French and German is required (substitution of other foreign languages such as Spanish or Russian may be permitted by the Executive Committee on recommendation of the group committee).

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.

* 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 in the College of Science, Literature, and the Arts.

§ This course is given by the Department of Mathematics and Mechanics in the Institute of Technology.

COURSES

MILLING ENGINEERING

- 100-101-102. Milling I, II, and III. A lecture course on the mechanical technology of the milling of wheat and related operations. 3 cred. per quarter. 3 lect. hours per week. Prereq.: M&M. 130 or equiv., Courses 23, 132. 3 cred. per quarter. MacKenzie.
- 103-104. Milling Laboratory I and II. Observations and experience in flour milling operations by arrangement with the industry. 6 lab. hours per week. Prereq.: Courses 35, 100 or registration in 100. 2 cred. per quarter. MacKenzie.
- 105-106. Milling Design I and II. Applications of the fundamentals of machine design as applied to flour milling equipment. Prereq.: Courses 100, 121, 160, and, for Milling Design II, Courses 104, 105. 2 cred. MacKenzie.
107. Packaging and Handling of Materials. A lecture course in modern packaging techniques and media combined with materials handling methods in the industry. 3 lect. hours per week. Prereq.: Courses 101, 104, 105. 3 cred. 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.: Course 12, Chem. 16. 3 cred. Holtby.
- 111.‡ Advanced Foundry Practice. Prereq.: Course 110, Phys. 9, Chem. 16. 3 cred. Holtby.
- 112.‡ Plastics Processing. A lecture and laboratory course dealing with the materials, equipment, and manufacturing processes used in fabricating plastics products, design of plastics products and molds. (Not offered to Mechanical Engineering students.) Prereq.: Course 15. 3 cred. Crowder.
- 113.‡ Advanced Machine Shop Practice. Selection, tooling, and set-up of machine tools. Estimating machinery time and preparation of operating instruction for complete units. Prereq.: Course 15. 3 cred. Crowder.
- 114.‡ Advanced Welding. Theory and applications of welding processes. Fundamental considerations in the design of weldments; factors affecting weldability of processes. Prereq.: Course 13. 3 cred. Hughes.
115. Control of Manufacturing Standards. Set-up and operation of the standards laboratory for checking, calibrating, and adjusting gages, measuring instruments required for the control of dimensions. Inspection of special tools, jigs, and fixtures required for the manufacture of interchangeable parts. Design of special measuring gages and fixtures for the rapid measurements of interchangeable parts. Prereq.: Course 15. 3 cred. Crowder.
117. Advanced Plastics. A lecture and laboratory course dealing with theory and application of plastics fabricating methods, material testing, equipment, proper mold and press design, and production set-ups. Prereq.: Course 17. 3 cred. Holtby.
170. Tool Design. The design of jigs and fixtures for manufacture of interchangeable parts products. Prereq.: Courses 15, 171. 2 cred. Crowder.

ENGINEERING KINEMATICS

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.

‡ A fee of \$2 is charged for this course.

MACHINE DESIGN

120. Advanced Engineering Design Drafting. Studies in design and layout of a complete machine; punch press, engine, lathe, automatic machine or special machinery, individually or by groups. Complete assembly and detail drafting with emphasis on design modifications and improvements. Prereq.: Courses 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.: Course 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.: Course 121. 2 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.: Course 121. 2 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 in. journal-bearing testing machine, electronic measuring devices. Prereq.: Course 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 in. journal-bearing. Prereq.: Course 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, free harmonic vibrations, critical speeds, lateral and torsional vibration of shafting, effects of damping, dynamic equations of equilibrium, balancing and balancing machines, vibration absorption and isolation, measuring instruments. Application of vibration analysis in the design of machines. Prereq.: M.&M. 127. 3 cred. Ryan.
- 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.: Course 121. 3 cred. Ryan.
- 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.: Course 121. 3 cred. Ryan.
- 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.: Course 121. 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.: Course 129. 3 cred. Ryan.

THERMODYNAMICS

- 131-132. Thermodynamics. A study of the 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 quarter. Hall.
133. Heat Transmission. The introduction theory and principal empirical rules for problems in conduction, forced and free convection, and radiation. Emphasis will be given to obtaining facility in the use of established empirical correlations. Prereq.: Course 132. 3 cred. Ritchey.
134. Thermodynamics of Fluid Flow. The fundamental thermodynamic procedures for the energy analysis of the flow of viscous and compressible fluids. Applications to flow systems such as ducts, diffusers, nozzles, ejectors, orifice plates, combustion chambers, heat exchangers, etc. Compressible flow phenomena occurring in mechanical engineering equipment. Flow of gases with suspended particles. Prereq.: Course 132 or Phys. 73. 3 cred. Hall.
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.: Course 132. 3 cred. Hall.
232. Advanced Fluid Thermodynamics. A critical examination of the principles of energy transformation and dynamics of flow of viscous and compressible fluids. Applications to laminar and turbulent flow of viscous fluids including boundary layer phenomena affecting friction and heat transfer. Energy transfer in heat exchangers and in rotating machinery. Prereq.: Course 134, M.&M. 153 or permission of instructor. 3 cred. Hall.
233. Advanced Heat Transmission. The mathematical theory of heat conduction with application to steady and non-steady heat flow for various boundary conditions and configurations. Development of radiation theory of heat with application to heat transfer from solids and high temperature gases. Prereq.: Course 133, M.&M. 153 or permission of instructor. 3 cred. Hall.

STEAM POWER

138. General Laboratory. (For Mining Engineering students only.) (a) Calibration of pressure gages. Steam calorimetry. Steam indicator practice, card calculation. Test of oils, engines, turbines, air compressors, and pumps. (b) The use of weirs, differential gages, etc., in the tests of centrifugal pumps, hydraulic turbines, etc. Prereq.: Min.E. 122. 2 cred. Ar.
141. Heat Power Engineering. Study of 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.: Course 132. 3 cred. Ritchey.
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.: Course 141. 3 cred. Andeen.
144. Steam Turbines. Theory and practice applied to various types. Thermodynamics and mechanical analysis of problems involved in the design of nozzles, blades, rotors, etc. Condition of operation; systems of transmission; lubrication; economy; field service. Laboratory investigation. Prereq.: Course 132. 3 cred. Lee.

146. Fuels and Combustion. Fuels classification and analysis, stoichiometry, rates, combustion processes, combustion equipment and controls. Prereq.: Course 141. 3 cred. Ritchey.
147. Design of Steam Machinery. Steam generating station layout. General design of all component parts. Prereq.: Course 141. 2 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.: Course 147. 2 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.: Courses 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.: Course 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.: Course 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.: Course 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.: Course 131. 4 cred. Robertson, Murphy.
- 150A. Internal Combustion Engines. (Aero.E.) Thermodynamics and combustion processes of real gases and vapors—Otto, Diesel, and Brayton cycle engines; volatile fuels; mixture of real gases and vapors; explosion pressures, flow temperatures, and combustion phenomena; heat losses, real cycle efficiencies. Prereq.: Course 131, Phys. 102. 4 cred. Robertson, Murphy.
151. Advanced Internal Combustion Engines. Special reference to automobile, truck, and airplane engines. Theoretical consideration of fuels, combustion, detonation, lubrication, supercharging, carburation, and fuel injection. Recent developments in automotive and airplane engines. Prereq.: Course 150. 3 cred. Robertson, 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.: Course 150A or 150. 2 cred. Robertson, 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.: Course 55 or 150. 3 cred. Robertson.
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.: Course 150. 3 cred. Robertson.
- 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.: Courses 121, 150. 2 cred. per quarter. Murphy.

- 154A. Design of Airplane Engines. Study of the 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.: Courses 27, 150. 2 cred. Murphy.
156. High Speed Engine Testing. Advanced laboratory procedure and instrumentation. Effect of fuel mixture, distribution, etc., upon general engine performance. Prereq.: Course 158 or 159 and minimum honor point average of 1.5. 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. Combined effects of altitude, speed, compression ratio, turbine temperature, etc., upon performance. Prereq.: Course 150 or 150A. 3 cred. Robertson, 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.: Course 150 or registration in 150. 2 cred. Murphy.
159. Internal Combustion Engine Laboratory. Tests of gasoline, aircraft, and Diesel engines. Power plant units, automotive engines, aircraft engines. Prereq.: Course 150 or registration in 150. 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.: Courses 121, 150. 3 cred. Murphy.
- 251.* Automotive Vehicles. Study of transmission systems, running gears, chassis, bodies, riding qualities of vehicles, and current developments. Lect. and problems. Cred. ar. Robertson.
252. Advanced Reciprocating Engines. Study of 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, and spark timing; problems with regard to detonation limits of fuels and use of antidetonants; problems with regard to cooling characteristics under limiting conditions of power and altitude. Prereq.: Course 151 or 151A. 3 cred. Robertson, 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.: Course 157. 3 cred. Hall, Murphy.
- 254.* Fleet Maintenance. Study of available types of motor coaches, automobiles, and trucks, their design features from a maintenance viewpoint, a survey of service depot requirements with a study of fleet service methods and maintenance practice. Prereq.: Course 153. 3 cred. Robertson.
- 255.* Thermal Jets and Rockets. Study of thermal jets and rockets with 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.: Courses 157, 134. 3 cred. Hall, Murphy.
- 256.* Engine Testing and Research. Problems involving volumetric efficiency, manifold-ing, friction losses, oil deterioration, cylinder corrosion, and other engine performance factors of current interest. Prereq.: Course 158A or 159. Cred. ar. Robertson, Murphy.

257. Combustion and Fuels for Gas Turbines, Jet Propulsion, and Reciprocating Power Plants. Characteristics of petroleum fuels and manufacturing processes. Combustion reactions—ideal and real. Heating value, heat of formation, energy of reaction, flame temperatures, equilibrium in combustion. Fuels for reciprocating engines—octane and performance numbers, volatility, specifications; fuel for gas turbines, turbo jets, and ram-jet motors; liquid and solid fuels for rockets. Prereq.: Courses 150, 157. 3 cred. Robertson, Hall.

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.: Course 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.: Course 160. 2 cred. per quarter. 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.: Course 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.: Courses 35, 160, or registration in 160. 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.: Course 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.: Courses 160, 265 or permission of instructor. 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.: Course 160 or permission of instructor. 3 cred. Algren.

INDUSTRIAL ENGINEERING

171. Elements of Industrial Engineering and Management. Basic functions in an industrial organization and their interrelationship. Elements of manufacturing cost. Economic considerations involved in selection of materials, product design, or manufacturing methods. Production planning, scheduling, dispatching, materials, control, and estimating. Prereq.: Courses 15, 16, 17. 3 cred. Ar.
172. Industrial Plants. Geographical location, design and layout of industrial plants. Materials handling methods and equipment. Consideration of safety, service facilities, working conditions, selection and purchase of equipment. Laboratory work involves

- problems taken from local industrial plants. Prereq.: Courses 171, 174 or registration in 174. 2 cred. Ar.
173. Elements of Supervision. Organization structure. Principles of organization. Main tasks of supervisor. Interpreting company policy. Human element in supervision. Grievances. Leadership. Maintaining interest in work. Common violations of supervision principles. Prereq.: Course 171. 3 cred. Ar.
174. Motion and Time Study Laboratory. Principles of motion economy affecting design of product, work place layout, and tools and equipment used in manufacture. Emphasis on cost reduction through work simplification. Need for time studies. Determination of production standards. Prereq.: Course 171. 2 cred. Ar.
175. Advanced Methods Engineering and Time Study. Correlation of factors affecting proper utilization of human effort and equipment. Economic justifications of methods changes. Establishment and use of standard data. Applications of output measurements. Wage incentives. Plant visits. Prereq.: Courses 172, 174 or registration in 172. 3 cred. Ar.
176. Quality Control. Organization and operation of quality control department. Economics of inspection, selection of personnel, collecting, reporting, sorting, and analyzing of inspection results. Application of statistical methods and sampling theory to inspection. Prereq.: Course 171; 115 recommended but not required. 3 cred. Ar.
179. Industrial Relations. Human problems in an industrial organization and relationship to industrial engineering. Functions of personnel department, collective bargaining, labor laws, job evaluation, wage and salary administration, safety engineering, employee training. Prereq.: Course 171. 3 cred. Ar.
- 277-278-279.* Industrial Engineering Problems. Special investigations of practical problems and suggested methods of procedure. Lect., assigned reading, shop visits, and reports. Prereq.: Courses 173, 175. 3 cred. per quarter. Ar.

REFRIGERATION

180. Refrigeration. Refrigeration cycles; thermodynamics of refrigeration; refrigerants; load calculations; compression, steam jet, and absorption refrigeration; refrigeration equipment. Prereq.: Courses 132, 160 or registration in 160. 3 cred. Jordan.
181. Advanced Refrigeration. Fluid flow and heat transmission applied to refrigeration; condensers and evaporators; refrigeration piping; refrigeration controls; low temperature refrigeration; refrigeration applications. Prereq.: Course 180. 3 cred. Jordan.
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.: Course 180. 2 cred. Jordan.
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.: Course 180 or registration in 180. 2 cred. Jordan.
- 280.* Theoretical Refrigeration. Advanced study dealing with problems involving the theory and design of refrigeration systems. Lect., assigned reading, and reports. Prereq.: Course 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, and reports. Prereq.: Course 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, and reports. Prereq.: Course 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 quarter. Rowley.
- 190-291-292.* 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.

MEDICAL SOCIAL WORK

For statement of prerequisites and of graduate courses and staff, see Sociology and Social Work, pages 192 and 185.

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. Anatomy, pathology, physiology, or psychology would be valuable as a minor for fellows specializing in nervous and mental diseases. 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; Assistant 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—Exemption from the language requirement may be made in exceptional cases by petition.

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

COURSES

- 152f. Metallography for Aeronautical Engineers. Principles of metallography: metallography of iron and steel with special reference to alloy steels and light alloys used in airplane construction. Lab. work and demonstrations. 3 cred. Dowdell, Mackay.
- 153f-154w-155s. Metallography. (Long course for metallurgical engineers.) Theory of metallic alloys. Metallographic technique and photomicrography. Properties of metals and alloys. Metallography of iron and steel and commercial alloys. Technical metallography. Lab. work. Prereq.: Course 12 or equiv. 4 cred. per quarter. Jerabek.

- 156f. Metallography for Mechanical, Mining, and Petroleum Engineers. Principles of metallography, including pyrometry, thermal analysis, constitution diagrams, microscopic and photomicrographic technique; metallography and heat treatment of iron and steel. 3 cred. Dowdell.
- 157w. Advanced Metallography for Mechanical, Mining, and Petroleum Engineers. Metallography of alloy steels, tool steels, high speed tool steels, and important non-ferrous alloys; metallography applied to engineering practice and specifications. Outside reading and special reports. Lab. work. Prereq.: Course 152, 156, or 160. 3 cred. Mackay.
- 160f,w,s. Metallography (Ch.E.). Principles of metallography, including constitution diagrams, preparation and standardization of thermocouples, preparation and thermal analysis of alloys, their microscopic examination and photomicrographs; typical alloy systems such as iron-carbon (steel, cast iron) and some nonferrous alloys. Lab. work. 3 cred. Jerabek, De Money.
- 161w. Advanced Metallography (Ch.E.). Metallography and heat treatment of iron and steel, including alloy steels, commercial uses of various steels, and engineering specifications. Two lect. and three lab. hours per week. Prereq.: Course 152, 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. and three lab. hours per week. Prereq.: Course 152, 156, or 160. 2 or 3 cred. depending on lab. Jerabek.
- 163f. Advanced Metallography Seminar. Work on recent advances in metallography. Lect. and recitations, with outside reading and special 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. and special reports. Prereq.: 6 cred. in metallography. 3 cred. Dowdell.
- 166f-167w-168s. Laboratory. Laboratory work on special problems in ferrous, nonferrous, and X-ray metallography. Prereq.: Course 155. 1 to 3 cred. per quarter. Dowdell, Jerabek.
- 170f-171w-172s. Special Problems in Metallography. 1 to 3 cred. Dowdell, Jerabek.
- 201f-202w-203s. Advanced Metallography. Intended primarily for research work. Cred. ar. Dowdell, Jerabek, Mackay.
- 204f-205w-206s. Metallographic Research. Special research problems and seminar in metallography. Cred. ar. Dowdell, Jerabek, Mackay.
- 210f-211w-212s. Thesis Courses. Intended primarily for research work. Cred. and hours ar. Dowdell, Jerabek, Mackay.

METALLURGY

Professors Thomas L. Joseph, Strathmore R. B. Cooke, Edward W. Davis; Assistant Professor Allan E. Martin; Instructor Gust Bitsianes.

Prerequisites—Elements of physics and chemistry.

Language requirement—Exemption from the language requirement may be made in exceptional cases by petition.

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

COURSES

- 106f. Nonferrous Metallurgy. Metallurgical principles involved in nonferrous metallurgy including leaching, roasting, smelting, and refining. Metallurgy of copper. 3 lect. hours per week. Prereq.: general inorganic chemistry. 3 cred. Bitsianes.
- 107w. Nonferrous Metallurgy. Pyrometallurgy and hydrometallurgy of the recovery and refining of lead, zinc, and cadmium. 3 lect. hours per week. Prereq.: general inorganic chemistry. 3 cred. Bitsianes.
- 108s. Nonferrous Metallurgy. The metallurgy of aluminum, magnesium, nickel, gold, silver, and other metals. 3 lect. hours per week. Prereq.: general inorganic chemistry. 3 cred. Bitsianes.
- 110f. Mineral Dressing. Study of jaw and gyratory crushers, ball mills, rod mills, tube mills, volumetric sizing, gravimetric sizing. Concentration by tables, jigs, bowl classifiers, log washers, and miscellaneous devices used in mineral dressing. 2 lect. and 3 lab. hours per week. Prereq.: Geol. 24. 3 cred. Cooke.
- 111w. Mineral Dressing. Principles of ore beneficiation by gravity methods. 2 lect. and 3 lab. hours per week. Prereq.: Course 110. 3 cred. Cooke.
- 112s. Mineral Dressing. Principles of flotation in ore beneficiation. Special attention to chemical and physical action of the different reagents used, such as frothing, collecting, depressing, activating, conditioning, etc. 2 lect. and 3 lab. hours per week. Prereq.: Course 111. 3 cred. Cooke.
- 121f. Ore Testing (Iron Ores). Methods of beneficiation, principles, methods and machines, concentration, formulas, metallurgical and economic considerations. 1 lect. and 3 lab. hours per week. Prereq.: Course 110. 2 cred. Davis.
- 122w. Advanced Mineral Dressing. Determination of economical methods for metallurgical extraction of nonferrous minerals from ores. 2 lect. and 1 recitation hour per week. Prereq.: Course 112. 3 cred. Cooke.
- 123s. Advanced Mineral Dressing. Consideration of factors affecting extraction. Study of distribution of values in mill and metallurgical products. 2 lect. and 1 recitation hour per week. Prereq.: Course 122. 3 cred. Cooke.
- 124f-125w-126s. Special Problems in Mineral Dressing. Detailed study of mineral dressing problems. Prereq.: Course 112. Cred. and hours ar. Cooke.
- 130f-131w-132s. Special Problems in Nonferrous Metallurgy. Seminar work on metallurgical problems. Prereq.: Course 108. Cred. and hours ar. Joseph, Martin, Bitsianes.
- 133w. Electrometallurgy. Application of electricity to thermometallurgy. Design and operation of electric furnaces and their use in smelting of metals and in the production of ferro alloys. 3 lect. and 3 lab. hours per week. Prereq.: Course 12. 3 cred. Martin.
- 134f. Advanced Metallurgy. Refractories, fuels, and principles of combustion. Thermochemistry of important reactions in process metallurgy. 3 lect. and 4 lab. hours per week. Prereq.: Course 12. 4 cred. Joseph, Martin.
- 135w. Advanced Metallurgy. Detailed study of the blast furnace process. Economics of raw materials, their size, preparation, and physical properties. Control of slag-metal reactions. Trend in furnace design and practice. 3 lect. and 4 lab. hours per week. Prereq.: Course 134. 4 cred. Joseph, Martin.
- 136s. Advanced Metallurgy. Detailed study of steel processes and current problems in controlling quality of product. Physical chemistry of steel making and its application to production problems. 3 lect. and 4 lab. hours per week. Prereq.: Course 135. 4 cred. Martin.
- 140f. Advanced Ore Testing (Iron Ores). Metallurgical calculations and report writing. Prereq.: Course 121. 2 cred. Davis.

- 141f-142w-143s. Special Problems in the Production of Iron and Steel. Conferences, laboratory work. 9 lab. hours per week. 3 cred. per quarter. Joseph, Martin.
- 213f-214w-215s. Thesis Course for Graduate Students. Intended primarily for research work. Cred. and hours ar. Joseph, Cooke, Martin.
- 216f-217w-218s. Special Problems in Metallurgy. Seminar work on metallurgical problems. Cred. and hours ar. Joseph, Martin.
- 219f-220w-221s. Special Problems in Advanced Metallurgy. Intended primarily for research work. Cred. and hours. ar. Joseph, Martin.

MINING AND PETROLEUM ENGINEERING

Professor Walter H. Parker; Associate Professor Louis S. Heilig; Assistant Professors Washington D. Lacabanne, Eugene P. Pfeider.

Prerequisites—Candidates for the degree of master of science in mining or petroleum engineering must have completed an undergraduate course of study, the substantial equivalent of that required for graduation in the School of Mines and Metallurgy of the University of Minnesota. The basic courses in mathematics through calculus; mechanics; strength of materials; hydraulics; general and mine surveying; a geologic sequence including general geology, mineralogy, rock study, petrography, economic geology, and ore deposits; chemistry through quantitative analysis; assaying and general metallurgy must be included. In addition candidates for the degree of master of science in mining engineering must have included in their undergraduate course, ore dressing, exploration, development, and mining methods. Candidates for the degree of master of science in petroleum engineering must have included additional geology so as to have a foundation in sedimentation, structural and metamorphic geology and paleontology, oil field exploration, development, and production methods. In all cases, before registering for advanced courses students will be expected to have the necessary prerequisites.

Language requirement—Exemption from the language requirement may be made in individual cases by petition.

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

MINING

- 111f. Exploration. Prospecting, boring, drill steel, drill bits. Prereq.: Geol. 105. 4 cred. Heilig, Pfeider.
- 112w. Exploration and Development. Explosives, blasting; timbering, timber treating; tunneling, drifting, and mine plant. Prereq.: Course 111. 4 cred. Heilig, Pfeider.
- 113s. Development and Exploitation. Shaft, sinking, raising, stoping, mining methods; support of excavations. Prereq.: Course 112. 4 cred. Parker, Pfeider.
138. The Stone Industries. Monumental and building stones, crushed stone, sand and gravel plants and operations. Prereq.: Course 112. 2 cred. Parker.
139. Practical Mining (Field Trip). Study of mining operations, mine plant, and mining in one or more mining camps. 6 cred. Parker, Pfeider.
- 141f. Report and Administration. Examinations and mining reports; valuation and amortization; depletion and depreciation; taxation; corporations; capitalization; stocks and bonds; contracts and specifications. Prereq.: Course 113. 4 cred. Parker.
- 142w. Coal Mining. Coal mining methods, mechanization, tippel arrangements, and coal preparation. Mine gases. Compensation laws. Mining law and court interpretation. Prereq.: Course 113. 4 cred. Parker.

- 143s. Mining Law, Quarries, and Placers. Mineral laws and court interpretations; mining laws of foreign countries; state mining codes and accident prevention. Placer mining, panning, rockers, sluicing, hydraulicking, dredging, and underground methods. Quarries: requirements, methods of working, machines used, and field for product. Prereq.: Course 142. 4 cred. Parker.
146. Nonmetallic Minerals. Mining and preparation of industrial minerals, gypsum, refractories, ceramic materials, fillers, pigments. Prereq.: Course 112. 2 cred. Parker, Pfeider.
147. Earth Handling and Excavation. Excavation by shovels, draglines, dredges. Handling materials by railroad, trucks, conveyors, and sluices. Prereq.: Course 112. 2 cred. Parker, Pfeider.
- 151-152-153.* Special Problems in Mining. Seminar work on mining problems. Cred. ar. Parker, Heilig, Pfeider.
- 201-202-203.* Special Problems in Mining. Seminar work on mining problems. Cred. ar. Parker.
- 210.* Field Course in Mining. Detailed study of the actual operations, accounts, ore treatment, etc., of a mine. To be arranged with individual students upon application to the department. This may be carried on during a summer. A detailed written report will be required. Cred. ar. Parker, Pfeider.
- 212-213-214.* Special Problems in Mining Economics. Intended primarily for research. Cred. ar. Parker.

PETROLEUM ENGINEERING

- 111f. Oil Field Development. Drilling and completion of oil wells; methods and equipment involved. Problems and protection of the completed well; directional drilling and well surveying; electrical and mechanical logging and other methods of securing underground information; well records. Prereq.: Geol. 105. 3 cred. Lacabanne.
- 112w. Oil Field Production. Principles and methods of producing oil. Characteristics of oil reservoirs, of oil and gas, phase relations under reservoir conditions, condensate fields; sand drainage; oil reservoir performance; lifting oil; secondary methods of oil recovery; gas wells. Prereq.: Course 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; oil refinery methods and principles of cracking; polymerization; alkylation. Prereq.: Inorg.Chem. 12, Phys. 9. 2 cred. Lacabanne.
- 134s. Petroleum Plant. Gas flow and fundamentals of metering methods and calculations. Natural gasoline extraction. Mechanical features of transmission lines for oil and gas. Flow formulas, soil corrosion and prevention. Prereq.: Course 112. 2 cred. Lacabanne.
135. Field Work. Study of equipment and operations in one or more oil fields. Prereq.: Course 112. 6 cred. Lacabanne.
- 138s. Oil Field Mapping. A study of the methods and practices of graphically displaying, studying, and interpreting oil field data. Oil and gas well logs; property, contour, cross-section and correlation maps; methods of displaying data and records, etc. Prereq.: Course 112. 2 cred. Lacabanne.
- 144w-145s. Advanced Petroleum Engineering. Lectures on explosives, rock drilling and blasting, oil well shooting. Shaft sinking and timbering, timber treating, marine foundations, and caissons. Coal mining methods, oil shale and oil sand mining. Proration, unitization, and legal problems of the industry. Valuation, amortization, and depletion. Preparation of a report on the exploration and development of an oil property or some phase of the industry. Prereq.: Course 141. 5 cred. per quarter. Parker.

- 152f-153w-154s. Petroleum Production Technology. Problems in oil and gas production. Mud fluids, core analysis, including permeability and porosity, electrical and mechanical coring, oil well cements, oil flow and drainage through porous formations, water analysis, oil shales, problems. Prereq.: Course 112. 3 cred. per quarter. Lacabanne.
- 155-156-157.* Special Problems in Petroleum Engineering. Seminar in petroleum problems. Prereq.: registration in Course 144-145. Cred. ar. Parker, Lacabanne.
- 201-202-203. Seminar Work on Petroleum Problems. Cred. ar. Parker, Lacabanne.
- 206.* Field Course in Petroleum Engineering. A detailed study of the actual operations, accounts, crude oil treatment, etc., of an oil field lease. To be arranged with individual students upon application to the department. This may be carried on during a summer. A detailed written report will be required. Cred. ar. Parker, Lacabanne.
- 207-208-209.* Special problems in petroleum engineering, intended primarily for research. Cred. ar. Parker, Lacabanne.

MUSIC

Professors Paul M. Oberg, Donald N. Ferguson.

Prerequisites—The candidate for graduate work is required to take a placement test in practical music and music theory.

Language requirement—Normally a reading knowledge of French or German is required. A substitution may be made when knowledge of a different language is necessary for an individual research problem. Such substitutions are made by petition.

Master's degree—Work for the Master's degree is offered under Plan A. An original musical composition with suitable introduction may be offered in place of the usual thesis. Plan B may also be followed for the Master's degree.

COURSES

- 200f-201w-202s.* Basis of Musical Expression. An analytical study of those factors and aspects of the substance of music which convey other impressions of emotional character than those attributable to the elements of structure. Application of the analytical process to the work of one composer, selected by the student with the permission of the instructor. The results are to be presented in a final critical study of the composer's work as literature. Prereq.: Course 56-57-58. 3 cred. per quarter. Ferguson.
- 205f-206w-207s. Composition in Larger Forms. Composition in fugal, symphonic, and choral forms. Prereq.: Course 83-84-85 or equiv. 3 cred. per quarter. Ferguson.
- 209f-210w-211s. Advanced Topics in Musical Analysis. A theoretic-historic treatment of music materials of the Western World with special emphasis on the technique of harmonic and contrapuntal analysis. Prereq.: Course 76. 3 cred. per quarter. Oberg.
- 212f,w,s.* Special Problems in Music. Prereq.: completion of, or concurrent enrolment in Course 200-201-202 and/or 209-210-211. Maximum of 9 cred. allowed. Oberg, Ferguson.

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 Elexious T. Bell, M.D., Head, Benjamin J. Clawson, M.D., Ph.D.; Associate Professors Robert Hebbel, M.D., Ph.D., Kano Ikeda, M.D., Nathaniel H. Lufkin, M.D., James S. McCartney, Jr., M.D., John F. Noble, M.D.; Assistant Professor Ambrose J. Hertzog, M.D., Ph.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.

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

Master's degree with designation in pathology—This degree is given only after three years of work.

Doctor's degree—The Ph.D. degree with designation in pathology may be awarded after the completion of three or more years of graduate work and the presentation of a thesis of high quality.

NOTE—For information on work in Cancer Biology, see pages 56-57.

COURSES

104f,w,s,su. Autopsies. The average number of post-mortems available is about 2,500 per year. Graduate students take part in post-mortems, prepare post-mortem records, and make microscopic examinations of various organs and tissues. The student may attend as many post-mortems as his other work allows. Prereq.: Courses 101, 102. Cred. ar. Staff.

107f,w. Diagnosis of Tumors. Prereq.: Courses 101, 102. 2 to 5 cred. per quarter. McCartney.

107af,w,s. Surgical Pathology. Prereq.: Courses 101, 102. 2 to 5 cred. per quarter. Hebbel.

107bw. Diseases of the Heart. Prereq.: Courses 101, 102. 2½ cred. Clawson.

107cs. Diseases of the Kidney. Prereq.: Courses 101, 102. 2½ cred. Bell.

109f,w,s,su. Clinical Pathologic Conference. The students are provided one week in advance with the clinical history of a case. The case is fully discussed clinically. The students are expected, in so far as possible, to predict the post-mortem findings from the clinical data. A full post-mortem report is then given. One hour per week. Prereq.: Courses 101, 102. 1 cred. per quarter. Bell.

110f,w,s. Seminar in Pathology. Prereq.: Course 102. 1 cred. per quarter. Bell.

111su,f,w,s. Conference on Autopsies. Prereq.: Course 102. 1 cred. per quarter. Bell and staff.

201f,w,s,su. Research. Graduate students with the 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, D.Sc., Ole Gisvold, Ph.D., Charles V. Netz, Ph.D.; Associate Professors Willard J. Hadley, Ph.D., Taito Soine, Ph.D.; Assistant Professor Frank E. DiGangi, Ph.D.

Prerequisites—Graduate work leading to the M.S. and Ph.D. degrees with a major in pharmaceutical chemistry is open to those students who have shown exceptional

scholarship and ability in the undergraduate course of this or some other college of pharmacy of equal standing. Consideration will be given to the applications of those 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 pursue work successfully at the graduate level with a major in pharmaceutical chemistry.

Language requirement—The language requirement of the Graduate School must be met. In exceptional cases a substitution is permitted by petition.

Master's degree—In general, work leading to the master of science degree is offered under Plan A. In exceptional cases, Plan B may be offered by petition.

Doctor's degree—Graduate work leading to the Ph.D. degree is offered to students properly prepared for advanced work in pharmaceutical chemistry.

COURSES

- 161f-162w-163s. Organic Pharmaceutical Products. This course treats of the sources, methods of production, properties, reactions, relationships of structures to activity, and uses of the natural and synthetic organic compounds used as therapeutic agents. 161f deals with hydrocarbons, halogenated hydrocarbons, alcohols, aldehydes, ketones, acids, phenols, ethers, and esters. 162w considers analgesics, organometallics, e.g., mercurials, silver compounds, arsenicals, bismuth compounds, dyes, surface active agents, miscellaneous antiseptic agents, sulfonamides, and antibiotics. 163s treats of 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. 3 cred. per quarter. Gisvold.
- 164w-165s. Special Analytical Methods. A consideration of the Food, Drug, and Cosmetic Act and of many of the official analytical methods of the United States Pharmacopoeia, National Formulary, and the Association of Official Agricultural Chemists. The laboratory work consists of special analytical methods, both physical and chemical, employed in the analyses of some drugs and foods. The viscosimeter, Abbé and Zeiss refractometers, polariscope, Duboscq colorimeter, photoelectric colorimeter, cryoscope, and other special instruments are used in the laboratory for quantitative measurements. Professional elective. (Students contemplating pursuing graduate work with a major in pharmaceutical chemistry and a minor in organic chemistry should elect Course 164w [3 cred.] for their winter professional elective and Org.Chem. 156s [3 cred.] and 159 [2 cred.] for their spring quarter professional elective.) Prereq.: Courses 3, 54, Org.Chem. 2. 3 cred. per quarter. Soine or DiGangi and assistants.
- 201f,w,s.* Pharmaceutical Chemistry Seminar. Required of all students majoring in pharmaceutical chemistry and pharmacognosy. 1 cred. per quarter. Gisvold.
- 202f-203w-204s.* Advanced Analytical Methods. The analyses of complex food, drug, and cosmetic products. Identification of colors, perfumes, flavoring agents, digestants, adulterants, etc. Special precision instruments. Prereq.: Course 165. 3 to 5 cred. per quarter. Rogers, Netz.
- 205f-206w-207s.* Chemistry of Medicinal Products. A study of the chemistry and of the relationships between constitution and physiologic action of organic compounds. Isolation of active principles and syntheses of medicinal compounds. 205f considers proteins, enzymes, co-enzymes, respiratory enzymes, biological oxidation and reductions, vitamins, some hormones, and the cardiac glycosides. Gisvold. 206w treats of organometallics (i.e., mercurials, arsenicals, and bismuth compounds), certain dyes, acridines, sulfones, sulfonamides, amidines, and the complex urcas. Gisvold. 207s considers central nervous system depressants, central nervous system stimulants, analgesics, local anesthetics, parasympathomimetics, sympathomimetics, and spasmolytics. Soine. Prereq.: Org.Chem. 2 and Course 163 or permission of instructor. 3 to 6 cred. per quarter.

- 208f. Carbohydrates and Glycosides. A consideration of the origin, isolation, characterization, and chemistry of the carbohydrates and glycosides. Prereq.: Course 163 or permission of instructor. 3 to 5 cred. Gisvold.
- 209f.* Alkaloids. A discussion of the chemistry and experiments on the methods used to isolate, purify, and characterize the alkaloids. Prereq.: Course 163 or permission of instructor. 3 to 5 cred. Soine.
- 210f.* History of Pharmaceutical Chemistry. 3 cred. Netz.
- 211w.* Terpenes, Carotinoids, Tannins, and Anthocyanins. A discussion of the chemistry and an experimental investigation of the methods of isolation and characterization of the volatile oils and their constituents. Prereq.: Course 163, or permission of instructor. 3 to 5 cred. DiGangi.
- 212s.* Fats, Waxes, Sterols, and Related Compounds. A consideration of the origin, isolation, characterization, and chemistry of the fats, waxes, sterols, and related compounds. Prereq.: Course 163 or permission of instructor. 3 to 5 cred. Gisvold.
- 213f,w,s,su. Special Problems. A 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.: Course 163 or permission of instructor. Cred. ar. Rogers, Gisvold, Hadley, Netz, Soine, DiGangi.
- 214f,w,s,su. Research in Pharmaceutical Chemistry. Cred. ar. Rogers, Gisvold, Hadley, Netz, Soine, DiGangi.

PHARMACOGNOSY

Professors Earl B. Fischer, Ph.D., Charles H. Rogers, D.Sc.

Prerequisites—Graduate work with a major in pharmacognosy is open to those students who have shown exceptional scholarship and ability in the undergraduate course of this or some other college of pharmacy of equal standing. Consideration will be given to the applications of those 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 pursue work successfully at the graduate level with a major in pharmacognosy.

Language requirement—The language requirements of the Graduate School must be met. In exceptional cases a substitution is permitted by petition.

Master's degree—In general, work leading to the master of science degree is offered under Plan A. In exceptional cases, Plan B may be offered by petition.

Doctor's degree—Graduate work leading to the Ph.D. degree is offered to students properly prepared for advanced work in pharmacognosy.

COURSES

- 162w‡-163s.‡ Biological Assay of Drugs. This course includes didactic and laboratory considerations of the biological assays of the vegetable and animal drugs of the United States Pharmacopoeia and National Formulary. Important nonofficial assay methods are also studied. Registration in this course is limited to available instructional facilities. Prereq.: Course 57 and Pharm.Chem. 56. 3 cred per quarter. Fischer.
- 201f.* Advanced Pharmacognosy. A study of the important constituents of vegetable and animal drugs. Laboratory work includes the microscopic study of cell contents as they occur in those drugs, and their isolation and identification by microscopical and microchemical means. Constituents studied include alkaloids, calcium carbonate, calcium oxalate, carbohydrates, fixed oils, glycosides, mucilages and gums, oleoresins, resins, silica, tannins, volatile oils, etc. Prereq.: Courses 55, 56, 57. 3 to 5 cred. Fischer.

‡ A fee of \$5 per quarter is charged for this course.

- 202w.* Advanced Pharmacognosy. A lecture and laboratory course dealing with microscopic characteristics, structure, and function of the various cell forms found in vegetable and animal drugs and the tissues which they constitute. Important microscopical accessories such as the micropolariscope, microphotographic camera, staining reagents, etc., are used in this work. Prereq.: Courses 55, 56, 57. 3 to 5 cred. Fischer.
- 203s.* Advanced Pharmacognosy. 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 and the arrangement of the latter in the plant is applied to the identification, determination of purity, evaluation, and detection of the adulteration of these drugs. Prereq.: Courses 55, 56, 57. 3 to 5 cred. Fischer.
- 204f,w,s,su. Research in Pharmacognosy. Cred. ar. Fischer, Rogers.
- 205f. Microscopy of Foods. The 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.: Courses 55, 56, 57. 3 to 5 cred. Fischer, Rogers.
- 206w. Technical Microscopy. A study of the microscopic characteristics and the identification of technical products such as vegetable and animal fibers, woods, barks, cellulose, textiles, seeds, etc. Prereq.: Courses 55, 56, 57. 3 to 5 cred. Fischer, Rogers.
- NOTE—All students majoring in Pharmacognosy are required to take Pharm.Chem. 201, Pharmaceutical Chemistry Seminar.

PHARMACOLOGY

Professor Raymond N. Bieter, M.D., Ph.D.; Associate Professor Harold N. G. Wright, Ph.D.

The laboratories of the Department of Pharmacology are excellently equipped for the study of both the chemical properties of drugs and their actions upon the functions of the living organs and tissues, for studies upon the detection, isolation, and estimation of poisons, and for experimental chemotherapy. By the co-operation of the clinical departments, special studies may be made of the action of drugs, old and new, upon patients in the University Hospitals and allied hospitals.

Opportunities are afforded for the special study of the actions of drugs which are used in each of the clinical specialties and the literature bearing upon them. As the needs of each graduate student are individual in this regard, these studies are taken up by conference, seminar, and experiments specially devised to meet each case.

Prerequisites—In addition to fulfilling the usual requirements for admission to the Graduate School including a Bachelor's degree, students should satisfy the requirements for entrance to the Medical School.

Minor—This department offers work for a minor to students in allied sciences.

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

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

COURSES

- 101f,w,su. Introduction to Pharmacology. The principles underlying the structure, physiochemical properties, physiologic, therapeutic, and toxic action of substances, natural or synthetic, used as medicines. Prereq.: at least one quarter of physiology. 2 cred. Bieter, Wright.
- 102w,s,su. General Pharmacology. A study of the most important drugs used in medicine with consideration of their chemical properties, actions on the normal and abnormal body, modes of administration, preparation, dosages, etc. Prereq.: at least one quarter of physiology. 6 cred. Bieter, Wright.

- 103f,s,su. General Pharmacology, in continuation. Lectures on narcotic, soporific, analgesic, antipyretic drugs. Remedies used for the treatment of arthritides, etc. Writing of prescriptions for the drugs used. 1 cred. Bieter, Wright.
- 104f,s,su. General Pharmacology, in continuation. Lectures on the salts of the metals, antiseptics, antisyphilitic drugs, chemotherapy, etc. 1 cred. Bieter, Wright.
- 108f,s,su. Prescription Writing. The principles of prescription writing. 1 cred. Wright.
- 109f,w,s,su. Pharmacological Problems. Special investigations and experimental study of one or more of the following topics: anesthetics; circulatory stimulants and depressants; drugs acting upon the kidneys; chemotherapeutic drugs; antiseptics; urinary antiseptics; poisons and antidotes; effects of common drugs; internal secretions; action of drugs upon parasites, tumors, etc. Cred. ar. Bieter, Wright.
- 110f,w,s,su. Poisons. Their detection, actions, and antidotes. Lect., 2 cred., lab., 3 cred. Wright.
- 111f,w,su. Advanced Toxicology. Quantitative toxicological analysis. Cred. ar. Wright.
- 123f,w,s,su. Special Topics in Pharmacology. 2 cred. Bieter, Wright.
- 124f,w,s,su. Pharmacology of Special Systems. Lect. and conferences. 3 cred. Bieter, Wright.
- 203su,f,w,s. Research in Pharmacology. Hours and cred. ar. Bieter, Wright.
- 204f,w,s. Advanced Pharmacology. With collateral readings. Limited to six advanced students. Hours ar. 1 cred. Staff.
- 205f,w,s. General Discussions in Pharmacology. With collateral readings. Hours and cred. ar. Bieter, Wright.

PHILOSOPHY

Professors George P. Conger, Alburey Castell, Herbert Feigl; Associate Professors Paul E. Meehl, Mary Shaw, Wilfrid Sellars; Assistant Professors Paul L. Holmer, John Hospers; Instructor Forrest O. Wiggins.

Prerequisites—For a major, 18 credits; for a minor, 9 credits. Registration for major work in philosophy is permitted only upon consultation with a graduate adviser in the department.

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

Doctor's degree—Students undertaking a graduate major in philosophy need not necessarily have completed an undergraduate major in philosophy. If they have not had Philosophy 1 (Problems of Philosophy) they must complete Philosophy 101-102-103 (Principles of Philosophy) before taking their preliminary examinations at the end of the second year. If they have not had Philosophy 50-51-52 (General History of Philosophy) they must complete Philosophy 230-231-232 (History of Philosophy, Advanced) or an acceptable program of courses in major historical figures before taking their preliminary examinations.

NOTE—Students interested in major work in American Studies will find a description of this work on pages 17-18. For credit in Humanities Seminar, see page 117.

COURSES

- 101f-102w-103s. Principles of Philosophy. 101f. Knowledge, meaning, and truth; 102w. Reality, mind, and nature; 103s. Human values and actions. Open only to students who have not had Course 1 (Problems of Philosophy). 2 cred. per quarter. Feigl.
- 106f-107w. Philosophy of Plato. Prereq.: Course 50 or permission of instructor. 3 cred. per quarter. Sellars.
- 108s. Philosophy of Aristotle. Prereq.: Course 50 or permission of instructor. 3 cred. (Offered biennially. Not offered in 1948-49.)

- 110f. Rationalism. Philosophies of Descartes, Spinoza, Leibniz. Prereq.: 2 courses from 50-51-52. 3 cred. Sellars.
- 111f. Empiricism. Prereq.: Course 52 or permission of instructor. 3 cred. Shaw.
- 112s. Kant. Prereq.: Course 52 or permission of instructor. 3 cred. Sellars.
- 113s. Kierkegaard and Scandinavian Philosophy. Prereq.: 2 courses from 50-51-52 or permission of instructor. 3 cred. Holmer.
- 114f. Introduction to American Philosophy: from Puritanism to Pragmatism. A study of John Edwards, deism, Emerson, evolutionism, and William James. Especially for students of American history and literature. 3 cred. Castell.
- 114Aw. American Philosophy since William James. Prereq.: Course 114 or permission of instructor. 3 cred. Castell.
- 114As. European Backgrounds of American Thought. A study of seventeenth-, eighteenth-, and nineteenth-century European thinkers who exercised an important influence on American thought. Prereq.: Course 114 or permission of instructor. 3 cred. Castell.
- 115s. Contemporary Philosophy. A study of current systematic and critical philosophies, especially idealism, naturalism, realism, pragmatism, and positivism, as represented by their principal exponents. Prereq.: Course 52 or permission of instructor. 3 cred. Ar.
- 116s. Philosophy of John Dewey. Prereq.: Course 52 or permission of instructor. 3 cred. Wiggins. (Not offered in 1948-49.)
- 117f-118w-119s. Readings in Recent Philosophy. An intensive study of works by Russell, Whitehead, and Collingwood; in other years, works by other authors. Prereq.: Course 52 or permission of instructor. 3 cred. per quarter. Holmer.
- 123w. Comparative Philosophy. Prereq.: 1 course from 50-51-52. 3 cred. Conger.
- 135s. 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. Castell.
- 143f. Theory of Knowledge. An analysis of the logical structure and the experiential roots of knowledge. The topics include meaning, validity, truth, reason, and experience, induction, criteria of objectivity and reality. Prereq.: Course 2 or permission of instructor. 3 cred. Feigl.
- 147s. Elements of Symbolic Logic and Semantics. A systematic introduction to modern mathematical logic and the logical analysis of language. The topics include the dimensions of language; calculus of propositions, classes, and relations; applications to foundations of mathematics. Prereq.: Course 2 or permission of instructor. 3 cred. Feigl.
- 153w. 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. The topics include description, explanation, prediction, experimentation; space, time, number, matter, energy; causality, probability, statistics; organic life, evolution, mind. Prereq.: Course 2 or permission of instructor. 3 cred. Feigl.
- 155s. Metaphysics. Prereq.: 2 courses from 50-51-52 or permission of instructor. 5 cred. Conger.
- 164s. Ethical Theory. Prereq.: 2 courses from 50-51-52 or permission of instructor. 3 cred. Sellars.
- 165w. Political and Social Ethics. Prereq.: permission of instructor. 3 cred. (Not offered in 1948-49.)
- 170f. Philosophy of History. Prereq.: 6 cred. in philosophy or 10 cred. in history. 3 cred. Holmer.
- 180f. History of Religions. Prereq.: 6 cred. or permission of instructor. 3 cred. Conger.

- 181w. Psychology of Religion. Prereq.: 6 cred. or permission of instructor. 3 cred. Conger.
- 182s. Philosophy of Religion. Prereq.: 6 cred. or permission of instructor. 3 cred. Conger.
- 191f-192w-193s. Seminar in Philosophy. Individual investigation, with topics to be determined after consultation with the department. Prereq.: 9 cred. in philosophy, permission of instructor. 3 cred. per quarter. Conger, Feigl, Castell, Sellars, and others.
- 220f-221w-222s. Seminar in Philosophical Analysis. A systematic study, at the advanced level, of the basic concepts and problems of epistemology. Prereq.: Course 143 or permission of instructor. 3 cred. per quarter. 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 Course 50-51-52 may enroll with permission of instructor. 3 cred. per quarter.
- 241f-242w-243s. Seminar: Philosophy of the Physical Sciences. 241f. Scientific explanation; 242w. Space and time; 243s. Causality and probability. Prereq.: permission of instructor. 3 cred. per quarter. (Not offered in 1948-49.)
- 244f-245w-246s. Seminar: Philosophy and Biology and Psychology. 244f. Fundamental problems of biology; 245w. The subject matter of psychology; 246s. Methods and theories in psychology. Prereq.: permission of instructor. 3 cred. per quarter. Feigl, Meehl.
- 247f-248w-249s. Seminar: Logic of the Exact Sciences. 247f. The nature of scientific method; 248w. Problems of modern logic; 249s. Foundations of mathematics. Prereq.: permission of instructor. 3 cred. per quarter. Feigl.
- 250f-251w-252s. Seminar: Philosophy of the Cultural Sciences. 250f. Theories of value; 251w. Philosophical problems of history and sociology; 252s. Philosophy of language. Prereq.: permission of instructor. 3 cred. per quarter. Feigl.
- 350f-351w-352s. Research in History of Philosophy. Prereq.: permission of instructor. Cred. ar. Sellars and others.
- 360f-361w-362s. Research in Philosophy of Science. Prereq.: permission of instructor. Cred. ar. Feigl and others.
- 370f-371w-372s. Research in Philosophy of Culture. Prereq.: permission of instructor. Cred. ar. Conger and others.

PHYSICS

Professors J. William Buchta, Edward L. Hill, Alfred O. C. Nier, John T. Tate, Joseph Valasek, John H. Williams; Associate Professors Charles L. Critchfield, Otto H. Schmitt, Clifford N. Wall; Assistant Professors Edward J. Lofgren, Edward P. Ney, Frank Oppenheimer, Joseph W. Weinberg.

Prerequisites—For major work, differential and integral calculus and two years of physics of college grade. For minor work, differential and integral calculus and one year of college physics.

Major—It is recommended that students taking a major in physics complete Courses 181-183-185 and 191-192-193. Alterations of this requirement may be made only after consultation with the chairman of the department.

Language requirement—For the Master's degree a reading knowledge of French or German is required. It is desirable that the language requirement be fulfilled before graduate work is begun. For the Ph.D. degree a reading knowledge of German and French is required. Russian may be substituted for one of these by petition.

Master's degree—Work for the Master's degree is offered under either Plan A or Plan B.

Doctor's degree—Work for the Ph.D. degree is offered by this department.

COURSES

- 101f-103w-105s. Theoretical Physics. An analytical survey of the fundamental principles of mechanics, heat, electricity, and magnetism designed to supplement the general courses and to prepare students for more specialized courses. Five lect. per week. Prereq.: 15 cred. in physics, Math. 106 or registration in Math. 106. 5 cred. per quarter. Nier.
- 107f*-109w*-111s.* Modern Physics. A survey of the newer developments in physics. Students may, with the permission of the instructor, enter any quarter. Prereq.: Math. 51, 15 cred. in physics. 3 cred. per quarter. Oppenheimer.
- 110w,s,su*‡-112w,s,su.*‡ Modern Experimental Physics. Laboratory work. Characteristics of vacuum gauges, mass spectroscopy, electronic tubes and associated circuits, radioactivity, Geiger counters, ionization of gases. Prereq.: Course 144. 3 cred. per quarter. Schmitt.
- 113w. Intermediate Acoustics. The mechanics of vibrating systems and wave motion. The production, propagation, analysis, and reception of sound. Prereq.: Math. 51, 15 cred. in physics. 3 cred. Buchta. (Not offered in 1948-49.)
- 114f,w,s*‡-116f,w,s*-118f,w,s.*§ Elementary Physical Investigation. Problems, either experimental or theoretical, in which the student may have some special interest. A written report on the work accomplished is required. Prereq.: registration by permission of department chairman. 3 cred. per quarter. Staff.
- 131f. Geometrical Optics. Theory of mirrors, prisms, and lenses. Optical instruments. Prereq.: 15 cred. in physics, Math. 51. 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 physics, Math. 51. 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 physics. 3 cred. Valasek.
- 135s. Spectroscopy. Light sources, instruments, and methods used in spectroscopy of the X-ray, ultra-violet, visible, and infra-red regions of the spectrum. Prereq.: 15 cred. in physics, Math. 51. 3 cred. Valasek.
- 136w,s.*‡ Spectrum Analysis. Laboratory work dealing with the measurement of wave lengths, intensities, and absorption coefficients in the infra-red, visible, and ultra-violet regions of the spectrum. 2 three-hour lab. periods a week. Prereq.: 15 cred. in physics. 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 physics, Math. 51. 3 cred. Wall.
- 146w.*‡ Electronics. Physics of vacuum tubes and associated circuits. Thermionics. Prereq.: Course 144, permission of instructor. 3 cred. Schmitt.
- 155w.* Biophysics. A survey of theoretical and experimental aspects of biology which can be studied by quantitative methods. Prereq.: course work in physics and zoology to a total of 25 cred., permission of instructor. 3 cred. Schmitt.
- 181f*-183w*-185s.* Atomistics and Elementary Quantum Mechanics. Atomic structure, X rays, spectrum analysis, and an introduction to wave mechanics. Prereq.: Course 101-103-105 or permission of instructor. 3 cred. per quarter. Tate.

‡ A fee of \$2 per quarter is charged for this course.

§ Students may enter any quarter.

191f*-192w*-193s.* Introduction to Mathematical Physics. An intensive treatment of the differential equations of mathematical physics using material drawn from the fields of mechanics, small vibrations of continuous media, acoustics, electromagnetic theory, and heat conduction. Prereq.: Course 101-103-105, registration in Math. sequence 106-107-108 or equiv. 3 cred. per quarter. Hill.

Mathematical Physics (191-192-193) or permission of the instructor and advanced calculus are prerequisites for all of the courses listed below. A reading knowledge of German is highly desirable and will be presumed in certain phases of the work. 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.

201f-202w-203s. Analytical Dynamics, Hydrodynamics, and Elasticity. Lagrange's equations, variational principles, fluid motion, wave propagation in fluid and solid media, theory of small vibrations, specification of elastic properties of materials. 3 cred. per quarter. Hill.

204f-205w-206s. Statistical Thermodynamics. Kinetic theory and statistical mechanics. Specific heats of gases and solids. Laws of thermodynamics, phase rule, equations of state, potentials, statistical interpretation of thermodynamics. 3 cred. per quarter. Wall.

207f-208w-209s. Electrodynamics and Theoretical Optics. General field equations, electron theory, and the special theory of relativity. Mathematical theory of the optical behavior of isotropic, anisotropic, and metallic media. 3 cred. per quarter. Weinberg.

210f-211w-212s. Quantum Mechanics. Fundamentals of wave mechanics and matrix theory. Application to spectra, atomic structure, nucleus, and theory of the electron. 3 cred. per quarter. Critchfield.

213f*-214w*-215s.* Seminar in Contemporary Experimental Physics. Discussions and presentation of reports on fields of major interest and importance. Various subjects may be selected such as radioactivity, nuclear physics, solid state, molecular or atomic spectra, X rays, crystal structure, cosmic rays, etc. 3 cred. per quarter. Staff.

216f*-217w*-218s.* Seminar in Contemporary Theoretical Physics. Discussions and reports on fields of major interest in theoretical physics, particularly quantum mechanics and its applications in chemistry and physics. 3 cred. per quarter. Staff.

The following courses will be offered whenever there is sufficient demand for them:

219f-220w-221s. The Partial Differential Equations of Mathematical Physics.

222f-223w-224s. The General Theory of Relativity.

225f-226w-227s. Advanced Quantum Theory.

228f-229w-230s. Advanced Nuclear Theory.

231f-232w-233s. Theory of Molecular Structure and the Solid State.

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

Professor Wallace D. Armstrong, M.D., Ph.D., Walter O. Lundberg, Ph.D., Karl Sollner, Ph.D.; Associate Professors Cyrus P. Barnum, Jr., Ph.D., David Glick, Ph.D.; Assistant Professors Saul L. Cohen, Ph.D., Elizabeth Frame, Ph.D.

Prerequisites—Students in this department are required to have a Bachelor's degree with a major in chemistry or physics and a minor in some other science. Organic

chemistry is required of all students, and in addition physical chemistry is required of candidates for the Ph.D. degree.

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

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

COURSES

- 100f,su-101w,su. Physiological Chemistry. The components of the animal body; foods, digestion, excreta, and metabolism. Prereq.: physics, organic chemistry. 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.: Course 100-101. Hours and cred. ar. Armstrong, Barnum, Glick, Lundberg, Cohen, Frame.
- 155f,w,s. Seminar and Conference on Dental and Oral Biochemistry. Reports on assigned topics and discussions of current literature. Prereq.: Course 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, Lundberg, Sollner, Cohen, Frame.
- 206f.§ Advanced Endocrinology and Steroid Chemistry. Prereq.: Course 100-101. 3 cred. Cohen. (Offered in sessions which begin with an odd-numbered year.)
- 207w.§ Ionic Equilibria and Mineral Metabolism. Prereq.: Course 100-101. 3 cred. Armstrong. (Offered in sessions which begin with an odd-numbered year.)
- 208s. Advanced Laboratory Technique. Limited to 10 students. Prereq.: Course 100-101. 3 cred. Staff. (Offered in sessions which begin with an odd-numbered year.)
- 209f.§ Histochemistry. Prereq.: Course 100-101 and histology or permission of instructor. 3 cred. Glick. (Offered in sessions which begin with an even-numbered year.)
- 210w.§ Nitrogen Metabolism. Prereq.: Course 100-101. 3 cred. Frame. (Offered in sessions which begin with an even-numbered year.)
- 211s.§ Intermediary Metabolism. Prereq.: Course 100-101. 3 cred. Barnum. (Offered in sessions which begin with an even-numbered year.)
- 212f,w,s,su. Histochemistry Laboratory. Selected problems in the field of histochemistry designed to meet the interests of the individual. Prereq.: Course 100-101 and with permission of the instructor only. Hours and cred. ar. Glick.
- 213f,w,s. Clinical Physiological Chemistry. Hours and cred. ar. Staff.

PHYSIOLOGICAL HYGIENE

Professor Ancel Keys, Ph.D.; Associate Professors Austin F. Henschel, Ph.D., Ernst Simonson, M.D.; Assistant Professors Josef M. Brozek, Ph.D., Henry L. Taylor, Ph.D.

Language requirements—In exceptional cases substitution of Spanish or Russian for French may be permitted by petition.

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

Doctor's degree—Work is offered in physiological hygiene leading toward the Ph.D. degree.

COURSES

P.H.190w. Science and Human Nutrition. Evaluation of nutritional status, surveys, undernutrition and malnutrition, special dietetics in social relief and medical practice. Prereq.: 8 cred. in organic chemistry or biochemistry, Courses 91, 92 or Physiol. 103 or equiv., permission of instructor. 3 cred. Keys.

§ Offered only if 8 or more students are registered.

- P.H.192w. Physiology of Exercise. Mechanics of motion, physical training and de-training, acute and chronic effects of exercise, muscular efficiency, muscular defects. Prereq.: Course 92 or Physiol. 103 or equiv., permission of instructor. 4 cred. Keys and staff.
- P.H.194f. Human Factors in Industry. Primarily for students in the Schools of Business Administration and Public Health and the Institute of Technology. Job requirements, physiological cost of work, industrial fatigue, industrial hazards, environment, accidents, absenteeism. Prereq.: 20 cred. in at least two of the following: chemistry, biology, psychology, engineering. 3 cred. Brozek, Simonson.
- P.H.202w. Nutrition in Public Health. Current developments in nutrition related to public health. Limited enrolment. 1 cred. Keys. (To be offered in 1948-49 and alternate years thereafter.)
- P.H.204f. Tests and Measurements in the Appraisal of Human Physical Fitness. Current developments in the measurement of strength, endurance, co-ordination, and fitness. Limited enrolment. 1 cred. Simonson, Brozek, Henschel. (To be offered in 1948-49 and alternate years thereafter.)
- P.H.206w. Gerontology. Physiological and psychological problems of old age. Limited enrolment. 1 cred. Brozek, Taylor. (To be offered in 1949-50 and alternate years thereafter.)
- P.H.208f. Human Adaptation in Health and Disease. The human body as a whole and its responses to physiological and pathological stresses. Limited enrolment. 1 cred. (To be offered in 1949-50 and alternate years thereafter.) Keys and staff.
- P.H.220f,w,s. Readings in Problems of Physiological Hygiene. Prereq.: permission of instructor. Cred. ar.
- A. Electrocardiographic Interpretation. Simonson.
 - B. Industrial Fatigue. Brozek.
 - C. Physical Training and De-training. Henschel.
 - D. Human Climatology. Taylor.
 - E. Circulatory Mechanics. Keys.
 - F. State and Function of Human Muscle. Simonson.
- 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, Ernst Gellhorn, M.D., Ph.D., K. Wilhelm Stenstrom, Ph.D., Herbert S. Wells, M.D.; Associate Professors Allan Hemingway, Ph.D., Joseph T. King, M.D., Ph.D., Nathan Lifson, M.D., Ph.D.; Assistant Professor Roger M. Reinecke, M.D., Ph.D.

Prerequisites—For a major or minor in physiology, acceptable courses in general zoology or anatomy, general chemistry, organic chemistry, and college physics are prerequisites. Physical chemistry is desirable.

Language requirement—A reading knowledge of German, French, Russian, or Spanish is required of candidates for the Master's degree in this department, and a reading knowledge of French and German of candidates for the Doctor's degree unless substitution is permitted upon the student's petition.

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—Work for the master of science degree is offered under both Plan A and Plan B, the latter only by petition.

Doctor's degree—Work for the Ph.D. degree is offered to candidates whose background of training is approved by the department.

COURSES

- 103su,s. Physiology of Muscle, Circulation, Respiration, Digestion, Metabolism, and Nutrition. Prereq.: organic chemistry and zoology. 9 cred. Visscher, Gellhorn, Hemingway, King, Lifson.
- 104f,su. Physiology of Excretion, the Endocrines, Nervous System, and Special Senses. Prereq.: Course 103 or organic chemistry and neurology. 6 cred. Visscher, Gellhorn, Hemingway, King, Lifson.
105. Roentgen Rays, Light, and Radium. The physical and physiological basis of physical therapy. 1 cred. Stenstrom.
- 113su,f,w,s. Problems in Physiology. Arranged by instructors with qualified students. Each student will be assigned a topic for special laboratory study, leading in some cases to original investigation. Conferences and reading. May be taken one or more quarters. Prereq.: Courses 103, 104, or equiv. 3 cred. per quarter or ar. Visscher, Gellhorn, Hemingway, King, Lifson.
- 135af,w,s.* Conference on Physiology, with qualified students. 1 cred. Visscher, Gellhorn, Hemingway, King, Lifson.
- 135bf,w. Seminar in Neurophysiology. 1 cred. Gellhorn.
- 201f,w,s,su.* Seminar in Physiology and Physiological Chemistry. For instructors and advanced students. Cred. ar. Visscher, Armstrong.
- 202f,w,s,su.* Readings in Physiology. Topics will be selected for each student, and written reviews will be prepared and discussed. 1 to 3 cred. Visscher, Gellhorn, Hemingway, King, Lifson.
- 203f,w,s,su. Research in Physiology. Hours and cred. ar. Visscher, Hemingway, King, Lifson.
- 204f,w,s,su. Research in Physics and Physiology of Radiation. Cred. ar. Stenstrom.
- 206s.* Seminar in History of Physiology and Related Sciences. 1 cred. Visscher.
- 208f,w,s. Clinical Physiology. Hours and cred. ar. Wells.
- 209f,w,s. Conference on General Physiology. Hours and cred. ar. Staff.

PLANT PATHOLOGY AND BOTANY

Professors Elvin C. Stakman, Clyde M. Christensen, Jonas J. Christensen, Carl J. Eide, Helen Hart; Assistant Professors Louise Dodsall, Raymond H. Landon, Alvin H. Larson, Milton F. Kernkamp; Instructors Harold G. Heggeness, Matthew B. Moore, Thomas H. King.

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), including mycology.

Plant Pathology minor: The minimum requirement is (a) three years (27 credits) in the basic biological sciences; (b) five credits in plant pathology (not including mycology).

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.

Plant Physiology and Agricultural Botany minor: The minimum requirement is (a) three years (27 credits) in the basic plant sciences; (b) five credits in plant physiology.

Language requirement—For the Master's degree under Plan A, foreign language required; for the Master's degree under Plan B, a reading knowledge of a foreign language strongly advised but not required.

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

Doctor's degree—Work for the Ph.D. degree is offered by this division under the regular conditions of the Graduate School.

COURSES

PATHOLOGY

- 104w. Industrial Mycology. Fungi in relation to industrial processes and products. Prereq.: Course 1, 10, or 56. 3 cred. C. M. Christensen.
- 105f-106w-107s. Mycology. Morphology and taxonomy of fungi. Lect., lab., and field work. Prereq.: Course 1 or 10 or equiv. 3 or 5 cred. per quarter. Dodsall.
- 111w. Diseases of Field Crops. Symptomatology, etiology, and practical methods of control. Lab., lect., and greenhouse work. Prereq.: Course 1 or 10. 4 cred. J. J. Christensen, Kernkamp.
- 112s. Diseases of Fruit and Vegetable Crops. Detailed study of fruit and vegetable diseases, especially those important in Minnesota. Lab., lect., and field work. Prereq.: Course 1 or 10. 4 cred. King. (Offered in alternate years. Offered in 1948-49.)
- 114w. Advanced Forest Pathology. Wood rots, including a study of the deterioration of wood products caused by fungi. Lect. and lab. Prereq.: Course 1 or 10. 4 cred. C. M. Christensen.
- 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.: Course 1 or 10. 3 cred. Eide. (Offered in alternate years. Not offered in 1948-49.)
- 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.: Course 1 or 10. 3 cred. Eide. (Offered in alternate years. Offered in 1948-49.)
- 119s. Principles of Plant Disease Control. A general consideration of principles and practices in controlling plant diseases. Prereq.: Course 1 or 10. 3 cred. Moore, King.
- 120f,w,s. Advanced Plant Pathology. A course in general plant pathology, including lectures, laboratory, and greenhouse work and special problems. Prereq.: the equiv. of Course 1 or 10 or permission of instructor; not open to students who have had Course 1 or 10. 3 cred. C. M. Christensen, Moore.
- 141f-142w. Insects in Relation to Plant Diseases. A study of 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 entomology or plant pathology. 3 cred. per quarter. J. J. Christensen, Granovsky.
- 143f. Methods. Theoretical and practical consideration of methods used in mycological and pathological research. Prereq.: Course 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 botany or permission of instructor. 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, J. J. Christensen, Eide, Hart, C. M. Christensen, Dodsall, Kernkamp, King.
- 207f-208w-209s-210su.* Special Problems in Mycology. Research work along following suggested lines: 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.: Course 105-106-107. For minor or major. Cred. ar. Stakman, C. M. Christensen, Dodsall.

- 211w. History of Plant Pathology. The development of plant pathology as a science. 2 cred. Stakman.
- 213.* Seminar. Critical review of progress and problems in plant pathology. 2 cred. Stakman, J. J. Christensen, Eide, Hart, C. M. Christensen, Dossdall, Kernkamp, King.
- 215f.§ Genetics of Plant Pathogens. A study of physiologic specialization, sexuality, hybridization, mutation, and similar phenomena in plant pathogens, with particular emphasis on practical implications. Prereq.: Course 1 or 10 and Agron. and Pl.Gen. 131. 5 cred. Stakman, J. J. Christensen. (Offered in alternate years. Offered in 1948-49.)
- 216f.§ Physiology of Plant Pathogens. The physical and chemical requirements and effects of plant pathogens in relation to their parasitism. 3 or 5 cred. (Offered in alternate years. Not offered in 1948-49.)
- 217s.§ Ecology of Plant Pathogens. The effect of environmental factors on the development of plant pathogens and plant disease epidemics. 3 cred. Kernkamp. (Offered in alternate years. Not offered in 1948-49.)
- 218w. Principles of Plant Pathology. A systematic consideration of the basic factors governing the development of plant diseases. Prereq.: Course 1 or 10, Bact. 53, and 6 additional cred. in plant pathology. 5 cred. Stakman, Eide.

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 botany 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.: Bot. 51, Agr.Biochem. 4. 3 cred. Landon, Larson.
- 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. Larson, Dunham.
- 160f. Plant Histochemistry. The localization, identification, and function of plant constituents. Lect., demonstration, and lab. Prereq.: Bot. 51 or equiv. 3 cred. Landon.
- 161f. Technology of Fruits and Vegetables. The effects of temperature, respiration, packing, etc., on storage life. Prereq.: 3 cred. in plant physiology. 3 cred. Landon.
- 162w. Temperature Relations of Crop Plants. Detailed study of hardiness and general temperature effects. Prereq.: 3 cred. in plant physiology. 3 cred. Landon.
- 163s. Applied Plant Physiology. A general discussion of plant physiology as applied to the food industries and to agriculture and forestry. Lect. and demonstrations. Prereq.: Bot. 51. 3 cred. Landon.
- 250s.* Research Methods in Applied Plant Physiology. Advanced research methods of analysis and physical measurements applied in physiology. Lab. and lect. 3 to 5 cred. Landon.
- 251f-252w-253s.* Seminar in Applied Plant Physiology. 1 cred. per quarter. Landon.
- 254f-255w-256s-257su.* Research Problems in Applied Plant Physiology. Special assignment of work in applied plant physiology. Cred. ar. Landon.
- 258f-259w.* Growth Factors in Crop Plants. A lecture and reading course covering genetic physiology, the initiation of growth, growth rate, and effect of the environment on growth. Prereq.: cytology and genetics. 3 cred. per quarter. Landon.
- 260f,261w,262s,263su. Research Problems in Agricultural Botany. Special assignment of problems in agricultural botany. 3 or 5 cred. per quarter. Stakman, Larson.

§ If there is sufficient demand for courses offered in alternate years, they will be given out of turn.

POLITICAL SCIENCE

Professors Harold S. Quigley, William Anderson, Asher N. Christensen, Benjamin Lippincott, Clarence C. Ludwig, Lennox A. Mills, Lloyd M. Short; Associate Professors Werner Levi, Mulford Q. Sibley; Assistant Professors Alfred J. de Grazia, Herbert McClosky, Charles H. McLaughlin, Arthur E. Naftalin, Edward W. Weidner.

Prerequisites—Courses in political science are open to all regularly enrolled graduate students who can meet the prerequisites prescribed for particular courses. Before being accepted as a candidate for a graduate degree with a major or minor in political science, a student shall satisfy his adviser that he is sufficiently prepared to carry on graduate work in the fields in which he proposes to specialize. In exceptional cases the completion of preparatory courses in other social sciences may be accepted as part of the prerequisites.

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 within that field that are offered by the department. He is, however, required to prepare himself for examination in some extensive part of the field that is dealt with in courses and seminars offered by the department.

The fields ordinarily recognized, though somewhat overlapping, are as follows: (a) American government, politics, and administration; (b) public law; (c) comparative modern government; (d) political theory; (e) local government and administration; (f) international law, organization and relations. The same course may not be used to satisfy the requirements in two or more fields.

REQUIREMENTS FOR THE DEGREE OF MASTER OF ARTS

General Requirement—All candidates for the degree of doctor of philosophy and master of arts under Plan A are required to complete Course 229 (Scope and Methods of Political Science), or to present evidence of the satisfactory completion of a course similar in content and purpose at another approved institution. Candidates for the degree of master of arts who are not in residence at a time when this course is offered are excused from the requirement.

Plan A with major in political science—The work leading to the degree of master of arts consists of at least one full year of graduate study. This may be estimated as follows: (1) at least 18 quarter credits in political science in addition to Course 229; (2) at least 9 quarter credits in the minor department; and (3) satisfactory completion of a substantial thesis based upon independent research. The courses taken in the major should be grouped in two fields of specialization, and those taken in the minor should consist of a single 9-credit course, or a three-quarter sequence of related courses totaling 9 quarter credits.

Plan A with minor in political science—A candidate for the degree of master of arts who elects political science as his minor must take at least one 9-credit course, or a three-quarter sequence of related courses totaling 9 quarter credits.

Plan B with political science as the field of concentration—A candidate for the degree of master of arts without thesis shall take 21 to 27 quarter credits in political science, of which 9 must be in courses marked with the asterisk (*). These courses should admit of a logical grouping in at least two, and not more than three, of the fields of specialization. In addition, the candidate is required to take 18 to 24 quarter credits in related fields, so as to make a total program of 45 quarter credits. The courses elected in political science along with those taken in the related fields should constitute an integrated plan of study.

REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Major in political science—The candidate shall, with the approval of his adviser, choose four fields of specialization, one of which shall be designated as his thesis field. The candidate is responsible for preparing himself in these fields, and must pass the examinations which are required by the rules of the Graduate School. To this end the candidate will pursue a program of courses and seminars in political science that will vary in content and amount according to his individual needs and the amount of work in political science and related fields completed as an undergraduate. He will also satisfy the requirements of the minor department. The work leading to the degree of doctor of philosophy consists of at least three full years of graduate study. The requirements for course work will be decreased for those who enter the Graduate School with advanced standing.

Minor in political science—A candidate for the degree of doctor of philosophy who elects political science as his minor shall prepare himself in not more than two fields of specialization.

NOTE—For information on work in Public Administration, see page 22; for International Relations, see page 21.

COURSES

- 101f.* Principles of the American Constitution. The nature of constitutions, judicial review, national-state, and interstate relations. Prereq.: Course 1-2 or equiv. 3 cred. Anderson.
- 102w.* Principles of the American Constitution. Organization and powers of the national government. Prereq.: Course 101 or equiv. 3 cred. Anderson.
- 103s.* Principles of the American Constitution. Constitutional rights, due process and equal protection of the law. Prereq.: Course 101 or 102 or equiv. 3 cred. Anderson.
- 104-105-106.* American Constitutional Development. An examination of the origin and development of the American constitutional system coupled with a critical analysis of its present structure and operation. The study covers such topics as the formation of the written constitution of 1787; the role of the legislative, executive, and judicial branches of government in constitutional change; and the origin, nature, and results of judicial review. Prereq.: 9 cred. or Hist. 20-21-22. 3 cred. per quarter. (Not offered in 1948-49.)
- 108w.* Legislative Organization and Procedure. A study of the structure and functioning of legislative bodies, including such topics as bicameralism, the committee system, party leadership, the caucus, parliamentary procedure, limitations on debate, legislative councils, bill drafting bureaus, and reference services. Prereq.: 6 cred. 3 cred. Short.
- 116f-117w.*† Local Government. Theory of local government, major functions and supervision, areas, organization, politics, and administration. Prereq.: 9 cred. or permission of instructor. 3 cred. per quarter. Ar.
- 118s.* Local Government: Legal Status, Powers, and Responsibilities. Prereq.: Course 116. 3 cred. Ar.
- 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 upon such topics as administrative organization, personnel, purchasing, contracting, budgeting, accounting, reporting. Prereq.: Course 120 or permission of instructor. 3 cred. Ludwig.
- 122s.* Municipal Problems. Intensive consideration of selected topics: public works, police, public relations, etc. Prereq.: Course 121 or permission of instructor. 3 cred. Ludwig.

- 123f.* City Planning. General survey of the economic, governmental, social, and technical phases of city planning and group housing. (The same as Architecture 104 and Sociology 106.) 3 cred. Jones, Anderson, Caplow, Filipetti, Vaile.
- 124w-125s.* Recent Social Legislation. A survey of governmental policies in the field of social welfare and social security. Historical development and comparative analysis of old age security measures, unemployment compensation, and other forms of social insurance. Detailed discussion of American social security legislation and its constitutional, administrative, and political problems. Prereq.: 6 cred. 3 cred. per quarter. Christensen.
- 126w-127s.* Government and the Economic Order. An examination of the powers of national, state, and local governments in the United States to regulate the various forms of business enterprise. A survey of the policies with reference to selected topics such as the trust problem, public utilities, communication agencies, food and drug legislation, and others. Emphasis on the legislative background, legal and administrative problems, and judicial interpretation of the statutes. Prereq.: 9 cred. 3 cred. per quarter. Ar.
- 131f.* Public Administration: Organization and Areas; Administrative Responsibility. Prereq.: 6 cred. 3 cred. Short.
- 132w.* Public Administration: Personnel Administration. Prereq.: Course 131 or permission of instructor. 3 cred. Short.
- 133s.* Public Administration: Financial Administration. Prereq.: Course 131 or permission of instructor. 3 cred. Short.
- 135.* Problems of Public Planning. A short survey of the history, nature, objectives, and theory of public planning; planning organization and research; brief comments on city and regional planning, natural resources, and social and economic planning. 3 cred. Anderson. (Not offered in 1948-49.)
- 137w.* American Political Parties. The historical development of the American party system; the composition, programs, and organization of parties at the present time; the two-party system; the spoils system; the role of political parties in the democratic state. Prereq.: 6 cred. 3 cred. Christensen.
138. American Political Campaigns and Elections. The nomination of candidates—party conventions and direct primaries, the formulation of party policy, campaign financing and corrupt-practices legislation, electioneering practices, the qualifications for voting, the registration of voters, the conduct of elections, popular participation in elections. Prereq.: 6 cred. 3 cred. (Not offered in 1948-49.)
- 141f-142w.*† European Governments: Theory and Practice. Prereq.: 6 cred. or 12 cred. in social science. 6 cred. McClosky.
- 143s.* Government of the U.S.S.R. and Adjacent States. Prereq.: 6 cred. 3 cred. McClosky.
- Psy.147s. Political Psychology. Prereq.: Courses 1-2, 4-5, 9 cred. in social science. 3 cred. Bird.
- 149f.* Government and Politics of the British Empire—India and the Tropical Colonies. Prereq.: 6 cred. or permission of instructor. 3 cred. Mills.
- 150w.* Government and Politics of the British Empire—Development of Dominion Status. Prereq.: 6 cred. or permission of instructor. 3 cred. Mills.
- 151s. British Problems of Closer Union. Problems of unity within the British Dominions; regional unions with adjacent states. Prereq.: Courses 149, 150 with grade of C+ or better or permission of instructor. 3 cred. Mills.
- 153s.* Far Eastern Governments. Constitutional and political development in Japan and China; government, political parties, and problems. Prereq.: 6 cred. 3 cred. (Not offered in 1948-49.)

- 155.* Government in Latin America. The constitutional and political development of the principal Latin-American nations; present governmental organization and the role of political parties. Prereq.: 6 cred. or permission of instructor. 3 cred. Christensen.
- 160f.* American Political Thought. An examination and appraisal of the more significant political ideas of American statesmen, writers, and movements from colonial times to the present. Special attention is given to the spokesmen of the movements of protest, discontent, and revolution. Prereq.: 6 cred. or 12 cred. in social science or permission of instructor. 3 cred. Sibley.
- 161w.* Problems of Democracy. An intensive examination of the main criticisms of democracy: intellectualist, including Plato, Carlyle, Stephen, Maine; scientific; psychological and biological; Marxist; Fascist. Prereq.: 6 cred. or 12 cred. in social science or permission of instructor. 3 cred. Sibley.
- 162s.*§ Recent Political Thought. An examination, comparison, and evaluation of the main ideas in the political philosophy of socialism, communism, fascism, and democracy. Prereq.: 6 cred. in political science or 12 cred. in social science or permission of instructor. 3 cred. Sibley.
- 164f.* Development of Political Thought: Greece and Rome. Prereq.: 6 cred. in political science or 12 cred. in social science or permission of instructor. 3 cred. Sibley.
- 165w.* Development of Political Thought: the Middle Ages. Prereq.: 6 cred. in political science or 12 cred. in social science or permission of instructor. 3 cred. Sibley.
- 166s.* Development of Political Thought: Early Modern. Prereq.: 6 cred. in political science or 12 cred. in social science or permission of instructor. 3 cred. Sibley.
- 175f-176w†-177s.* Conduct of American Foreign Relations. The Department of State and the Foreign Service; diplomatic and consular functions and problems; special economic and financial agencies; relations with international organizations; treaties and executive agreements; formulation of policy. Prereq.: 9 cred. or Hist. 93-94-95. 3 cred. per quarter. McLaughlin.
- 180f-181w†-182s.* International Law. 180f-181w. Relation of international law to individuals, states, international community; jurisdictional problems; survey of principles developed in diplomatic practice, national courts, international adjudications. 182s. War, military occupation, war crimes, neutrality, pacific settlement. Prereq.: 9 cred. or permission of instructor. 3 cred. per quarter. McLaughlin.
- 184f.* International Organization I. Development and conditions of success; one world, federal world, regionalism; United Nations and regional organizations. Prereq.: 6 cred. or permission of instructor. 3 cred. Levi.
- 185w.* International Organization II. Specialized agencies and other organs for the promotion of international co-operation, especially in the social and economic field. Prereq.: 6 cred. or permission of instructor. 3 cred. Levi.
- 186s.* International Organization III. Functioning of international organization; international offices and civil service; international administration. Prereq.: 6 cred. or permission of instructor. 3 cred. Levi.
- 191f.* Far Eastern Politics I. Political ideas, institutions, and foreign relations of China, Japan, and Korea prior to the opening of the treaty era in 1842. Prereq.: 6 cred. or permission of instructor. 3 cred. Quigley.
- 192w.* Far Eastern Politics II. Political development and international relations of China, Japan, and Korea from 1842 to the Washington Conference, 1921. Prereq.: 6 cred. or permission of instructor. 3 cred. Quigley.
- 193s.* Far Eastern Politics III. Contemporary political development and international relations of China, Japan, and Korea. Prereq.: 6 cred. or permission of instructor. 3 cred. Quigley.

§ No student may receive credit for both Political Science 162 and Philosophy 70.

- 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 of instructor. 3 cred. (Not offered in 1948-49.)
- 196.* Colonial Government and the Problems of Imperialism. Varieties of colonial rule in contemporary empires. Prereq.: Course 195 or permission of instructor. 3 cred. (Not offered in 1948-49.)
- 204w-205s.*† Seminar in Public Law. Prereq.: 18 cred. or permission of instructor. 3 cred. per quarter. Ar.
- 207-208-209.* Seminar in Theories of Law and Politics. Prereq.: 18 cred. in political science or permission of instructor. 3 cred. per quarter. (Not offered in 1948-49.)
- 210f-211w-212s.*† Special Seminar in Public Administration. (Registration only with permission of staff.) 3 cred. per quarter. Ludwig, Short.
- 214w.* Seminar in Political Parties. Prereq.: 12 cred. or permission of instructor. 3 cred. Christensen.
- 216f-217w-218s.* Seminar in Comparative European Government. Prereq.: 12 cred. in political science or permission of instructor. 3 cred. per quarter. McClosky.
- 219-220-221.* Seminar in Political Power in the Modern World. Prereq.: 12 cred. in political science or permission of instructor. 3 cred. per quarter. (Not offered in 1948-49.)
- 222-223-224.* Seminar in Recent Political Thought, American and Foreign, with special reference to the problems of democracy. Prereq.: 12 cred. in political science or permission of instructor. 3 cred. per quarter. (Not offered in 1948-49.)
- 225f-226w-227s.* Readings in the Classics of Politics (including Plato, Aristotle, Machiavelli, Hobbes, Locke, Rousseau, Mill, Marx, Lenin, Hitler). Prereq.: Course 15 or 164-165, which may be taken concurrently, or permission of instructor. 3 cred. per quarter. Lippincott.
- 228s.* Seminar in Political Theory. Freedom and control in the democratic state. Prereq.: 12 cred. or permission of instructor. 3 cred. Lippincott.
- 229f.* Scope and Methods of Political Science. The field of political science; relation to other studies; types of approach; research methods and techniques; bibliography. Problems of teaching at the college level. Prereq.: permission of instructor. 3 cred. Anderson.
- 236w-237s.* Seminar in Federalism and Intergovernmental Relations. Prereq.: permission of instructor. 3 cred. per quarter. Anderson.
- 238f.* Topics in International Law and Diplomacy I. Survey of the historical development of the law of nations and of international judicial activity in the modern world. Prereq.: Course 180-181 or permission of instructor. 3 cred. McLaughlin.
- 239w.* Topics in International Law and Diplomacy II. Modern international law: an examination of recent developments and current issues in the law of collective security, international criminal law, the codification and development of law through international agencies. Prereq.: Course 180-181 or permission of instructor. 3 cred. McLaughlin.
- 240s.* Topics in International Law and Diplomacy III. Legal aspects of international trade and finance. Status and rights of business enterprises abroad; their diplomatic protection. Legal regulation of international business transactions: tariffs, quotas, exchange restrictions; taxation; commercial treaties and conventions. Prereq.: Course 180-181 or permission of instructor. 3 cred. McLaughlin.
- 242f-243w-244s.*† Topics in Colonization. A series of essays and discussions on the American, British, Dutch, and French colonies, forming a comparative study of their twentieth-century political, administrative, and economic problems. Prereq.: Course 195-196 or permission of instructor. 3 cred. per quarter. Mills.

245f-246w-247s.* Seminar in Far Eastern Government and Politics. Prereq.: Course 191-192-193 or equiv. 3 cred. per quarter. Quigley.

248f-249w-250s.* Seminar in International Organization. Prereq.: 12 cred. or permission of instructor. 3 cred. per quarter. Levi.

The following seminars, with credits arranged, offer opportunities for research and directed individual study:

251f-252w-253s.* Public Law. Anderson.

254f-255w-256s.* American Government, Politics, and Administration. Anderson, Short, Christensen.

257f-258w-259s.* American Constitutional Development. Ar.

261f-262w-263s.* Local Government. Anderson, Weidner.

264f-265w-266s.* Municipal Administration. Ludwig.

271f-272w-273s.* Comparative European Government and Politics. McClosky.

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 Professor Thomas H. Canfield; Assistant Professors George M. Briggs, Robert N. Shoffner.

Prerequisites—For major and minor work in the division students must furnish evidence of satisfactory preparation in poultry husbandry and related subjects for graduate work. If deficiencies exist students may be required to take additional undergraduate courses without credit.

Major and minor work—With the approval of the adviser, courses in related fields such as agricultural economics, animal husbandry, bacteriology, biochemistry, genetics, physiology, veterinary medicine, and zoology 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.

Master's degree—Work for the Master's degree is 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 application of the principles of genetics and physiology of reproduction to the breeding of poultry. Lab. ar. Prereq.: Agron. 31. 4 cred. Shoffner.

153w. Poultry Feeding. The nutritive requirements of poultry and how they are met by the various feeds and systems of feeding. Prereq.: Agr.Biochem. 1. 3 cred. Briggs.

154f. Poultry Products. A study of grades and classes of market poultry and eggs, methods of processing and storage, and problems in produce plant operation. Prereq.: Course 1. 4 cred. Sloan, Canfield.

214f,w,s.* Research in Poultry Husbandry. Problems assigned to fit the needs of the student. Prereq.: 9 cred. in poultry husbandry. 3 to 9 cred. per quarter. Sloan, Canfield.

215f,w,s.* Research in Poultry Nutrition. Literature reviews or experiments in the fundamental problems involved in satisfying the nutrient requirements of poultry. Prereq.: 9 cred. in Agr.Biochem. 3 to 9 cred. per quarter. Briggs.

- 216f,w,s.* Research in Poultry Breeding. Studies of the problems involved in the genetic improvement of poultry. Prereq.: 9 cred. in genetics. 3 to 9 cred. per quarter. Shoffner.
- 217f,w,s.* Poultry Husbandry Seminar. Special assignments and review of literature pertaining to the poultry industry. 1 cred. per quarter. Sloan.

PSYCHOLOGY

Professors Richard M. Elliott, Charles Bird, John G. Darley, Starke R. Hathaway, William T. Heron, Howard P. Longstaff, T. Raymond McConnell, Donald G. Paterson, Miles A. Tinker, Edmund G. Williamson; Associate Professors Ralph F. Berdie, Paul E. Meehl; Assistant Professors Kenneth E. Clark, Harrison G. Gough, Kenneth MacCorquodale; Instructor Elmer R. John.

Prerequisites—Courses in psychology are open to all regularly enrolled graduate students who can meet the prerequisites prescribed for particular courses 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 in which he proposes to specialize. In certain cases the completion of preparatory courses in the fundamental sciences may be accepted as part of the prerequisites.

Major and minor—All candidates for graduate degrees who elect psychology as a major or minor must fulfill the general requirements of the Graduate School (see pages 8 to 16) and should consult advisers in both the major and minor departments.

In general it is expected that all graduate students, either major or minor, in psychology shall have fifteen credits of prerequisite work in psychology.

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

Doctor's degree—Work leading to the Ph.D. degree is offered in this department.

NOTE—For information on work in Psychometrics, see page 22.

COURSES

- 101f-102w†-103s.* Experimental Psychology. The theory and technique of the leading methods of experimental investigation in human psychology. Individual research problems in the second and third quarters. One lect., four lab. hours per week. Prereq.: Courses 1-2, 4-5 or equiv. in another science. 3 cred. per quarter. Tinker.
- 108f.* Systems of Psychology. A comparative study of the problems, methods, and viewpoints of modern psychology. Tutorially directed reading. Prereq.: preparation for advanced psychology, permission of instructor. 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.: Courses 1-2, 4-5 or Zool. 1-2-3, or Phil. 1. 3 cred. Elliott.
- 125f-126w-127s.* 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. Individual research problems in third quarter. Prereq.: Courses 1-2, 4-5, or 5 cred. in statistics. 3 cred. per quarter. Paterson.
- 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 psychology. 3 cred. per quarter. Heron.

- 130w,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. Prereq.: 9 cred. in psychology. 3 cred. per quarter. Paterson.
- 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 of instructor; for 137, Course 130. 2 cred. per quarter. Ar.
- 140w. Social Psychology. A study of experimental investigations of group behavior. Special emphasis will be put upon the place of emotions, drives, and personality traits in the adjustment of individuals to the demands of modern societies. Prereq.: Courses 1-2, 4-5, 9 cred. in social science. 3 cred. Bird.
- 144f-145w.† Abnormal Psychology. Normal and abnormal behavior contrasted. Varieties of maladjustment as illustrated in criminality, deficiency, fanaticism, and insanity. Stress will be laid on the inadequacies of personality as shown in everyday life. Prereq.: 9 cred. in psychology; or 6 cred. in psychology and either Zool. 1-2-3 or 12 cred. in social science. 3 cred. per quarter. Bird.
- 146s. Advanced Abnormal Psychology. Consideration of social, economic, and personal factors underlying mental abnormalities. Special emphasis on inductive and experimental studies, psychosomatic relationships, and psychoanalytic interpretations. Prereq.: Courses 144-145, 171. 3 cred. Bird.
- 147s. Political Psychology. A consideration of problems and points of view falling within the area of both political science and psychology. The importance of deriving techniques for the identification of political attitudes. The part played by psychological factors in the determination of belief, propaganda, and public opinion. Prereq.: Courses 1-2, 4-5, 9 cred. in social science. 3 cred. Bird.
- 148w. Physiological Psychology. The 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.: Courses 1-2, 4-5 or Zool. 1-2-3, or permission of instructor. 3 cred. Hathaway.
- 151f. Animal Psychology. Historical, philosophical, and biological foundations; consciousness; motivation; learning; reasoning; judgment; abnormal behavior; social influences. Prereq.: Courses 1-2, 4-5 or equiv. in other sciences. 5 cred. Heron.
- 152w,*153s.* Individual Investigations in Animal Psychology. Prereq.: Course 151. 3 cred. per quarter. Heron.
- 160f. Psychology in Personnel Work. Psychology as applied to the 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.: Courses 1-2, 4-5 or 3 cred. in statistics, and principles of economics or permission of instructor. 3 cred. Longstaff.
- 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.: Course 140 or 141. 3 cred. Clark.
- 168s. Research Project in Public Opinion Analysis. Students in journalism will be assigned to problems in co-operation with technical advisers in journalism. Prereq.: Course 167. 3 cred. Clark.

‡ A fee of \$1 per quarter is charged for this course.

‡‡ A fee of \$2 per quarter is charged for this course.

- 171w-172s.† Introduction to Clinical Psychology. A survey of the special methods of clinical psychology in relation to mental deficiency, special abilities and disabilities, behavior problems, personality disorders, and psychosomatic disturbances in adults and children. Prereq.: Course 144, either 125 or Ed.Psy. 120, or 5 cred. in statistics and 6 additional cred. in psychology, child welfare, or educational psychology. 3 cred. per quarter. Meehl.
- 200f-201w-202s.† History of Psychology: European. Origin and development of scientific psychology. Men, schools, and methods. Emphasis on the experimental period, 1860 to the present. Prereq.: permission of instructor. 1 cred. per quarter. Tinker. (Offered in alternate years. Not offered in 1948-49.)
- 203f-204w-205s.† History of Psychology: American. Psychology in America. Development of laboratories, departments, apparatus, texts, and journals. Present status. Prereq.: permission of instructor. 1 cred. per quarter. Tinker. (Offered in alternate years. Offered in 1948-49.)
- 210f-211w-212s. Research Problems. Laboratory investigations. Cred. ar. Elliott, Bird, Heron, Longstaff, McConnell, Paterson, Tinker, Hathaway, Darley, Berdie, Meehl, Clark, MacCorquodale.
- 215f-216w-217s. Seminar in Psychology. A basic seminar required of every candidate for the Ph.D. degree with a major in psychology who has completed one year of graduate study, unless excused in writing by his major adviser. Program based on a syllabus of required and optional readings prepared during the previous year. Lect., reports of reading and research, and discussions. 3 cred. per quarter. Staff.
- 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 and habit and conflict; dynamics of motivation; the factor analytic approach; the ego and ego-involvement; role-playing; derived needs and functional autonomy; the problem of anxiety. Prereq.: Courses 171-172, one of 86, 146, or 286, written permission of instructor. 2 cred. per quarter. Meehl, Gough.
- 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 candidates for the Ph.D. degree with a major in psychology who have completed one year of graduate study. Other graduate students are urged to attend. 2 cred. Staff.
- 230f-231w-232s. Field Work in Psychometrics and Applied Psychology. For properly qualified students. Prereq.: written permission of instructor. Cred. ar. Paterson, Darley, Longstaff, and others.
- 240f-241w-242s. Seminar in Student Personnel Work. Discussion of topics and problems relating to the content, development, and co-ordination of comprehensive student personnel programs. Critical review of current research being made by university personnel workers. Prereq.: permission of instructor. 1 cred. per quarter. Williamson.
- 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. Elliott, Bird, Hathaway, Heron, Longstaff, Paterson, Tinker, Darley, Berdie, Clark, MacCorquodale, Meehl.

- 256w.* Advanced Psychology of Advertising. Lecture and text material the same as Psy. 56 but graduate students must satisfy additional requirements either by writing reports on experimental literature in this field or by conducting a minor research project. 3 cred. Longstaff.
- 260f*-261w*-262s.* Seminar in Application of Psychological Methods to the Study of Nervous and Mental Diseases. Recent experimental literature and interpretations in terms of clinical practice. Discussion and experimentation in the field of personality evaluation. Prereq.: permission of instructor. 1 cred. per quarter. Hathaway.
- 265f-266w-267s. Seminar in Advanced Clinical Psychology. A practicum in the diagnosis and evaluation of personality traits and structure in relation to occupational and social roles. Prereq.: advanced statistics, Course 171-172, permission of instructor. 1 cred. per quarter. Hathaway, Meehl.
- 270f,s. Advanced Psychological Measurement. Lecture and basic text material the same as Psy. 70, but graduate students must satisfy additional requirements either by analysis and interpretation of a set of research data, or by writing reports on advanced psychometric topics. 3 cred. Clark.
- 271f*-272w*-273s.* Seminar in the Recent Literature of Psychology. Designed to acquaint students with a variety of contemporary topics by survey and critical discussions. Prereq.: open to graduate students majoring in psychology. 1 cred. per quarter. MacCorquodale.
- 281f-282w-283s. Clinical Practice in the Student Counseling Bureau. Designed to give properly qualified students experience in the use of psychological and related methods in dealing with individuals. Prereq.: permission of instructor and adviser. 1 to 3 cred. per quarter. Berdie.
- 286s. Advanced Biographical Psychology. Lecture and basic text material the same as in Psy. 86 but graduate students must prepare under tutorial guidance a report based on recent literature in this field. 3 cred. Elliott.
- 290w. Theory of Projective Methods. A general survey of the field of projective methods, including a didactic introduction to the administration, scoring, and interpretation of the currently used devices; major emphasis is put on theory, methodological considerations, and published studies of reliability and validity. Prereq.: Course 144-145 with or after 171. 3 cred. Meehl.
- 291s. Practicum in Projective Techniques. Prereq.: Course 290, written permission of instructor. 3 cred. Meehl.
- 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 of instructor. 1 cred. per quarter. Paterson.
- 299w. Tabulating Equipment Laboratory. Designed to give properly 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, Ruth E. Boynton, M.D., M.S., Harold S. Diehl, M.A., M.D., D.Sc., Charles A. Mann, Ph.D., J. Arthur Myers, M.D., Ph.D., Alan E. Treloar, Ph.D., Harold A. Whittaker, B.A.; Associate Professors Ruth E. Grout, Ph.D., C.P.H., Theodore A. Olson, M.A., George O. Pierce, M.S., C.P.H., Margaret S. Taylor, M.A., Stewart C. Thomson, M.P.H., M.D., Myron M. Weaver, M.D., Ph.D.; Assistant Professor Jeanette Vroom, A.A.,

Ph.B.; Lecturers Harold S. Adams, B.S., Herbert M. Bosch, B.S., M.P.H., Leslie W. Foker, M.D., M.P.H., William A. Jordan, D.D.S., M.P.H., Paul W. Kabler, M.D., Ph.D., M.P.H.

Master's degree—Work for the Master's degree is 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, and (5) public health nursing, unless specifically excused by the department.

[Inquiries concerning other work in public health, including the course 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. Susceptibility and resistance to disease; occurrence and prevention of communicable, degenerative, and industrial diseases; protection of food, water, and milk; school health work; vital statistics. Prereq.: Course 3 or 50 or equiv. and a course in bacteriology. 5 cred. for public health nurses, hospital administrators and social workers; 4 cred. for medical students. Anderson.
- 102f,s. Environmental Sanitation I. Methods for promoting man's health and comfort by controlling his environment: water supply sanitation, food sanitation, pollution abatement; sewage, excreta, and waste disposal; bathing place sanitation, air hygiene, illumination, housing, control of insect and animal vectors of disease, industrial hygiene and sanitation. Prereq.: Course 50 or 51 or 53 or 100 or permission of instructor, or may be taken 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 of instructor. 3 cred. Kabler.
- 104f*-105w. Epidemiology. Factors underlying the spread of infectious diseases, with detailed discussion of selected diseases; simple statistical and epidemiologic methods in the study of diseases. Lect., lab., and seminars. Prereq.: Course 53 or 100, permission of instructor; physicians, others by permission. Must be taken in conjunction with Course 140 unless student has taken P.H. 110 and 111. 3 cred. per quarter. Anderson.
- 106w.* Public Health Administration. Structure, basic functions, and activities of public health agencies; public health laws and regulations; administrative procedures in public health practice; relationship to other governmental and social activities. For physicians, engineers, nurses, social workers, and others by arrangement. Prereq.: Course 53 or 100 or equiv., or to be taken simultaneously with either of these. 3 cred. Anderson.
- 107f. Child and Adult Hygiene. Promotion of hygiene through public health and community effort—maternal, infant, preschool, school, college, industrial, and adult. Lect. and field trips. For physicians and graduate students in public health nursing or medical social work. Prereq.: Course 53 or 100. 3 cred. Boynton and associates.
- 108w. Care of the Handicapped Child. Extent of problem; history and development of program for care; types of physical defects; means of prevention and correction; medical social aspects; mental and emotional aspects; vocational training and placement. Prereq.: Courses 53 or 100, 57, 58. 2 cred. Ar.
- 110f,s. Biometric Principles. See Biostatistics courses.
- 111f,s,‡ Biostatistics Laboratory. See Biostatistics courses.

† A fee of \$1 is charged for this course.

- 112w.¶ Water Supply Sanitation. Sanitary problems associated with the location, construction, and operation of water supplies, purification works, and distribution systems. Public health supervision of water supplies. Lect., field, and lab. demonstrations. Prereq.: Courses 102 and 100 or 104. 4 cred. Whittaker, Pierce, Olson.
- 113s.¶ Sewage, Excreta, and Waste Disposal. Public health supervision of, and methods for, the treatment and disposal of sewage, excreta, garbage, and other wastes; methods for the study and control of stream, lake, and ground water pollution. Lect., field, and lab. demonstrations. Prereq.: Courses 102, 104. 4 cred. Pierce, Olson.
- 114w.¶ Environmental Sanitation II. Public health supervision of activities in the field of urban and rural sanitation. Demonstration of methods of sanitary control of environmental factors. Lect., field, and lab. demonstrations. For physicians, nurses, veterinarians, and others by arrangement. Prereq.: Course 102. 2 cred. Whittaker, Pierce, Olson.
- 115w. Food Sanitation. Sanitary problems associated with the production, processing, and distribution of milk, meat, shellfish, and other foods, methods of public health supervision. Lect., field, and lab. demonstrations. Prereq.: Courses 102, 106, and 100 or 104. 3 cred. Olson.
- 116s.*¶ Public Health Engineering Administration. Administrative organization of environmental sanitation activities at the various levels of government and in other organizations including methods and procedures for supervision and control. Prereq.: Courses 102, 100 or 104, 106 and at least two of the following: 112, 113, 115. Cred. ar. Whittaker and associates.
- 117f-118w. Sanitary Biology. Survey of plant and animal forms important in environmental sanitation, with special reference to those of concern in problems relating to water supply, sewage treatment, water pollution, bathing places, air pollution, food sanitation, and disease vectors. Prereq.: permission of instructor. Cred. ar. Olson.
- 119f,w,s,su.‡‡ Field Practice in Environmental Sanitation. Prereq.: permission of instructor. Cred. allowed according to experience in this field. Whittaker, Kingston, Handy.
- 120s. Correlation Analysis. See Biostatistics courses.
- 121s.‡ Correlation Laboratory. See Biostatistics courses.
- 122s.* Public Health Administration Problems. Conference discussion of selected problems; budgeting and program planning; appraisal of public health procedures and activities. Prereq.: Course 106. 3 cred. Anderson.
- 123f,w,s. Topics in Public Health. Selected readings in public health with discussion based on those readings. Prereq.: permission of instructor. Cred. ar. Staff.
- 125w. The Community Health Education Program. A course intended primarily for those preparing for leadership in community health education to include organization, administration, and evaluation of community health education programs and the selection, preparation, and use of media commonly employed in health education. Prereq.: Courses 53 or 100 or 104, and 106, or to be taken concurrently with 106. 3 cred. Grout.
- 126f. Industrial Health Problems. Organization of industrial health services, state programs in industrial hygiene. Industrial hazards and their control. Procedures in industrial health services. Prereq.: Course 53 or 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. Duties of nurses in industry. Program planning; records, relationships; interdepartmental, professional, and community evaluation. Prereq.: to be taken in conjunction with Course 126. 1 cred. Taylor.

‡ A fee of \$1 is charged for this course.

‡‡ A fee of \$1 per credit is charged for this course.

¶ Students who have taken Courses 112, 113, or 116 will not be given credit for Course 114.

- 129f,w,s,‡‡ Field Work in Industrial Nursing. Planned observation visits to selected industrial health services to demonstrate range of industrial health problems. Supervised experience in industrial medical unit. Weekly conferences. Emphasis on practical functioning of the nurse in industrial and commercial organizations. Prereq.: Course 67. Cred. ar. Taylor.
- 130w. Random Sampling Distributions. See Biostatistics courses.
- 131w.‡ Sampling Laboratory. See Biostatistics courses.
- 133w,s. Mental Hygiene. Discussion of emotional factors underlying wholesome family relations and of problems which interfere with successful adjustment in family and community life. Illustrative case material related to problems met by the public health nurse will be used. Prereq.: Course 62 or experience in public health nursing. 3 cred. Clarke.
- 135s. Conservation of Hearing. Detection, prevention, and amelioration of hearing impairments as related to public health education, school, industrial, and public health nursing, and medical social service. Prereq.: Courses 53 or 100 and 62 or to be taken concurrently. 1 cred. Boies and associates.
- 136s. Sight Conservation. Conditions that impair human vision; community programs of vision testing and correction of defects; sight conservation programs. Prereq.: Courses 53 or 100 and 62 or to be taken concurrently. 1 cred. Hansen and associates.
- 137s. Dental Health. Conditions resulting in tooth decay and loss; preventive and corrective measures; mouth hygiene; community programs for dental health. Prereq.: Courses 53 or 100 and 62 or to be taken concurrently. 1 cred. Jordan.
- 138f,w,s,‡‡ Field Work in Child Hygiene. Field practice, conferences, and seminars in prenatal, infant, and child care. Offered in conjunction with Rochester City Health Department and Rochester Child Health Projects. Prereq.: permission of instructor. Cred. ar. Aldrich, Spock, Mouw, and associates.
- 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; in family agency, county welfare, schools, child guidance centers. Prereq.: permission of instructor. Cred. ar. Taylor and associates.
- 140f.‡ Vital Statistics. See Biostatistics courses. To be taken only in conjunction with Course 104.
- 141s. Social and Economic Aspects of Medical Care. A survey of social and economic forces affecting administration and financing of medical care; the need for sickness insurance, group hospitalization; the concern of government in the provision of pre-paid medical care. Prereq.: permission of instructor. 3 cred. Weaver.
- 150w.‡ Life Tables. See Biostatistics courses.
- 152f,w,s. Industrial Hygiene Engineering. Field and laboratory methods used by the industrial hygiene engineer in the study and control of occupational health hazards. Lect., field and lab. demonstrations. 3 cred. Pierce.
- 170s.* Supervision in Public Health Nursing. Nature of supervision, classification of activities; methods of supervision, including field visitation, individual counseling, group conferences, staff education programs, administrative functions of supervisors, preparation and selection of supervisors. Prereq.: Courses 53 or 100, 61, 63, and experience in public health nursing, or by permission. 3 cred. Taylor.
- 171f,w,s.* Problems in Public Health Nursing. For advanced students who wish to work on special problems in public health nursing. Prereq.: Course 170 or permission of instructor. Cred. ar. Taylor and associates.

‡ A fee of \$1 is charged for this course.

‡‡ A fee of \$1 per credit is charged for this course.

- 173f,w,s,†† Field Work in Supervision of Public Health Nursing. For public health nurses only. Prereq.: Course 170 or permission of instructor. Cred. ar. Taylor and associates.
- 174f,w,s. Supervision Laboratory. Critical analysis of supervisory procedures. Construction of rating scales, experience and efficiency sheets, manuals, and other materials of supervision. Prereq.: public health nurses only; to be taken concurrently with Course 170. 2 cred. Taylor and associates.
- 190f,w,s,†† Field Work in the Community Health Education Program. Three months of practical field experience in community health education under the supervision of qualified health educators. Details will be worked out in accordance with individual needs of the students. One academic year of approved study toward a Master's or Doctor's degree either in education or public health. Prereq.: Courses 125, 227. Cred. ar. Grout and associates.
- 200f,w,s,* Research. Opportunities will be offered by the University and by the various co-ordinated organizations for qualified students to pursue research work. Cred. ar. Staff.
- 210f,w,s,* Seminar in Preventive Medicine and Public Health. Cred. ar. Staff.
- 227f,w,s. Problems in the Community Health Education Program. For advanced students who wish to pursue independent study and experimentation in health education. Prereq.: permission of instructor. Cred. ar. Grout and associates.

RADIOLOGY

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

ROMANCE LANGUAGES

Professors Francis B. Barton, Walter T. Pattison, Edward H. Sirich; Associate Professors Emmert M. Brackney, Herbert E. Clefton, Jacques A. Fermaud, Raymond L. Grismer, Emilio C. LeFort; Assistant Professors Thomas B. Irving, Elizabeth Nissen.

Prerequisites—For major work, 27 Senior College credits or equivalent; for minor work, 18 Senior College credits or equivalent.

Language requirements—Candidates for the Master's degree must have a reading knowledge of at least one other modern language 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 German.

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

Doctor's degree—Work for the Ph.D. degree is offered in both French and Spanish.

COURSES

FRENCH

- 100s. Practical French Phonetics. Prereq.: Course 20 or 53-54 or permission of instructor. 3 cred. Ar.
- 103f-104w-105s.† French Syntax and Composition. Special studies in characteristic problems of French syntax. Prereq.: Course 63 or registration in 63. 3 cred. Barton.
- 107s. Cours de Style. Prereq.: Course 63-64 or permission of instructor. 3 cred. Ar.
- 110f*-111w*-112s.*¶ French Literature: Nineteenth Century. 110f. Chateaubriand and Romantic Prose; 111w. Drama; 112s. Poetry. Prereq.: Course 70-71-72 or 73-74. 3 cred. per quarter. Barton, Clefton.

†† A fee of \$1 per credit is charged for this course.

¶ Students may enter any quarter with permission of instructor.

- 113w. Ste. Beuve and the Modern French Critics. Prereq.: Course 70-71-72 or 73-74 or permission of instructor. 3 cred. Ar.
- 115f*-116w*-117s.*¶ French Literature: Seventeenth Century. 115f. Formation of the classic ideal; 116w. Molière, Racine, La Fontaine; 117s. Moral and didactic literature. Prereq.: Course 70-71-72 or 73-74. 3 cred. per quarter. Fermaud.
- 118f-119w-120s.*¶ French Literature: Eighteenth Century. 118f. Beginnings of the philosophic movement, Bayle, Montesquieu, Diderot; 119w. Voltaire; 120s. Rousseau, the theater, the novel. Prereq.: Course 70-71-72 or 73-74. 3 cred. per quarter. Sirich.
- 121f-122w-123s.* French Literature: Sixteenth Century. 121f. The Rhétoriqueurs, Marot, Rabelais; 122w. The Pléiade; 123s. Montaigne, Amyot. Prereq.: 9 cred. in literature above Course 74 or permission of instructor. 3 cred. per quarter. (Not offered in 1948-49.)
- 130f. French Romantic Poetry: Victor Hugo. Prereq.: Course 70-71-72 or 73-74. 3 cred. Clefton. (Not offered in 1948-49.)
- 131w. Parnassian Poetry. Prereq.: Course 70-71-72 or 73-74. 3 cred. Clefton. (Not offered in 1948-49.)
132. Baudelaire, Verlaine, and Rimbaud. Prereq.: Course 70-71-72 or 73-74. 3 cred. Clefton.
- 146.* Contemporary French Dramatic Literature. Course 70-71-72 or 73-74. 3 cred. Barton. (Offered biennially. Not offered in 1948-49.)
- 156s. French Realistic Novel. Prereq.: Course 70-71-72 or 73-74. 3 cred. Barton. (Offered in alternate years. Offered in 1948-49.)
- 157w. French Novel, France, Loti, and Bourget. Prereq.: Course 70-71-72 or 73-74. 3 cred. Brackney. (Not offered in 1948-49.)
- 158s. Contemporary French Novel I. Course conducted in French. Prereq.: Course 70-71-72 or 73-74. 3 cred. Fermaud. (Not offered in 1948-49.)
- 159s. Contemporary French Novel II. Continuation of Course 158. Social problems. Prereq.: Course 70-71-72 or 73-74. 3 cred. Fermaud.
- 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 of instructor. 1 cred. per quarter. Brackney.
- 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 quarter. Brackney.
- 204f-205w-206s. Reading in Old French Literature. An introductory course in the reading of Old French. Different types of literature will be read and their origin and development discussed. A certain amount of collateral reading required. 2 cred. per quarter. Brackney.
- 207f-208w-209s. Old Provençal. Reading in early Provençal literature with special attention to the poetry of the troubadours. 2 cred. per quarter. Brackney.
- 222f-223w-224s.* French Seminar. Classical period. 2 cred. per quarter. Ar. (Not offered in 1948-49.)
- 225f-226w-227s.* French Seminar. Balzac. 2 cred. per quarter. Desgranges.
- 230-231-232. Research Methods and Material. 1 cred. per quarter. Ar.
- 259f-260w-261s.* Research in Romance Languages. Cred. depends upon amount of work accomplished. Staff.

† Students may enter any quarter with permission of instructor.

ITALIAN

- 159f-160w.¶ Dante. *The Divina Commedia*. (Alternates with 161-162.) Prereq.: one course above 50. 3 cred. per quarter. Nissen.
- 161f-162w. The Sixteenth Century. Reading of texts and study of literary influences. Prereq.: one course above 50. 3 cred. per quarter. Nissen. (Not offered in 1948-49.)
- 164s. Dante (in English). Lectures, reading, and discussion of the *New Life* and the *Divine Comedy*. Prereq.: permission of instructor. 3 cred. Nissen.

SPANISH

- 103f-104w-105s. Spanish Syntax and Composition. Prereq.: Course 60 or registration in Course 60. 1 cred. per quarter. Pattison.
- 110f-111w-112s. Spanish Literature: Nineteenth Century. Prereq.: Course 65-66-67 or 68-69. 3 cred. per quarter. Pattison.
- 115f-116w-117s.* Spanish Literature: Seventeenth Century. 115f. The drama; 116w. The novel; 117s. Lyric and epic poetry. Prereq.: Course 65-66-67 or 68-69. 3 cred. per quarter. Grismer. (Alternates with 155-156-157. Offered in 1949-50.)
120. The Ballad. Prereq.: Course 65-66-67 or 68-69. 3 cred. (Not offered in 1948-49.)
130. Cervantes: Don Quijote. Prereq.: Course 65-66-67 or 68-69. 3 cred. Grismer.
131. The Picaresque Novel. Prereq.: Course 65-66-67 or 68-69. 3 cred. Grismer. (Not offered in 1948-49.)
- 140f-141w-142s. Contemporary Latin-American Literature. Prereq.: Course 65-66-67 or 68-69 or 74-75-76. 3 cred. per quarter. Irving.
- 143f-144w-145s. Colonial and Nineteenth Century Latin-American Literature. Prereq.: a survey of the literature of Spain or Latin America. 3 cred. per quarter. Floripe.
- 155f-156w-157s.* Spanish Literature: Sixteenth Century. 155f. The drama; 156w. Cervantes and the novel; 157s. Poetry, the mystics. Prereq.: Course 65-66-67 or 68-69. 3 cred. per quarter. Grismer. (Alternates with 115-116-117. Offered in 1948-49.)
- 174f-175w-176s. Contemporary Spanish Literature. 174f. The drama; 175w. The novel; 176s. Poetry. Prereq.: Course 65-66-67 or 68-69. 3 cred. per quarter. Pattison. (Alternates with 110-111-112. Not offered in 1948-49.)
- 241f-242w-243s.* Old Spanish Philology. 2 cred. per quarter. Grismer.
- 244f-245w-246s.* 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 quarter. (Not offered in 1948-49.)
- 247f-248w-249s. Spanish Seminar: Hispano-Arabic Culture. 2 cred. per quarter. Irving.
- 250f-251w-252s.* Spanish Seminar. 2 cred. per quarter. Pattison.
- 253f-254w-255s. Seminar in Spanish-American Literature. 2 cred. per quarter. Ar.

SCANDINAVIAN

Associate Professor Alrik Gustafson.

Prerequisites—For major work, 27 credits in language and literature, 18 of which must be in Scandinavian; for minor work, 18 credits in language and literature, 12 of which must be in Scandinavian. Candidates for the Master's degree must have a reading knowledge of one foreign language in addition to any one of the Scandinavian languages.

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

¶ Students may enter any quarter with permission of instructor.

COURSES

- 113f-114w.* Gothic. (The same as German 113-114.) 113f. Gothic. Introduction to Germanic Linguistics. 3 cred. Downs. 114w. Gothic Texts. Prereq.: Course 113. 3 cred. Downs.
- 153s. The Modern Scandinavian Home as an Expression of Northern Art. (The same as ArtEd. 153.) Knowledge of Scandinavian not required. 3 cred. Lien.
- 161w.* The Scandinavian Novel I. The Late Nineteenth Century. An examination of "the great tradition" in the modern Scandinavian novel, together with the circumstances, intellectual and political, social and economic, out of which it grew. Knowledge of Scandinavian not required. Prereq.: Course 4-5-6 or 10-11-12 or 8 cred. in literature. 3 cred. (Not offered in 1948-49.)
- 162s.* The Scandinavian Novel II. Contemporary Trends. A study of characteristic trends in Scandinavian life and thought in the twentieth century as expressed in the prose fiction of Sigrid Undset, Johannes V. Jensen, Olav Dunn, Hjalmar Bergman, Pär Lagerkvist, and others. Knowledge of Scandinavian not required. Prereq.: Course 4-5-6 or 10-11-12 or 8 cred. in literature. 3 cred. (Not offered in 1948-49.)
- 171f.* Ibsen and the Beginnings of the Modern Drama. An 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.: Course 4-5-6 or 10-11-12 or 8 cred. in literature. 3 cred. Gustafson.
- 172w.* Strindberg and the Drama in Revolt and Transition. A study of 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.: Course 4-5-6 or 10-11-12 or 8 cred. in literature. 3 cred. Gustafson.
- 173s.* The Contemporary Scandinavian Theater. An examination of the Scandinavian theater of today, particularly with reference to its "experimental" trends both in dramatic composition and staging. Knowledge of Scandinavian not required. Prereq.: Course 4-5-6 or 10-11-12 or 8 cred. in literature. 3 cred. Gustafson.
- 176f-177w. Problems and Research Trends in Germanic Philology. (The same as German 176-177.) 176f. The Germanic Languages; 177w. The Germanic Literary Tradition. A comparative discussion of the native and foreign records of the Old Germanic Period. Prereq.: at least two Germanic dialects. 3 cred. per quarter. (Not offered in 1948-49.)
- 180.* Old Norse Literature. (The same as German 180.) 3 cred. (Not offered in 1948-49.)
- 182.* Germanic Mythology. (The same as German 182.) (Not offered in 1948-49.)
- 183.* Germanic Heroic Poetry. (The same as German 183.) 3 cred. (Not offered in 1948-49.)
- 185.* History of the Scandinavian Languages. Prereq.: Course 4-5-6 or 10-11-12 or at least one Germanic language. 3 cred. (Not offered in 1948-49.)
- 191f-192w-193s. Readings in the Scandinavian Literatures. Intensive reading of representative Scandinavian texts. Designed especially for majors and minors in Scandinavian, each student fulfilling his reading requirements in Danish or Norwegian or Swedish depending upon his language of primary interest. Prereq.: Course 4-5-6 or 10-11-12. 3 cred. per quarter. Gustafson.
- 195.* Introduction to Old Norse Language and Literature. (The same as German 195.) Prereq.: Course 113. 3 cred. (Not offered in 1948-49.)
196. Eddic Poetry. (The same as German 196.) 3 cred. (Not offered in 1948-49.)
- 215-216-217.* Studies in Scandinavian Romanticism. 3 cred. per quarter. Gustafson. (Not offered in 1948-49.)

- 218f-219w-220s.* Studies in Late Nineteenth-Century Scandinavian Literature. 3 cred. per quarter. Gustafson.
- 221f-222w-223s.* Biographical Problems in Strindberg. 3 cred. per quarter. Gustafson.
- 230f-231w-232s.* Seminar: Germanic Languages and Literature. Texts in Germanic dialects. Runic inscriptions. (The same as German 218b-219b-220b.) Prereq.: at least two Germanic dialects. 3 cred. per quarter. (Not offered in 1948-49.)

SOCIAL WORK

Professors F. Stuart Chapin, Anne F. Fenlason; Associate Professors Monica K. Doyle, John C. Kidneigh, Hyman S. Lippman, Verval J. Mueller, Alice L. Shea; Assistant Professors Richard G. Guilford, Gisela Konopka, Lyndell Scott, Marvin Sukov.

Prerequisites—An applicant of satisfactory scholastic record whose Bachelor's degree was granted by an institution on the list of colleges and universities approved by the Association of American Universities may be admitted by the dean of the Graduate School upon recommendation of the Admissions Committee of the School of Social Work. The scholastic records of applicants from institutions other than those on the approved list of the Association of American Universities will be reviewed and the applicant may be admitted, with or without condition.

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 must include a course in statistics. In addition the candidate should present some credits in physiology or biology and a course on the field of social work. However, if the candidate is otherwise eligible for admission but lacks some prerequisites he may be permitted to enter the School of Social Work but will be required to complete such prerequisites before becoming a candidate for the Master's degree.

Application blanks and instructions regarding admission should be secured from the School of Social Work, 110 Nicholson Hall, University of Minnesota, Minneapolis 14, Minnesota.

Applications and transcripts in duplicate must be filed in advance of the registration date; otherwise delays and possible fines for late registration are almost unavoidable. The number of beginning students is limited, with preference given to students wishing to enroll in the fall quarter and planning to remain throughout the academic year. Beginning graduate students are admitted only fall and spring quarters. Students who plan to attend two years continuously for the Master's degree are advised to enter fall quarter. Group work students are admitted fall quarter only. Students who plan for two or three quarters only may be admitted spring quarter. Persons with previous training and experience may be admitted at the quarter which makes progression from their previous training feasible.

The application for admission is considered first by a committee of the major advisers in social work, which makes recommendations to the dean of the Graduate School upon whose approval the candidate is admitted. Acceptance of candidates is based upon the following criteria: evidence of ability to meet standards of graduate work, usually indicated by grades of high quality; psychological tests when available; letters of reference indicating personal aptitude for social work.

Advanced standing may be granted for work done in other approved schools of social work, limited by the rules stated below.

Language requirement—Knowledge of a foreign language is not required, but is strongly recommended.

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:
 - (a) Case Work
 - (b) Psychiatric and Psychological Information
 - (c) Medical Information
 - (d) Public Welfare
 - (e) Social Administration
 - (f) Community Organization
 - (g) Group Work
 - (h) Social Research
3. A degree project of 9 quarter credits consisting of seminar research papers or a single research report requiring independent work under faculty supervision which demonstrates capacity for critical evaluation and analysis must be presented. All 9 of these research credits must be earned preferably 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 quality.
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 successfully pass a written examination and 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 the 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. The school will recommend to the Graduate School dean, through the appropriate graduate group committee, the acceptance or rejection of the application for candidacy.
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 (see the *Bulletin of the Graduate School*). Such students may, in lieu of completing requirements for 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 the record made is distinctly superior, become candidates for the Ph.D. degree in social work (requiring at least four years of graduate work) by:

1. Completing advanced work in social work in courses or seminars approved by the major adviser
2. Completing a minor satisfactory to the department in which the minor is taken
3. Meeting university requirements of reading proficiency in foreign languages
4. Passing the comprehensive preliminary examination covering major and minor fields. Subsequently the research, thesis requirements, and final examinations must be completed.
5. Otherwise meeting Graduate School requirements for the Ph.D. degree.

For further particulars see the *Bulletin of the Graduate School*.

[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,s. The Field of Social Work. A study of the field of social work, including fields of specialization, functions of agencies, and contributions made by outstanding leaders. 3 cred. Doyle.
- 201w. The History and Theory of Social Work. A consideration of the historical backgrounds of the modern social work movement and the evolution of the theory underlying it. 3 cred. Doyle.
- 205f,206w,207s. Special Topics in Social Work. Cred. ar. Staff.
- 209f,w,s. Seminar in Social Agencies and Institutions. Cred ar. Doyle.

B. FIELD WORK

- 210f,s‡-211w‡-212f,s,‡ Initial Field Training in Social Work. Field practice in social work process under direct supervision. Prereq.: Course 220 or 282A, which must be taken simultaneously, or equiv. Cred. ar. Staff.
- 215f,w,s‡-216f,w,s‡-217f,w,s,‡ Advanced Field Training in Social Work. Field practice in social work process under direct supervision. Prereq.: Course 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. Scott and staff.

C. CASE WORK

- 220f,s. 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.: Courses 200 or equiv., 210, which must be taken simultaneously, or equiv. 3 cred. Scott.
- 221w. Case Work II. A continuation of Case Work I emphasizing a critical analysis of the case work process and development of skills in case work method. Prereq.: Course 220 plus 211, 236, both of which may be taken simultaneously, or equiv. 3 cred. Scott.
- 222w. Advanced Family Case Work. Case discussion focused primarily on treatment processes. Prereq.: Course 221 or equiv. 3 cred. Fenlason.
- 224f,w,s. Seminar in Case Work in the Public Agency. Prereq.: Course 221 or permission of instructor. Cred. ar. Scott. (Not offered in 1948-49.)

‡ A fee of \$3.50 is charged for this course.

- 225w,s. Seminar in Family Case Work. Prereq.: Course 221 or permission of instructor. Cred. ar. Fenlason.
- 226f,w. Seminar in Case Work in Health Problems. Prereq.: Course 221 or permission of instructor. Cred. ar. Mueller.
- 227f,w,s. Seminar in Case Work in the Psychiatric Setting. Prereq.: Courses 221, 215-216-217, which must be taken simultaneously. Cred. ar. Shea.
- 228f. Seminar in Social Case Recording. Cred. ar. Fenlason.
- 229f,s. Seminar in Case Work Supervision. Prereq.: Course 222 or 230 or 251 or 261. Cred. ar. Fenlason.

D. PSYCHIATRIC AND PSYCHOLOGICAL COURSES

- 230f,s. Psychiatric Social Case Work. Case discussion focused on the function of the social worker in the psychiatric setting with emphasis on diagnosis and treatment of the emotionally disturbed. Prereq.: Course 221 or equiv. 3 cred. Shea.
- 235f. Introductory Psychiatry. A lecture course, the subject matter of which includes a discussion of: mental hygiene, mental mechanisms, psychiatric history taking, review of schools of psychiatry, classification of mental diseases. 3 cred. Hinckley.
- 236f. Personality Development as It Affects Social Case Work. A consideration of factors involved in personality development and how these factors aid case work practice. Prereq.: Course 220, which may be taken simultaneously. 2 cred. Clarke.
- 239s. Seminar in Psychiatric Social Work. Prereq.: Courses 230, 235, 236. 2 cred. Hinckley.
240. Dynamics of Human Behavior Based on Psychoanalytic Theory. Prereq.: Course 235. 3 cred. Lippman. (Not offered in 1948-49.)
- C.W.140f,s. Behavior Problems. Prereq.: 12 cred. in psychology, educational psychology, or sociology. 2 cred. Ar.
- C.W.141w. Behavior Problems. Prereq.: 12 cred. in psychology, educational psychology, or sociology. 2 cred. Ar.
- C.W.190f. Principles of Mental Measurements. Prereq.: 12 cred. in psychology, educational psychology, or sociology. 2 cred. Ar.
- Neuropsy.171w. Descriptive Neuropsychiatry. A study of the general plan of the nervous system and its functions; a consideration of some of the more common functional and nervous system diseases. Prereq.: Course 235 or equiv. 3 cred. Baker.
- Psy.114w. Human Behavior. Prereq.: Psy. 1-2; S.W. 4-5 or Zool. 1-2-3; or Phil. 1. 3 cred. Elliot.
- Psy.171w-172s. Introduction to Clinical Psychology. Prereq.: Psy. 144, either Psy. 125 or Ed.Psy. 120 or 5 cred. in statistics, 6 additional cred. in psychology or child welfare or educational psychology. 2 cred. per quarter. Meehl.

E. MEDICAL SOCIAL WORK

- 250s. 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.
- 251f-252w-253s. Advanced Medical Social Work. Case work function of the social worker in medical programs with an analysis of cases demonstrating the social problems associated with illness and disability. Prereq.: Courses 221 or equiv., 215-216-217, which must be taken simultaneously. 3 cred. per quarter. Mueller.
- 259f,w,s. Seminar in Medical Social Work. Prereq.: Courses 221, 251-252-253, which may be taken simultaneously. Cred. ar. Mueller.

- P.H.106w. Public Health Administration. Prereq.: P.H. 53 or equiv. 3 cred. Anderson.
 P.H.141s. Social and Economic Aspects of Medical Care. Prereq.: P.H. 106. 3 cred.
 Weaver.

F. CHILD WELFARE

- 260w. 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. Prereq.: Course 200 or equiv. 3 cred. Guilford.
- 261f,s. Problems in Children's Case Work. This course deals with substitute parental care. Principles and methods of child placement, including adoption, selection of foster home or institution are considered. Case materials reflecting current theories and practices are used throughout the course. Prereq.: Courses 211, 221. 3 cred. Guilford.
- 262s. Principles of School Social Work. Case work function of social worker in public school programs with discussion of the kinds of cases and problems encountered by the visiting teacher. Prereq.: Course 221. 2 cred. Laabs.
- 266w,s. Seminar in Child Welfare. Cred. ar. Guilford.
- Soc.103s. Juvenile Courts and Probation. Prereq.: Soc. 53 or permission of instructor. 3 cred. Monachesi.
- Soc.234f,w,s. Seminar in Juvenile Delinquency and Treatment. Cred. ar. Monachesi.

G. PUBLIC WELFARE

- 267f,s. Public Welfare I. Historical development and existing functions of present-day public welfare services. Prereq.: Course 200 or equiv. 3 cred. Guilford.
- 268w. Public Welfare II. Continuation of Public Welfare I. Prereq.: Course 267. 3 cred. Guilford.
- 269f,w,s. Seminar in Public Welfare Administration. Prereq.: Course 268. Cred. ar. Kidneigh.
- Pol.Sci.124w-125s. Recent Social Legislation. Prereq.: 6 cred. in political science or permission of instructor. 3 cred. per quarter. Christensen.

H. SOCIAL ADMINISTRATION AND COMMUNITY ORGANIZATION

- 275w. Principles of Administration Applied to Social Work. A technical study of methods of planning, organizing, and directing social agencies, and of making the public aware of their work. Prereq.: Course 200 or equiv. 3 cred. Kidneigh.
- 276f. Legal Aspects of Social Work. Legal information for social workers to furnish background for understanding social problems having legal implications with reference to the court system; legal process; legal rights of recipients. Not designed to teach technical law. Prereq.: Course 200 or equiv. 3 cred. Adelsheim.
- 279s. Seminar in Administration and Community Organization. Prereq.: Courses 275, 280. Cred. ar. Kidneigh.
- 280f,s. Community Organization. An analysis of the process by which groups and individuals within a community work together toward a social goal and the professional worker's role in this process. Prereq.: Courses 200, 220, 282, or permission of instructor. 3 cred. Kidneigh.

- Journ.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 director of School of Journalism. 2 cred. Casey, Emery.
- Soc.115w. Social Aspects of Housing and Standards of Living. Prereq.: Soc. 1, 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Chapin.
- Soc.160f. Rural Community Organization. Prereq.: permission of instructor. 3 cred. Nelson.

I. GROUP WORK

- 282Af.s. Principles of Group Work I. A general introduction to the philosophy of social group work, its place in the community, understanding of the needs of individuals in groups, the group work process and its use in various fields, as recreation, hospital, and psychiatric settings. Special emphasis on case work-group work relations and the referral process. 3 cred. Konopka.
- 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 as the effect of social forces in the community on group behavior. Teaching of record writing, use of face sheet material. Prereq.: Course 282A plus 211 and 236, which may be taken simultaneously. 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. Understanding the value of specific program in relation to needs. Teaching skill in planning and executing program activities. Prereq.: Course 282A. 2 cred. Konopka.
- 284s. Use of Program in Groups II. Continuation of 283 with special emphasis on the teaching of principles and practice of the discussion method. Prereq.: 282A. 1 cred. Konopka.
- 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.: Course 282B. 2 cred. Konopka.
- 286f. Therapeutic Group Work. Group work in a psychiatric setting. Work with individuals in a group for therapeutic purposes. Understanding of the role of the worker. Therapeutic grouping. A discussion of literature on group therapy. Prereq.: Course 282A, 230, 251, or 261. 2 cred. Konopka.
- 287w. 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.: Courses 284, 286. 2 cred. Konopka.
- 288s. 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. Methods to carry out this responsibility. Prereq.: Course 287. 2 cred. Konopka.
- 289f,w,s. Seminar in Group Work. Cred. ar. Konopka.

J. RESEARCH

- Soc.180f. Methods of Social Research. Prereq.: Soc. 45 or 182 or equiv. 3 cred. Ar.
- Soc.182f. Statistical Methods. Prereq.: Soc. 1 and 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Chapin.
- Soc.183w. Problems in Social Measurement. Prereq.: Soc. 45 or 182 or equiv. 3 cred. Ar.

- 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. Monachesi.
 300f,w,s. General Seminar in Social Work. Cred. ar. Staff.

SOCIOLOGY

Professors F. Stuart Chapin, Clifford Kirkpatrick, Elio D. Monachesi, Lowry Nelson, George B. Vold, Malcolm M. Willey; Associate Professor Douglas Marshall; Assistant Professors Theodore Caplow, Neal Gross, Don Martindale.

Prerequisites—For major work, 18 quarter credits; for minor work, 12 quarter credits.

Master's degree—Work for the Master's degree is 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 page 23.

COURSES

A. SOCIAL PROBLEMS AND SOCIAL POLICY

- 100s. Contemporary Penology. An analysis of some of the more important developments in recent attempts at the treatment of criminals and the prevention of crime. Prereq.: Courses 1, 53, 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Vold.
- 101f. Criminological Theories—Historical and Contemporary. A consideration and an evaluation of the major historical and contemporary theories of criminal behavior. Prereq.: Courses 1, 53, 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Vold.
- 102w. Adult Parole and Probation. A critical examination of problems and practices in the supervision of adult criminals. Prereq.: Courses 1, 53, 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Vold.
- 103s. Juvenile Courts and Probation. The 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—its "causes," its modification, and its prevention. Prereq.: Course 53. 3 cred. Monachesi.
104. Police Problems and Practices in the United States. A study of personnel, organization, and public relations of police forces with special attention to successful techniques of integrating police work with other community agencies. Prereq.: Courses 1, 53, 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. (Not offered in 1948-49.)
- 106f. City Planning. General survey of the economic, governmental, social, and technical phases of city planning and group housing. (The same as Architecture 104 and Political Science 123.) 3 cred. Jones, Anderson, Caplow, Filipetti, Vaile.
- 111w. Population Trends. This is a course emphasizing the cultural and social phases of population change as related to the institutional aspects of both rural and urban life. Population policy will be discussed with particular reference to the United States. Prereq.: Course 1, 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Marshall.

- 112s. Population Policy. Prereq.: Course 111. 3 cred. Ar.
- 115w. Social Aspects of Housing and Standards of Living. An analysis of the housing of the masses in relation to the problems arising in urban overcrowding, population distribution, and standard of living as affected by the distribution of national income, and the factors related to personal and social disorganization. Prereq.: Course 1, 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Caplow.

B. SOCIAL PSYCHOLOGY AND SOCIAL PROCESSES

- 120f,w. Social Psychology. Prereq.: Course 1, 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Kirkpatrick.
- 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.: Course 1, 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Vold.
- 123f,s. Interaction of Racial and Cultural Groups in America. Processes leading to group contact; characteristics and contributions of ethnic groups in the United States; mechanisms and problems of group adjustment. Democratic theory and practice; sources of prejudice; contemporary status of principal minority groups; international implications; trends and proposed solutions. Prereq.: Course 1, 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Kirkpatrick.

C. SOCIAL ORGANIZATION AND SOCIAL INSTITUTIONS

- 140w,s. Social Organization. The 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.: Course 1, 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Chapin.
- 141f,w,s. The Family. The 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.: Course 1, 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Kirkpatrick.
142. Religion as a Social Institution. Prereq.: Course 1, 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. (Not offered in 1948-49.)
143. The Newspaper as a Social Institution. Prereq.: Course 1, 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. (Not offered in 1948-49.)

D. RURAL LIFE AND WELFARE

- 160f. Rural Community Organization. A study of the historical evolution, ecological characteristics, and demography of the rural community; the social processes, stratification, assimilation, conflict, and co-operation as manifested in rural society. Prereq.: Course 1, 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Nelson.
- 161s. Rural Community Analysis. Course intended primarily for prospective rural teachers and extension workers. Emphasis will be placed on methods of making field studies of communities. Prereq.: Course 1, 15 cred. in social science, permission of instructor. 3 cred. Marshall.

162w. Rural Social Institutions. Factors in the rural environment that condition the functioning of rural social institutions, including the family, school, church, local government, health, and welfare. Prereq.: Course 1, 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Nelson.

E. THEORIES OF SOCIAL CHANGE AND SOCIAL ORDER

- 170f. Social Life and Cultural Change. The theory of cultural lag. The idea of progress. The genesis of the unilinear conception of change and its implications for sociological theory. Prereq.: Course 1, 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Martindale.
- 171w. Theories of Social Order. A survey of the leading theories of social organization in the European tradition, including the theory of hierarchy of estates and the doctrine of harmony of interests; the theory of the contract of society and equilibrium of interests; and the realist or conflict theory. Prereq.: Course 1, 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Martindale.
- 172s. Theories of Social Reconstruction. American reformers and reform movements from the 1830's to the present. Societies of co-operation and religious communisms in the United States. The muckrakers. The effects of war behavior on social reconstruction and reform movements. Prereq.: Course 1, 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Martindale.

F. RESEARCH METHODS AND TECHNIQUES

- 180f. Methods of Social Research. A survey of the major methods employed in social research including a consideration of their advantages and limitations when applied to specific types of research problems. Prereq.: Course 45 or equiv. 3 cred. Gross.
- 181s. Problems in Rural Social Research. A survey of methods currently used by students in investigating rural society; class reports on recent samples of rural research. Prereq.: Course 1, 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 2 cred. Nelson.
- 182f. Statistical Methods. Selected problems of social relationship described, analyzed, and interpreted by means of the common statistical methods. Prereq.: Course 1, 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Chapin.
- 183w. Problems in Social Measurement. A theoretical analysis of problems involved in measuring social variables, including a consideration of problems of reliability, validity, and standardization in the construction of new measuring instruments. Prereq.: Course 45 or 182 or equiv. 3 cred. Gross.
- 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.: Course 45 or 182, which may be taken simultaneously. 2 cred. per quarter. Gross.

G. SEMINARS

- 200f,w,s.* Seminar: Research Problems in Criminology. Cred. ar. Vold.
- 201f,w,s.* Seminar: Social Psychology of Family Relationships. Cred. ar. Kirkpatrick.
- 202f,w,s.* Seminar: Topics 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-210w-211s.* Seminar: Problems in Population Research. Cred. ar. Ar.
 215f.* Seminar in Rural Sociology: Rural Life in Latin America. Cred. ar. Nelson.
 216w.* Seminar in Rural Sociology: Rural Life in Selected Countries in Europe. Cred. ar. Nelson.
 217s.* Seminar in Rural Sociology: Current Rural Social Problems in the United States. Cred. ar. Nelson.
 234f,w,s.* Seminar in Juvenile Delinquency and Treatment. Cred. ar. Monachesi.
 238f-239w.*† Principles of Sociology. 3 cred. per quarter. Monachesi.

SOILS

Professors Clayton O. Rost, Paul R. McMiller; Associate Professor Alfred C. Caldwell; Assistant Professor John M. MacGregor.

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 is essential. With the approval of the adviser, courses in physical and plant sciences may be accepted as part of the major work.

Language requirement—Candidates for the Master's degree must have a reading knowledge of German or French. In special cases, where other languages are needed for the development of the thesis, Spanish, Russian, or the Scandinavian languages may be substituted by petition. For certain foreign students to whom English is an acquired language, exemption from a specific language requirement may be granted on recommendation of the major adviser and approval of the graduate group committee, also by petition. In no case where English is the native language will the language requirement be waived.

Master's degree—Work for the Master's degree is 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 types of erosion; relation of erosion to soil types; control of erosion by tillage, contour-cultivation, strip farming, terracing, and crops; control of moisture and conservation of plant nutrients; relation of forests to erosion control. Prereq.: Course 4. 3 cred. MacGregor.
 104s.* Soil Mapping. Practice in the identification and mapping of soil types in the field; preparation of soil maps and gathering of field data. Prereq.: Courses 108, 109. 3 cred. McMiller.
 107w. Fertilizers. Fertilizers and fertilizer materials, their sources, manufacture, and chemical properties. Uses and factors influencing their availability to crops. Review of long-time fertility experiments. Prereq.: Course 5. 3 cred. MacGregor.
 108w. Physical Properties of Soils. The determination of physical constants of soils, including mechanical composition. Lect. and lab. Prereq.: Course 4. 3 cred. McMiller.
 109s. Soil Genesis and Classification. Processes of soil formation; soil profile studies; geographical distribution of soils; zonal and intrazonal soils; soil surveys; soil maps and their interpretation. Soil association areas with special reference to Minnesota; factors affecting soil productivity ratings. Prereq.: Courses 4, 108. 3 cred. McMiller.
 202f,w,s,su.* Research Problems in Soils. Individual laboratory or field work upon some special problem 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; McMiller, Caldwell, MacGregor.

- 203f,w,s. 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.
- 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.: Course 108. 3 cred. Caldwell.
- 207w. Advanced Soils. The principles of soil formation; the chemical properties of soils, soil colloids, soil organic matter, reaction; the physical properties of soils, soil temperature, structure, soil water; soil microbiology. Prereq.: one year of chemistry. 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.: Course 4. 3 cred. Rost.

SPEECH

Associate Professor E. William Ziebarth, Chairman; Professors Bryng Bryngelson, Howard Gilkinson; Associate Professors Ernest H. Henrikson, Frank M. Whiting; Assistant Professors Kenneth L. Graham, LeRoy D. Hedgecock, William S. Howell, John V. Irwin, David W. Thompson.

Prerequisites—For major work, 18 quarter credits in speech, including fundamentals of speech, speech correction, phonetics, interpretative reading, and theater.

Master's degree—Work for the Master's degree is 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.

Doctor's degree—In consultation with his major adviser the candidate will elect three of the following areas of study: dramatics, oral interpretation of literature, rhetoric, general speech, speech pathology. 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.

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. Argumentation as a method of analysis of controversial questions. Modes of reasoning, briefing, speech composition, critical reports. Prereq.: Course 1-2-3 or 5-6, Psy. 1-2, 10 cred. in social science. 3 cred. per quarter. Howell.
- 105s.* Theory of Reading and Acting. The forms of literature; literature regarded as art; psychology of creative imagination; speech elements in literature; technique governing use of auditory and visual symbols. Collateral readings, speech problems, reports, term papers. Prereq.: Courses 1-2-3 or 5-6, 81-82-83, Psy. 1-2. 3 cred. Ar. (Offered in alternate years. Offered in 1949-50.)

- 106f,w,s. Discussion. Co-operative thinking; recognition and definition of problems, critical analysis, examination of possible solutions. Planning, preparing for, participating in, and leading classroom, public, and radio discussions. Prereq.: Course 1-2-3 or 5-6. 3 cred. Howell.
- 107s. Platform Reading. An advanced course in the oral reading of selected plays of Shakespeare. Speech melody, rhythm, platform technique. Problems in esthetic analysis. Lecture recitals. Prereq.: Course 81-82-83 with grade of B in 83. 3 cred. (Not offered in 1948-49.)
- 109.* Classical Rhetoric. Prereq.: Course 101-102-103, Psy. 140. 3 cred. (Offered in alternate years. Not offered in 1948-49.)
- 111f††-112w††-113s.*†† Stage Direction. An advanced course in the 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.: Courses 31, 32, 34, 91, 92, 93. 3 cred. per quarter. Whiting.
- 115f-116w. Playwriting and Production. Creative practice, both historical and experimental, in the problems of dramatic form and content. Two original one-act plays fall quarter, one full-length play winter quarter. The best plays will receive production in the University Theatre. Prereq.: Courses 31, 32-33, permission of instructor. 3 cred. per quarter. Thompson.
- 117s. Writing Radio Drama. The course is designed specifically for students interested in writing radio drama, including documentary plays, adaptations, original scripts. Prereq.: Courses 31, 32-33, permission of instructor. 3 cred. Thompson.
- 122f.* Introduction to Research. Selection of problems for research; techniques of investigation; preparation of the thesis. Required of all graduate majors in speech. Prereq.: Course 1-2-3 or 5-6, Psy. 1-2. 3 cred. Gilkinson.
- 124w. Experiments in General Speech. An examination of studies of the correlates of speech skills, audience reactions, and speech improvement. Prereq.: Course 1-2-3 or 5-6, Psy. 1-2. 3 cred. Gilkinson.
- 126s. History and Criticism of Public Address. An examination of historical and critical studies of oratory. The study of orators: education and training, style, speech composition, topics and issues, historical settings. Prereq.: Course 1-2-3 or 5-6, Psy. 1-2. 3 cred. Gilkinson.
- 131s.†† Community Dramatics. The cultural values of children's theater and children's creative dramatics. Specimen projects, reports, term papers. Observation of children working in creative dramatics. Prereq.: Courses 91-92-93, 111-112-113, or permission of instructor. 3 cred. Graham.
- 141f. Anatomy and Physiology of the Voice Mechanism. Consideration of respiration, articulation, and phonation; practical applications to speech improvement. Prereq.: Courses 1-2-3 or 5-6, 67, Psy. 1-2, 4-5. 3 cred. Irwin.
- 142w. The Physical Bases of Speech. Relationship of basic principles of sound to speech mechanism. Analysis of speech sound production. Prereq.: Courses 1-2-3 or 5-6, 67. Psy. 1-2, 4-5. 3 cred. Irwin.
- 143s. Speech Instrumentation. Application of mechanical and electronic equipment to speech; basic theory and uses. Prereq.: Courses 1-2-3 or 5-6, 67, Psy. 1-2, 4-5. 3 cred. Irwin.
- 151su. The Teaching of Speech. Orientation in problems of speech education: history, applications of psychology; objectives, programs, and methods; direction of extracurricular activities; evaluation of texts. Prereq.: Course 1-2-3 or 5-6. 3 cred. Gilkinson.

†† A fee of \$2 per quarter is charged for this course.

- 152f-153w.* **Problems of Hearing.** A study of the hearing mechanism and its function, techniques of determining hearing acuity and electronic aids to hearing. Prereq.: Courses 1-2-3 or 5-6, 61, 67, Psy. 1-2, or permission of instructor. 3 cred. per quarter. Hedgecock.
- 155s.* **Lip Reading and Lip Reading Methods.** A study of the positions and movements involved in English speech and the current methods used in teaching lip reading. Prereq.: Course 1-2-3 or 5-6, Psy. 1-2, or permission of instructor. 3 cred. Hedgecock.
- 162w-163s.† **Speech Pathology.** The 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.: Courses 1-2-3 or 5-6, 61, 67, 85, permission of instructor. 3 cred. per quarter. Bryngelson, Henriksen.
- 164f-165w-166s.* **Clinical Methods and Practice in Speech Pathology.** (The same as Ed.C.I. 174-175-176.) Study of cases and practice in clinical diagnosis and remedial treatment. Prereq.: Courses 1-2-3, 61, 67, 85, 162-163, and Ed.Psy. 142. 3 cred. per quarter. Bryngelson.
- 169w. **Speech and Language in Human Behavior.** Basic orientation in the place of speech and language in human behavior. Individualized projects and collateral reading. Prereq.: permission of instructor. 3 cred. Henriksen.
- 171f-172w-173s.* **History of the Theater.** A study of the arts and crafts of the theater over a period of 3000 years. Special reports and projects. Prereq.: Courses 1-2-3 or 5-6, 31; courses in dramatic literature highly recommended. 3 cred. per quarter. Thompson. (Offered in alternate years. Offered in 1948-49.)
- 174f-175w-176s.* **Theater Backgrounds.** A study and analysis of the play structure and content as limited and evolved through production practices. Materials to be selected from the various dramatic epochs of the theater. Special reports and projects. Prereq.: Courses 1-2-3 or 5-6, 31. 3 cred. per quarter. Whiting. (Offered in alternate years. Not offered in 1948-49.)
- 181f-182w-183s. **Readings in Speech.** Directed reading and the preparation of reports on selected subjects. Prereq.: Course 1-2-3 or 5-6 and 6 additional cred., permission of instructor. Cred. ar. Staff. .
- 184f-185w-186s. **Interpretation of the Drama.** (The same as English 184-185-186.) Prereq.: 6 cred. above English 50, Eng. 55-56 advised. 3 cred. per quarter. Bentley.
- 191f-192w-193s. **Technical Stage Problems.** Advanced problems in design and construction; stage management, color effects, and wiring. Special problems assigned to individual students. Prereq.: Course 111-112-113. 3 cred. per quarter. Whiting.
- 201f,w,s.* **General Seminar.** A survey and analysis of current literature and general problems in the field of speech. Theory and methods of research in speech education. Reports of reading and research projects by students and members of the staff. Required of all graduate majors in speech. 1 cred. Staff.
- 207f-208w-209s.* **Seminar in Rhetoric and Persuasion.** Study of English and American orators. Critical examination of the literature on rhetoric and persuasion. Methods in the study of persuasion. Prereq.: Courses 1-2-3 or 5-6, 101-102-103, Psy. 1-2, 140, 10 cred. in social science. 3 cred. per quarter. Howell.
- 211f-212w-213s.* **Seminar in Dramatic Theory.** An analysis of the critical theory of theatrical arts. A study of the major trends in drama as related to dramatic production. Prereq.: Courses 111-112-113, 171-172-173, or 174-175-176, 9 cred. in English, French, or German drama. 3 cred. per quarter. Thompson.

- 221f-222w-223s.* Seminar in the Oral Interpretation of Literature. Problems of silent and oral readings. Theories of speech in relation to language and types of literature. Prereq.: Courses 1-2-3 or 5-6, 81-82-83, 105, 122, Psy. 74. 3 cred. per quarter. 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 of instructor. 3 cred. per quarter. Gilkinson.
- 261f-262w-263s.* Seminar in Speech Pathology. Study of significant literature in speech pathology, with emphasis on the analysis and evaluation of research methods. Prereq.: Courses 1-2-3 or 5-6, 61, 67, 122, 162-163, Psy. 1-2. 3 cred. per quarter. Henrikson.
- 291f-292w-293s.* Research. Open to graduate students who are 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 *Graduate Medical Bulletin*.

VETERINARY MEDICINE

Professors Willard L. Boyd, Howard C. H. Kernkamp, Martin H. Roepke; Associate Professors Reuel Fenstermacher, Benjamin S. Pomeroy; Instructors Jay H. Sautter, Ralph L. Kitchell.

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.

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

Major work—The candidates taking their major work for their Master's degree or Doctor's degree may, upon approval of the adviser, select courses in physiology, bacteriology, hematology, and pathology in the Medical School as part of their major work.

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.) Fall, 7 cred.; winter, 4 cred.; spring, 3 cred. Kitchell.
- 104f,w,s,su. Special Studies in Animal Anatomy. Individual problems for further study in animal anatomy. Prereq.: Course 101. 1 to 3 cred. per quarter. Kitchell.
- 111f-112w-113s. Animal Histology and Embryology. Microscopic studies of the various tissues and organs, including embryology, of the domestic animals. Open to graduate students with permission. (Enrolment limited.) Fall, 6 cred.; winter, 4 cred.; spring, 3 cred. Kitchell.
- 114f,w,s,su. Special Studies in Animal Histology and Embryology. Individual problems for further study in animal histology and embryology and histological techniques. Prereq.: Course 111 or equiv. 1 to 3 cred. per quarter. Kitchell.
- 201f,w,s. Advanced Animal and Poultry Pathology. Studies of clinical material, collateral reading, and conferences. Prereq.: permission of instructor. Cred. ar. Boyd, Kernkamp, Fenstermacher, Pomeroy, Sautter.

- 205f,w,s. Advanced Animal Bacteriology. Studies on clinical material, collateral reading, and conferences. Prereq.: permission of instructor. Cred. ar. Boyd, Kernkamp, Fenstermacher, Pomeroy.
- 209f,w,s. Advanced Clinical Technique. A more detailed application of clinical techniques in the diagnosis and therapy of animal diseases. Prereq.: permission of instructor. Cred. ar. Boyd, Kernkamp, Fenstermacher, Pomeroy.
- 213f,w,s. Veterinary Obstetrics and Gynecology. A course designed to give the student a more comprehensive training in the disorders and diseases of reproduction of domestic animals through studies on clinical material, collateral reading, and conferences. Prereq.: permission of instructor. Cred. ar. Boyd.
- 217f,w,s. Seminar in Veterinary Medicine. Special assignments and review of research problems in veterinary medicine. 1 cred. Boyd, Roepke, Kernkamp, Fenstermacher, Pomeroy.
- 230f,w,s,su. Research in Veterinary Medicine. Cred. ar. Boyd, Kernkamp, Roepke, Fenstermacher, Pomeroy.

ZOOLOGY

Professors Dwight E. Minnich, Samuel Eddy, Alexander C. Hodson, Clarence E. Mickel, Adolph R. Ringoen, H. Burr Steinbach, Jerry E. Wodsdalek; Associate Professors Sheldon C. Reed, Otto Schmitt, Franklin G. Wallace; Assistant Professor Kenneth L. Osterud.

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.

Master's degree—Work for the Master's degree is 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. The content of this course is subject to the direction of the major adviser. Cred. ar., not to exceed 3 cred. per quarter. Ar.
- 107f.‡ Protozoology. General morphology, taxonomy, habits, and life histories of free-living and symbiotic protozoa. Lect., lab., reading. Prereq.: 15 cred. in zoology. 3 cred. Osterud.
- 108s.‡ Protozoology. Cytology, physiology, reproduction, genetics, and identification of free-living protozoa. Lect., lab., reading. Prereq.: Course 107. 3 cred. Osterud.
- 109w.‡ Sense Organs. A survey of the structure and function of the sense organs of invertebrate and vertebrate animals. Lect. and demonstrations. Prereq.: 15 cred. in zoology, permission of instructor. 3 cred. Minnich.
- 110s.‡ Animal Reactions. A survey of the nervous system, effectors, and behavior patterns of animals. Lect. and demonstrations. Prereq.: 15 cred. in zoology, permission of instructor. 3 cred. Minnich.
- 112f-113w.‡ Advanced General Physiology. Interactions between cells and environment; enzyme actions and general protoplasmic structure and metabolism. Lect. and lab. Prereq.: 15 cred. in zoology, permission of instructor. 3 cred. per quarter. Steinbach.
- 117f.‡ Animal Ecology. General ecology stressing ecological principles and land communities. Lect., lab., assigned reading, field trips. Prereq.: 15 cred. in zoology or entomology. 3 cred. Eddy, Hodson.

‡ A fee of \$1.50 per quarter is charged for this course.

- 118w.‡ Animal Ecology. Experimental approach to the study of environmental factors affecting animal populations. Lect. and lab. Prereq.: 15 cred. in zoology or entomology. 3 cred. Hodson.
- 119s.‡§ Animal Ecology. A study of the conditions for life in the water and distribution of aquatic animals. Lect., lab., assigned reading, field trips. Prereq.: 15 cred. in zoology or entomology. 3 cred. Eddy.
- 120s.§ General Ecology of Insects. Special emphasis on its application to problems in economic entomology. Lect., field trips, reading. Prereq.: Courses 117, 118. 3 cred. Hodson.
- 121f.‡ Ichthyology. A study of the taxonomy and habits of North American fishes with special reference to those of upper Mississippi drainage. Lect. and lab. Prereq.: 15 cred. in zoology. 3 cred. Eddy.
- 125f‡-126w‡-127s.‡ Advanced General Entomology. Morphology, biology, and classification of insects. Lect., lab. Frequent field trips in 127s. Prereq.: Course 52 or equiv. or permission of instructor. 3 cred. per quarter. Mickel.
- 128f‡‡-129w.‡‡ Insect Physiology. General and comparative physiology of insects, a survey of the organ systems and their functioning in various insects. Special emphasis is placed on research methods and evaluation of data. Lect., lab., and reading. Prereq.: 15 cred. in zoology or entomology, permission of instructor. Course 50 or equiv. recommended. 4 cred. per quarter. Richards.
- 144f.‡ Medical Entomology. A study of the principal arthropods noxious to man and animals. Special emphasis is placed on those arthropods which serve as pathogenic organisms of man and animals. Lect. and lab. Prereq.: Course 52 or equiv. or permission of instructor. Burroughs.
- 145w.‡ Parasitic Protozoa. The structure, life histories, and economic relations of protozoal parasites of man and animals. Lect., lab., diagnosis. Prereq.: 15 cred. in zoology. 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 zoology. 3 cred. Wallace.
- 149w‡-150s.‡ Histology and Organology. Comparative study of the microscopic structure of tissues and organs. Textbook, lect., demonstration, and lab. Prereq.: 15 cred. in zoology. 3 cred. per quarter. Ringoen.
- 155w.‡ Biophysics. A survey of the theoretical and experimental aspects of biology that can be studied by quantitative physical means. Includes tissue ultrastructure as revealed by refringence, X ray, electron, and radioactive means; tracers; surface phenomena; colloidal and micellar phenomena; and the excitatory process in nerve and muscle. Lect. and lab. Prereq.: 25 cred. in physics and biological science, including work in both. 3 cred. Schmitt.
- 160f‡-161w.‡ Cytology. A 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 of instructor. 3 cred. per quarter. Wodsedalek.
- 170f‡-171w.‡ Advanced Genetics. General laws involved in heredity and variation, with their applications to micro-organisms, higher plants, and animals exclusive of man. The second quarter is restricted to consideration of the factors in speciation. Textbooks, lect., lab. Prereq.: 15 cred. including Course 83, or permission of instructor. 3 cred. per quarter. Reed.

‡ A fee of \$1.50 per quarter is charged for this course.

‡‡ A fee of \$5 is charged for this course.

§ Either 119s or 120s or both may be taken to complete Course 117f-118w.

- 175s. Human Genetics. A study of the inherited characters in man, particularly from the point of medicine with some reference to the relation of genetics to marriage and to social conditions. Lect. and lab. Prereq.: Course 83, permission of instructor. 3 cred. Reed.
- 180s.‡ Comparative Embryology. A study of the embryological development of invertebrate and vertebrate forms, including fertilization, cleavage, formation of germ cells, parthenogenesis, polyembryony, hermaphroditism, growth, and differentiation. Attention is given to mammalian reproductive cycles, implantation, placentation, twinning, and monster formation. Lect., ref., and lab. Prereq.: 15 cred. including Course 21 or equiv. 3 cred. Ringoen.
- 181f. Endocrines and Reproduction. Lectures and readings on the endocrines with special reference to those concerned with the physiology of reproduction. Prereq.: 15 cred. including Course 21 or equiv. 3 cred. Ringoen.
- 182w. Experimental Embryology. Lectures and discussions of the more recent investigations in developmental mechanics. Prereq.: 15 cred. including Course 21 or equiv. 3 cred. Ringoen.
- 197f-198w-199s.* Problems. Advanced work in some special line. Prereq.: Course 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. Ringoen.
- 233-235.* Research in Embryology. Ringoen.
- 237-239.* Research in Cytology. Wodsedalek.
- 241-243.* Research in Protozoology. Osterud.
- 251-253.* Research in Genetics. Reed.
- 261-263.* Research in Parasitology. Wallace, Burroughs.
- 291-293. General Seminar. Ar.
- 296-298.* Seminar in Special Research Fields. Ar.

‡ A fee of \$1.50 per quarter is charged for this course.

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