

The Bulletin of the
UNIVERSITY of MINNESOTA

The Graduate School
Announcement for the Years 1946-1948



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UNIVERSITY CALENDAR

Fall Quarter

1946			Registration for graduate students
Aug. 5-Oct. 5			Fall quarter classes begin, 8:00 a.m. ¹
September	30	Monday	Language examinations
October	10	Thursday	Last day for filing Ph.D. theses for the fall quarter
November	7	Thursday	Last day for filing Master's theses for the fall quarter
November	22	Friday	Commencement, 8:00 p.m.
December	19	Thursday	Fall quarter ends, 6:00 p.m.

Winter Quarter

1947			Registration for graduate students
January	6-11		Winter quarter classes begin, 8:00 a.m. ¹
January	6	Monday	Language examinations
January	16	Thursday	Last day for filing Ph.D. theses for the winter quarter
February	6	Thursday	Last day for filing Master's theses for the winter quarter
February	20	Thursday	Commencement, 8:00 p.m.
March	20	Thursday	Winter quarter ends, 6:00 p.m.

Spring Quarter

March 31-April 5			Registration for graduate students
March	31	Monday	Spring quarter classes begin, 8:00 a.m. ¹
April	10	Thursday	Language examinations
May	2	Friday	Last day for filing Ph.D. theses for the spring quarter
May	9	Friday	Last day for filing Master's theses for the spring quarter
June	13	Friday	Seventy-fifth annual commencement, 8:00 p.m.
			Spring quarter ends, 6:00 p.m.

Summer Session

June	16-17		Registration, first term. First term fees due
June	18	Wednesday	First term Summer Session classes begin, 8:00 a.m. ¹
June	26	Thursday	Language examinations
			Last day for filing theses for first term of Summer Session
July	24	Thursday	Commencement, 8:00 p.m.
July	25	Friday	First term closes
July	28	Monday	Registration, second term. Second term fees due
July	29	Tuesday	Second term classes begin, 8:00 a.m. ¹
August	7	Thursday	Last day for filing theses for second term of Summer Session
August	29	Friday	Second term closes

¹ First hour classes begin at 7:45 at University Farm.

THE GRADUATE SCHOOL

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 simply desire 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 register, if residents of Minnesota, as special students in the college giving the work. Under university rules the status of adult special is closed to nonresidents during the fall, winter, and spring quarters.

The results of the Graduate Record Examination when available will be considered as supplementary information in determining the admission of students. 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 two weeks before the opening of the quarter in which the student matriculates.

THE GRADUATE SCHOOL

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 CREDIT

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 11 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 4, "From other institutions to apply toward the Master's degree," and Requirements for the Doctor's Degree, page 11 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 two weeks before the opening of the quarter in which the student enters the Graduate School.

Registration in the Graduate School includes the making out of the program, which 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.

FEES

Tuition fee for residents (except for clinical medicine) per quarter	\$32.00
Tuition fee for nonresidents per quarter	56.00
Tuition fee per credit hour for students carrying less than full work	
Residents	2.75
Nonresidents	4.75
Tuition fee for graduate study <i>in absentia</i> for the professional engineer degrees (to be paid but once for each degree)	96.00
Tuition fee for thesis registration only per quarter	5.00
Incidental fee	10.65
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	1.50
Fee for publication of Ph.D. thesis summary	25.00

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.

¶ For the academic year 1946-47 late registration penalties will not be applied to registration completed one week later than the dates specified above.

§ 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 tho 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.

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 things 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 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 a 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.

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

† Students should consult departments with respect to their policy as to the use of Plan B.

The choice of 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.

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 four weeks* (in the spring quarter, five 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, one dollar 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	Four weeks before graduation (in June, five weeks)
Approval of thesis	Thesis committee	Before admission to final oral examination
Final written examination in major	Major department members of the graduate faculty	Not later than three weeks before commencement and 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 14) 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 15.) 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. In so far 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, credit hours should be in a single field of concentration. 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 the approval of his adviser 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 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 program is then to be submitted to the dean for final approval. He 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.

[§] 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 GRADUATE SCHOOL

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.

THE MAJOR WORK

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

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 all of this work shall be completed and certified to by the department in which the minor is taken 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 which 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 which 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* (four weeks in the first term of the Summer Session) before the commencement at which the candidate expects to receive the degree.

* 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.

¶ 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.

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 \$25 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.

Directions for Preparing the Summary

1. Original copy on good quality bond, double-spaced, student's name on each page.
2. Few references and those to be listed at the end of the summary.
3. Signature of the adviser following careful editing for both content and form.
4. No bibliography.
5. No acknowledgments.
6. 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 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 \$25 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 \$25 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 doctoral 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 commencement—normally from about April 25 to May 25.

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 the examination shall be open to any member of the graduate faculty. 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 \$25	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 pages 7-10), 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 *four weeks* before the end of the session in which they take the degree. (See pages 8-9.)

MASTER'S DEGREE, PLAN B

All requirements for Plan B may be completed in six summer terms of six weeks each and must be completed within seven years following the first registration. (See page 10.)

GRADUATE WORK IN SPECIFIC FIELDS

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, Professor Tremaine McDowell, Folwell Hall, University of Minnesota.

GRADUATE WORK IN CANCER BIOLOGY

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. 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.

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.

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.

For list of courses in cancer biology see under Physiology.

GRADUATE WORK IN DENTISTRY

Graduate work for a limited number of students is offered in certain fields of dental research and dental specialties. The work is under the direction of a joint committee in dentistry and medicine in the Graduate School. Candidates for admission must be gradu-

ates of an acceptable dental school with at least two years of preliminary general college work. 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 on 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*. Altho a reading knowledge of German is recommended as highly desirable, candidates for the Master's degree in dentistry are exempted from the foreign language requirements. Qualified students who give full time to their studies and absolve the requirements, including a satisfactory thesis, will normally require three years for the degree of master of science in dentistry.

The fields of research and specialization in which work will be directed are: oral pathology, oral surgery, orthodontia, periodontia, pedodontia, restorative dentistry.

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.

REQUIREMENTS FOR THE ENGINEER DEGREES

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.

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

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 6) 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 6.

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 towards 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.

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.

FEEs

A fee of \$96, to be paid in advance, is required for the year of graduate study towards the professional Engineer degrees if taken *in absentia*. Students in residence are charged the regular Graduate School fees. In addition the regular graduation fee of \$10 must be paid for each degree obtained, at the time of qualifying for the degree. The student must also pay \$1.50 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 tho 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 dean normally four weeks (in the case of the June commencement, five weeks) before the commencement at which the degree is to be obtained. The deposit of one dollar and a half 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, or college, and dean	On completion of 9 to 15 credits
Quarterly reports if <i>in absentia</i>	Adviser	Following approval for candidacy and at beginning of second quarter
Thesis subject	Adviser and group committee ..	
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 ..	Four weeks before graduation (five, in June)
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.

INTERNATIONAL RELATIONS AND AREA STUDIES

Candidates for the Master's degree may pursue a program of study in any one of five political and cultural areas : Western Europe, Central Europe, Russia, 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 studise 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 five 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), K. Reichardt (Russia), H. S. Quigley and W. B. Cline (Far East), and E. C. LeFort (Latin America).

GRADUATE WORK IN LAW

Under certain properly approved conditions graduate students may offer courses in law as a minor for an advanced degree when their major work is in political science or economics.

A course leading to the degree of master of laws may be taken under the direction of the Graduate School of the University. Candidates must have completed two years of college work, and the work required for the first law degree in a school which is a member of the Association of American Law Schools. The course elected by the student must be approved by an adviser and by the Graduate School. Subjects in the curriculum of the Law School not counted towards the first degree and additional work in subjects already studied may be elected. The candidate may also elect graduate studies in the social sciences in the College of Science, Literature, and the Arts, and in the School of Business Administration. The candidate must complete the usual course requirements for the Master's degree and prepare a thesis that will be accepted for publication in the *Minnesota Law Review*. The course may be shaped to secure a more extensive survey of the law and related subjects, or to give a more thoro training in some special branch.

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. Several 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 de-

partments with courses in statistics, technical courses in psychological testing, and field work, supplemented whenever possible by internships.

Professors Florence L. Goodenough (Child Welfare), Walter W. Cook (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 Committee on Training for Public Administration.

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 committee. 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 several departments, will be planned for each student, in consultation with members of the staff, which must be approved by the Committee on Training for Public Administration. 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 pre-service 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.

GRADUATE WORK IN STATISTICS

The Graduate School has authorized a program of study leading to the degree of doctor of philosophy with a major in statistics and 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, W. C. Waite; Associate Professor A. E. Treloar.

* Major adviser, Lloyd M. Short, director of training program.

THE GRADUATE SCHOOL

DOCTOR OF PHILOSOPHY

MAJOR IN STATISTICS

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

Major—The course work for the major should normally include a minimum of 50 credits chosen from the courses listed below. 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 include a minimum of 24 credits in 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 minimum number of credits for this minor will be 24, and 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.

	Credits
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 7-11 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.

A special bulletin, *Vocational Diagnosis and Counseling for Rehabilitation Workers*, may be obtained from the Office of Admissions and Records, University of Minnesota, Minneapolis 14, Minnesota.

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 for 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.

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 enrolment 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 \$1,575 for full-time service for the academic year of nine months. In general they vary from approximately \$400 for 25 per cent of full-time service to approximately \$800 for half-time service for the academic year.

Personnel assistantships, providing board and room but not carrying exemption from

§ Applications for fellowships and assistantships must be made on or before March 1, 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.

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

Applications are due March 1 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.

FELLOWSHIPS

Abbott Laboratories Fellowship—This fellowship of \$750 is open to graduate students majoring in organic chemistry under Professor Walter M. Lauer.

Administrative and Clinical Fellowships—Four 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), five in the Student Housing Bureau, four in the Student Activities Bureau, 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, 213 Administration Building, University of Minnesota, Minneapolis 14, Minnesota.

Albert Howard Fellowship—This fellowship affords a stipend of \$240 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 are open to graduates of the University of Minnesota who major in botanical and zoological science.

Allied Chemical and Dye Corporation Fellowships—Two fellowships of \$1,200 each plus tuition are available, one in chemistry and one in chemical engineering. Holders must be citizens of the United States, preferably male students in the last year of work for the doctorate.

Arthur Andersen Fellowship—This fellowship of \$500 in accounting or related fields is open to men students holding a Bachelor's degree from the University of Minnesota.

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. 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.

Carbide and Carbon Chemicals Corporation Fellowship in Organic Chemistry—This fellowship of \$1,000 also provides tuition and fees not to exceed \$500 per year. Work is to be done under Professor C. F. Koelsch.

Carl Schlenker Memorial Fellowship—This stipend of \$300 annually 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 fees.

Class of 1890 Fellowship—Whenever sufficient funds have accumulated, this fellowship of approximately \$250 is open to a graduate of the College of Science, Literature, and the Arts, or the College of Engineering and Architecture.

Consolidated Vultee Aircraft Corporation Fellowships—Two fellowships of \$750 each 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.

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 degrees 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 and exemption from tuition.

du Pont Fellowships in Chemistry and Chemical Engineering—Two fellowships, one in each field, of \$1,200 each (or \$1,800 if the student is married) plus tuition and fees not otherwise paid by any governmental or private agency, are available.

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

Ebin Fellowships for Graduate Medical Education—Five fellowships of \$1,000 each are offered annually for a period of five years beginning January, 1946. In awarding these fellowships preference is given to veterans.

Foreign Student Scholarships—Thirty tuition scholarships open in any department or college are offered to qualified foreign graduate and undergraduate students. These offer no stipend, but grant exemption from tuition only. Applications should be made preferably before March 1, but will be accepted up to June 1, of each year. Applications should be addressed to the Office of the Dean of Students, 213 Administration Building, University of Minnesota, Minneapolis 14, Minnesota.

Grace Ellis Ford Fellowship of the Minneapolis College Women's Club—This carries a stipend of \$750, open in alternate years to a graduate woman student without restriction as to major field. Offered for 1946-47.

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.

Hormel Research Foundation Fellowships—Two fellowships, one in chemistry and one in chemical engineering, of \$1,000 each with exemption from tuition and fees.

In-service fellowships in public administration—Two fellowships with stipends varying from \$1,000 to \$1,200 and with exemption from tuition are offered by the University of Minnesota each year to graduates of recognized universities and colleges who have had not less than three years of experience in government service, and who wish further to prepare themselves for positions of administrative responsibility. Preference is given to employees of Minnesota state and local governments.

Application blanks and additional information concerning these fellowships may be secured from the secretary of the Committee on Training for Public Administration, 13 University Library, University of Minnesota, Minneapolis 14, Minnesota.

Lederle Fellowships—Three fellowships in pharmaceutical chemistry, of \$1,000 each, are offered annually for research work in the field of pharmaceutical chemistry under Professor C. O. Wilson.

Merck Fellowship in Organic Chemistry—This fellowship provides \$1,000 plus tuition and fees not to exceed \$500.

Midland Cooperative 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. Altho 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 March 1.

Minnesota State Division of the American Association of University Women Fellowship—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 1947-48.

Minnesota State Pharmaceutical Association Fellowship—This fellowship of \$500 with exemption from tuition 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.

Monsanto Chemical Company Fellowship in Organic Chemistry—This fellowship provides a stipend of \$1,200, with study under Professor C. F. Koelsch.

Norwegian-American Graduate Fellowships—A limited number of these fellowships are open to qualified graduate students from Norway. Stipend is \$350 without exemption from tuition.

Peavey-Van Dusen-Harrington Fellowship—This fellowship of \$1,000 a year for a three-year period is offered by the University of Minnesota to a qualified Chinese graduate student who wishes to major in some field of agriculture, forestry, or home economics. It includes exemption from tuition and affords an excellent opportunity for either a man or a woman to pursue advanced studies.

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.

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 1947-48, one in the College of Agriculture, Forestry, and Home Economics and one in the College of Science, Literature, and the Arts. Similar fellowships will be offered in 1948-49 in the School of Chemistry and the Medical School. These fellowships carry exemption from tuition.

Sigerfoos Fellowship in Zoology—This fellowship offers a small sum of money annually to graduate students in the field of zoology to enable them to forward their studies primarily by a period of work at marine or tropical laboratories.

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.

Several Red Cross Fellowships at \$65 per month and tuition are available in medical social work for second year students, and in home service work for first and second year students. Students who accept these fellowships are committed to accept Red Cross employment for one year.

A limited number of fellowships are made available by the Board of Charities of the American Lutheran Church, with a stipend up to \$800, conditioned by the students' financial need. These are available to Lutheran students with acceptable scholarship standards. They do not grant exemption from tuition. Students accepting these fellowships are committed to accept employment approved by the Lutheran Board of Charities.

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

Standard Oil Fellowship in Hydraulics—One fellowship of \$1,000 plus 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, Minneapolis 14, Minnesota.

Thomas F. Andrews Fellowship in Geology—A small fund varying from \$250 to \$400, with exemption from tuition, is available at intervals of two or three years to a graduate student majoring in geology.

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 \$200 during any one year or a maximum of \$400. All applications should be made to the Bureau of Student Loans and Scholarships, 207 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.

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 and whose family income does not exceed \$2,000. 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 subletting, 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 10-11.

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 *Combined Class Schedule* 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 Professors Robert G. Urquart, 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.

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 3 and M.&M. 25. 3 cred. Mr. Cronk.
- 103f-104w-105s. Advanced Aerodynamics. Prereq.: Course 102. 3 cred. per quarter. Mr. Cronk.
- 115f. 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. Mr. Urquart.
- 116w. 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. Mr. 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. 120f, 3 cred.; 121w, 4 cred.; 122s, 3 cred. Mr. Upson, Mr. Harris.
- 123f,w,s-124f,w,s-125f,w,s.* Advanced Airplane Design. Problems in airplane design or development. Prereq.: Course 121. 2 to 5 cred. per quarter. Mr. Akerman.
- 126s.* Propeller Design. Graphical and analytical methods of investigation. Prereq.: Course 120. 3 cred. Mr. Akerman.
- 127f,w,s*-128f,w,s. Advanced Problems in Airscrew Design. Prereq.: Course 126. 2 to 5 cred. per quarter. Mr. Akerman.
- 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. Mr. Cronk, Mr. Upson.
- 160s. Airships. Theory and design. Rigid and nonrigid types; stresses; performance. Prereq.: Courses 83, 102, M.&M. 128. 3 cred. Mr. Piccard.

- 164s. Problems Relating to the Stratosphere. 3 cred. Mr. 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. 2 to 4 cred. per quarter. Mr. Akerman, Mr. Piccard.
- 170s. Air Transport Economics. Airports and airways and their equipment; air commerce rules and regulations; communication. 2 cred. (Not offered in 1946-47.)
- 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. 2 to 5 cred. per quarter. Mr. Piccard.
- 190f-191w-192s.* Seminar. Readings, reports, conferences, and discussions. Prereq.: Course 102. 1 cred. per quarter. Mr. Akerman, Mr. Piccard.
- 193f,w,s-194f,w,s-195f,w,s.* Advanced Problems in Aeronautical Engineering. 2 to 5 cred. per quarter. Mr. Akerman, Mr. Piccard, Mr. Robertson, Mr. Wise, Mr. Cronk.
- 201f-202w-203s. Advanced Problems in Aerodynamics. Prereq.: Course 102 or special permission. 3 cred. per quarter. Mr. Cronk.
- 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. Mr. 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. Mr. Wise.
- 272f-273w-274s.* Research in Aeronautical Engineering. 2 to 5 cred. per quarter. Mr. Akerman, Mr. Piccard, Mr. Robertson, Mr. Cronk, Mr. Upson.
- 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. Mr. Akerman, Mr. Robertson.

AGRICULTURAL BIOCHEMISTRY‡

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

Prerequisites—For major work, credit in general chemistry and qualitative analysis, in organic chemistry, in quantitative analysis, and at least 10 quarter credits in biological science. College physics and physical chemistry are strongly advised. Unless the student presents credits in those subjects on entrance he will, in general, be required to register for *physical chemistry* early in his graduate program. The adviser with whom the student wishes to work may require additional prerequisites.

For minor work, credit in general chemistry and qualitative analysis, in organic chemistry, and 10 quarter credits in biological science.

‡ 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 breakage 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.

Majors—All students majoring in this division must include Course 224 in their study programs. With the approval of the adviser, courses in bacteriology, botany, dairy husbandry, genetics, plant pathology, physiology, physiological chemistry, zoology, etc., and courses in the School of Chemistry may be accepted as major work.

Minors should be arranged only after consultation with the instructors concerned.

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.

Master's degree—Work for the Master's degree is offered in general under Plan A. In exceptional cases Plan B may be offered by petition approved by a special committee composed of 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. Mr. 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. Mr. Geddes.
- 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. Mr. 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. Mr. 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. 3, 4, or 5 cred. depending on the amount of work completed. Mr. Geddes.
- 116w. Advanced Animal Nutrition. Recent developments in animal nutrition, covering the field of proteins, mineral metabolism, and vitamins. Prereq.: Courses 106 or equiv., 120 or physiological chemistry. 3 cred. Mr. Schultze, Miss Kennedy.
- 117s.‡ Laboratory Problems in Animal Nutrition. A laboratory course on methods used in nutrition studies. Prereq.: Course 116 and permission of instructor. 3 cred. Mr. Schultze, Miss Kennedy.
- 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.

‡ A laboratory fee of \$5 is required for each quarter of this course. The \$5 card purchased from the cashier's office, University Farm, must be presented before laboratory space will be assigned. A \$5 breakage card against which breakage can be charged must be purchased also.

§ Lectures only may be taken upon permission of instructor.

- 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 Org. Chem. 3 cred. Mr. 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. Mr. Sandstrom.
121w. Carbohydrates. Mr. Geddes.
122s. Lipides. Mr. 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. Mr. Sandstrom.
- 129f.‡ Colloids Laboratory. Methods for the preparation, purification, and study of the physico-chemical properties of inorganic and biocolloid systems. Prereq.: Course 2, parallel Course 119. 2 cred. Mr. Briggs.
- 130w.‡ Proteins Laboratory. Qualitative and quantitative biochemical methods for the preparation, identification, and analysis of proteins and their hydrolytic products. Prereq.: Course 2, parallel Course 120. 2 cred. Mr. Sandstrom.
- 131w.‡ Carbohydrates Laboratory. Qualitative and quantitative biochemical methods for the preparation, identification, and analysis of sugars and polysaccharides. Prereq.: Course 2, parallel Course 121. 2 cred. Mr. Geddes.
- 132s.‡ Lipides Laboratory. Qualitative and quantitative biochemical methods for the preparation, identification, and analysis of lipides. Prereq.: Course 2, parallel Course 122. 2 cred. Mr. Briggs.
- 133s.‡ Enzymes Laboratory. Qualitative and quantitative biochemical methods for the preparation of enzymes and for the study of their properties. Prereq.: Course 2, parallel Course 123. 2 cred. Mr. Sandstrom.
- 201w. Advanced Colloids. Lectures and library studies involving modern colloid concepts and techniques. Prereq.: Course 119 and Phys. Chem. 103. 3 cred. Mr. Briggs.
- 202f.‡ Biochemical Micromethods. Micro quantitative analysis of biochemical materials for organic and inorganic constituents by chemical and biological methods. Prereq.: Course 2, Bacteriology 53, and Physics 9. 3 cred. Mr. Boyer.
- 203f,w,s,su.*‡ 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,su.* 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 and permission of instructor. 1 cred. per quarter. Mr. 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. Mr. Schultze, Miss Kennedy, Mr. Boyer.
- 213f,w.* Seminar in Dairy Chemistry. Prereq.: Course 103 and permission of instructor. 1 cred. Mr. Jenness.

- 216f,w.* Nutrition Seminar. Prereq.: Course 116 and permission of instructor. 1 cred. Mr. Schultze, Miss Kennedy, Mr. Boyer.
- 219f,w.* Colloid Chemistry Seminar. Prereq.: Course 119 and permission of instructor. 1 cred. Mr. Briggs.
- 220f,w.* Protein Chemistry Seminar. Prereq.: Course 120 and permission of instructor. 1 cred. Mr. Sandstrom.
- 221f,w. Carbohydrate Chemistry Seminar. Prereq.: Course 121 and permission of instructor. 1 cred. Mr. Geddes.
- 222f,w.* Chemistry of Lipides Seminar. Prereq.: Course 122 and permission of instructor. 1 cred. Mr. Briggs.
- 223f,w.* Enzymes Seminar. Prereq.: Course 123 and permission of instructor. 1 cred. Mr. Sandstrom.
- 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; Assistant Professors Rex W. Cox, Selmer A. Engene.

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 in general under Plan A. In exceptional cases Plan B may be accepted.

Doctor's degree—This department 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. Mr. Pond.
- 103s. Farm Management: Operation. A continuation of 102 with special attention to efficiency in farm operation. Prereq.: Course 102. 3 cred. Mr. 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. Mr. 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. Mr. Engene.
- 110f-111w.† 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. per quarter. Mr. 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. Mr. 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. Mr. 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.: Courses 30, 191. 3 cred. Mr. 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. Mr. Cox.
- 141w. Marketing Organization: Dairy and Poultry Products. Prereq.: Course 40. 3 cred. Mr. Jesness.
- 142s. Marketing Organization: Fruits and Vegetables. Prereq.: Course 40. 2 cred. Mr. Cox.
- 143w. Marketing Organization: Livestock and Meats. Prereq.: Course 40. 3 cred. Mr. Dowell.
- 144f. Co-operative Organization. Prereq.: Course 40. 3 cred. Mr. Jesness.
- 150s. Advanced Farm Finance. Prereq.: Course 50 or equiv. 3 cred. Mr. Koller.
- 170s. Land Economics. Prereq.: Course 2. 3 cred. Mr. 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 consent of instructor. 3 cred. Mr. Dowell.
- 190f. Agricultural Statistics. Intended for beginning graduate students who have had no course in the elements of statistical method. 3 cred. Mr. Cox.
- 191w. Advanced Agricultural Statistics. Prereq.: Course 190. 3 cred. Mr. Waite.
- 200f-201w-202s.* General Seminar in Agricultural Economics. § Cred. ar. Mr. 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. Mr. 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. Mr. Pond.
- 226s.* Advanced Farm Organization. Analysis of farm organization and the application of the budgeting method in improving the farm business. 3 cred. Mr. 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. Mr. Pond. (Offered when the demand warrants.)

§ Under this head are arranged special seminars on subjects suited to the needs of particular groups of graduate students, or on subjects upon which members of the staff are doing work at the time.

- 241f.* Seminar in the Marketing of Livestock and Livestock Products. 3 cred. Mr. Dowell. (Offered when the demand warrants.)
- 244w.* Seminar in Co-operative Marketing. 3 cred. Mr. Jesness, Mr. Koller. (Offered when the demand warrants.)
- 246f.* Seminar in Economics of Consumption. 3 cred. Mr. Waite. (Offered when the demand warrants.)

AGRICULTURAL ENGINEERING

Professor Arthur J. Schwantes; Associate Professors Andrew Hustrulid, Philip W. Manson; Assistant Professors Clarence H. Christopherson, Hall B. White.

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.

It is conceivable that 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 only under Plan A. 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. Mr. Manson.
- 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. Mr. Manson.
- 105w. 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. Mr. Manson.
- 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. Mr. White.
- 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 physics, Courses 3 and 6 or equiv. 3 cred. Mr. White.
- 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.: Course 71 or 72. 2 to 6 cred. per quarter. Mr. Schwantes, Mr. Hustrulid.

- 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 agricultural machinery. 3 cred. Mr. Schwantes, Mr. Hustrulid.
- 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 and 25 or equiv. 3 cred. Mr. 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 and 71 and Agr.Econ. 102. 3 cred. Mr. 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. Mr. Manson.
- 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. Mr. White.
- 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. Mr. Schwantes, Mr. Hustrulid.

AGRONOMY AND PLANT GENETICS

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

Prerequisites—In agronomy, sufficient work in plant sciences to satisfy the adviser that advanced work may be pursued 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 altho 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.

AGRONOMY

- 121w. Grain Crops. Structure, functions, culture, improvement, and uses of corn, wheat, oats, barley, rye, flax, and buckwheat. 4 cred. Mr. 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. Mr. Lambert.
- 123f. Forage Crops. Characteristics of meadow and pasture plants, methods of obtaining stands, stage of maturity of cutting or grazing in relation to continued productivity, yields, and quality of product. Hay and silage makings and storage. 4 cred. Mr. Schmid.
- 124s. Problems in Farm Crops. Through the use of the program method, the student is given opportunity to deal with important phases of agronomy. Prereq.: Pl. Gen. 131 and at least two courses from Courses 121, 123, 134, and Pl. Gen. 132. 3 cred. (Not offered in 1946-47.)
- 126f. Crop Judging. Identification of crops, weeds, and diseases in relation to judging and grading farm crops. Prereq. Course 122. 4 cred. Mr. 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. Mr. Schmid.
- 134s. Seminar in Agronomy. Critical studies of problems in agronomy. Prereq.: 9 cred. in agronomy. 2 cred. Staff.
- 201f,w,s,su.* Research in Farm Crops. Problems in physiology, production, and classification of crop plants. Prereq.: Courses 121, 123. Cred. ar. Mr. Dunham, Mr. Schmid.
- 202f,w.* Farm Crops Seminar. Reviews and discussions of important agronomic literature. Prereq.: 9 cred. in farm crops. 1½ cred. per quarter. Mr. Dunham, Mr. Schmid, Mr. Thomas.

PLANT GENETICS

- 131f,w. Principles of Genetics. Fundamental principles of breeding, heredity, variation, biometry, and evolution. 4 cred. Mr. Lambert, Mr. Thomas.
- 132w. Farm Crops Plant Breeding. Applied genetics. Methods of breeding each of the important agricultural crops. Prereq.: Course 131. 4 cred. Mr. 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. Mr. Hayes, Mr. Burnham, Mr. Rinke.
- 242f,s.* Plant Breeding Seminar. Plant genetics in relation to plant breeding, a discussion of research problems. 1 cred. per quarter. Mr. Hayes, Mr. Burnham, Mr. Krantz, Mr. Currence, Mr. Rinke, Mr. Wilcox.
- 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. Mr. 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. Mr. Burnham.
- 246w.* Genetics Seminar. Important contributions to genetic theory and practice. 2 cred. Mr. Burnham, Mr. Hayes, Mr. Krantz, Mr. Currence, Mr. Wilcox, Mr. Winter.
- 247s. 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. Mr. 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. Mr. Thomas.

ANATOMY

Professors Edward A. Boyden, Ph.D., Chairman, Andrew T. Rasmussen, Ph.D., Richard E. Scammon, Ph.D., LL.D.; Associate Professor Berry Campbell, Ph.D., Christopher T. Hamre, 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

- 100-101. Gross Human Anatomy. Dissection, including osteology. 9 cred. per quarter. Enrolment limited. Dr. Boyden.
- 103. Human Histology. Microscopic study of the various tissues and organs. Prereq.: Course 100-101 or equiv. 9 cred. Dr. Kirschbaum.
- 107. Human Embryology. Development of the human body. Prereq.: Course 100-101 or equiv. 6 cred. Dr. Wells.
- 111. 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. Dr. Rasmussen.
- 115. History of Anatomy. Prereq.: Course 100-101. 2 cred. each quarter. (Temporarily discontinued.)
- 116. Correlated Anatomy. Review of anatomy by dissections and demonstrations. Prereq.: Course 100-101. 2 cred. each quarter. (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.)
- 132. Anatomical and Functional Aspects of Reproduction. Lectures and demonstrations with experimental animals. 2 cred. Dr. Wells.
- 134. Anatomy of the Newborn. A detailed laboratory study of the anatomy of the newborn. Prereq.: Course 107 or equiv. 3 cred. per quarter. Dr. Wells.

149. Experimental Neurology. A study of the morphology of the central nervous system as determined by experimental methods. Prereq.: Course 111. Hours and cred. ar. Dr. Campbell.
150. Special Topics in Neurology. Study of the literature in selected phases of human neurology. Prereq.: Course 111. Hours and cred. ar. Dr. 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. Dr. Boyden, Dr. Rasmussen, Dr. Campbell, Dr. Hamre, Dr. Kirschbaum, Dr. Wells, Dr. Hartmann, Dr. Sundberg, Dr. Williams.
157. Developmental Anatomy of the Head. Prereq.: Course 107. 3 cred. Dr. Boyden. (Temporarily discontinued.)
158. Special Histology and Neurology of the Head Region. Prereq.: Courses 103, 111. 3 cred. Dr. Rasmussen.
159. Experimental Methods for the Study of Neoplastic Growths. Hours and cred. ar. Dr. Kirschbaum.
160. Seminar in Problems of Reproduction. 1 cred. Dr. Wells.
- 161f-162w-163s. Quantitative Methods. Same as Courses 110-111, 120-121, 130-131 in Biostatistics. 5 cred. per quarter. Dr. Treloar and others.
- 165-166. 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. 4 cred. per quarter. Dr. Sundberg.
167. Seminar in Hematology. Discussion of literature and research. Prereq.: Course 165-166. 1 cred. (Temporarily discontinued.)
- 201f-202w-203s-204su. Research in Anatomy. Qualified students may undertake the investigation of problems in anatomy, including embryology, histology, and neurology. Special facilities are offered to graduate students in the clinical departments for work upon problems in applied anatomy. Hours and cred. ar. Dr. Boyden, Dr. Rasmussen, Dr. Scammon, Dr. Campbell, Dr. Hamre, Dr. Kirschbaum, Dr. Wells, Dr. 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. Dr. Boyden and staff.

ANIMAL AND POULTRY HUSBANDRY

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

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—Upon approval of the graduate faculty, candidates doing major work for the Master's degree in animal or poultry husbandry may take a minor in animal breeding.

Candidates doing major work for the Doctor's degree may major in animal husbandry, poultry 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.

ANIMAL HUSBANDRY
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. Mr. 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. Mr. Anderson.
- 112w. Animal Breeding. The application of the physiology of reproduction and genetics to the breeding of farm animals. Prereq.: Agron. 31. 3 cred. Mr. 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. Mr. Peters.
- 116f. Prenatal Development of Farm Animals. Textbook, lectures, and demonstrations dealing with prenatal development in farm animals. Prereq.: Course 112 or equiv. and approval of instructor. 3 cred. Mr. 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.: Courses 112 and P.H. 110. 3 cred. Mr. 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. Mr. 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. Mr. 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. Mr. Winters.
- 206w.* Advanced Livestock Feeding I. A study of experimental results bearing on feeding problems and review of literature applicable to them. Prereq.: Courses 56-57. Agr.Biochem. 6, or equiv. 3 cred. Mr. Ferrin.
- 207s.* Advanced Livestock Feeding II. Prereq.: Course 206. 3 cred. Mr. Ferrin.
- 208f,209w,210s.* Animal or Poultry Husbandry Seminar. Special assignments and review of literature pertaining to the livestock or poultry industry. 1 cred. per quarter. Mr. 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. Mr. Ferrin.
- 212f,w,s.* Research in Meats. Problems assigned to fit the needs of the student. 3 to 9 cred. per quarter. Mr. Anderson.
- 213f,w,s.* Research in Animal Husbandry. Problems assigned to fit the needs of the student. 3 to 9 cred. per quarter. Mr. Peters, Mr. Ferrin, Mr. Winters, Mr. Harvey.

POULTRY HUSBANDRY

- 102w. Poultry Breeding. The application of the principles of genetics and physiology of reproduction to the breeding of poultry. Prereq.: Agron. 31. 3 cred. Mr. 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. Mr. Sloan.
- 215s.* Poultry Nutrition. The role of the various nutritive elements in satisfying the nutritional requirements of poultry. 4 cred. Mr. Sloan.

ANTHROPOLOGY

Professor Wilson D. Wallis; Associate Professor Walter B. Cline; Instructors Joseph H. Greenberg, Linvill F. Watson.

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

- 105w. 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. Mr. Greenberg.
- 106s. European Prehistory. Types of prehistoric men and cultures. 3 cred. (Not offered in 1946-47.)
- 109s. General Linguistics. 3 cred. Mr. Greenberg.
- 110f. Physical Anthropology. Physical types of man, prehistoric and contemporary. 3 cred. Mr. Wilford.
- 116s. Indians of the Southwest. Pueblo and nomadic tribes. 3 cred. (Not offered in 1946-47.)
- 118f. Indian Civilizations of Mexico and Peru. 3 cred. Mr. Cline.
- 119s. 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. Mr. Greenberg.
- 120w. 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. Mr. Wilford. (Not offered in 1946-47.)
- 122f-123w-124s. Problems in Anthropology. Advanced work with individual guidance. For students with special problems. Cred. ar. Mr. Cline, Mr. Greenberg, Mr. Watson, Mr. Wilford.
- 130f-131w-132s.* Races and Cultures of Arabia, Egypt, and North Africa. A chronological survey, with special emphasis upon interrelations and relations with extraneous cultures. 3 cred. per quarter. Mr. Cline.
- 133f-134w.* Races and Cultures of the Far East. This course will focus on the growth of native civilization in China and Japan. Attention will be given also to the cultures of Mongolia, Tibet, Korea, and southeastern Asia, especially in their relation to the Chinese. 3 cred. per quarter. Mr. Cline.
- 135f-136w-137s. Cultural History of Egypt from the Earliest Times to the Sixteenth Century A.D. 3 cred. per quarter. Mr. Cline, Mr. Jones. (Offered alternate years. Offered in 1946-47.)
- 140su. Field Trip in Archeology. 1 to 8 cred. Mr. Wilford.
- 150f-151w-152s. Selected Readings in Ancient History. Early cultures of the Mediterranean Basin. (The same as Hist. 150-151-152.) 3 cred. per quarter. Mr. Cline, Mr. Jones. (Offered alternate years. Not offered in 1946-47.)
- 161s.* Primitive Religion. Concepts of the sacred and the supernatural. Religious and ceremonial practices. 3 cred. Mr. Watson.

- 162f. Peoples of Negro Africa. Physical types, social, political, and economic phases of the cultures of Negro Africa. 3 cred. Mr. Watson.
- 163w. Ethnology of India. A survey of primitive cultures in India, and relations with other areas. 3 cred. (Not offered in 1946-47.)
- 165w.* Psychological Phases of Culture. The role of the individual in primitive culture. Psychological factors in diffusion of culture traits. 3 cred. (Not offered in 1946-47.)
- 166w.* History of Anthropological Theory and Method. An examination and critique of theory and method in historical perspective. 3 cred. (Not offered in 1946-47.)
- 167s. Primitive Mythology. The role of myth in culture. Cosmogonic and animal myths. Plots, motifs, and their diffusion. 3 cred. (Not offered in 1946-47.)
- 168w. Ethnology of Australia. Physical types and cultures. 3 cred. Mr. Watson.
- 169f. Peoples of the South Seas. A survey of the native cultures of the Pacific Islands. 3 cred. Mr. Cline. (Not offered in 1946-47.)
- 170s. 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 1946-47.)
- 204f-205w-206s.* Seminar in Anthropology. Individually directed research. 3 cred. per quarter. Mr. Cline, Mr. Greenberg, Mr. Watson, Mr. Wilford.

ARCHITECTURE

Professors Roy Jones, Leon E. Arnal, S. Chatwood Burton, Robert 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 Econ. 111, Pol. Sci. 124, Soc. 104.) 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. Mr. Robert Jones, Mr. Anderson, Mr. Chapin, Mr. Filipetti, Mr. Vaile.
- 105w,s,su. Professional Relations. Relations of the architect to clients, contractors, and fellow practitioners. Procedures of architectural practice. 2 cred. Mr. Roy Jones.
- 106s. City Planning. Technical phases of modern city planning, with special reference to the architects' functions therein. Prereq.: Course 104. 3 cred. Mr. Robert Jones.
- 110f. Architectural Acoustics. Principles, methods, and materials involved in the acoustical treatment of buildings. Prereq.: Physics 1-2-3. 2 cred. Ar.
- 160f,w,s,‡ (DP-IV). Drawing and Painting, Grade IV. Studies in graphic expression dealing especially with advanced figure composition and mural decoration. Prereq.: DP-III or equiv. 6 cred. (normally 2 cred. per quarter). Mr. Burton.
- 201f,w,s. Special Researches in Architectural History. Prereq.: Course 61-62-63. Cred. ar. Mr. 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. Mr. Arnal, Mr. Roy Jones, Mr. Robert Jones.
- 261f,w,s.(DP-V). Drawing and Painting, Grade V. Continuation of Course 160(DP-IV). Prereq.: Course 160(DP-IV) or equiv. 6 cred. (Normally 2 cred. per quarter.) Mr. Burton.
- 262f‡,w,‡s,‡(M-III). Modeling, Grade III. Continuation of M-II. Prereq.: M-II or equivalent. 6 cred. (Normally 2 cred. per quarter.) Mr. Burton.

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

ASTRONOMY

Professor Willem J. Luyten.

The Astronomical Observatory possesses a ten and one-half inch refracting telescope; a five-inch star camera; a filar micrometer; a photographic measuring machine by the Société G n voise.

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. Mr. Luyten.
- 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. Mr. Luyten.
- 140f. Method of Least Squares. Applied especially to engineering, physics, and astronomy. Prereq.: Math. 51. 3 cred. Mr. Luyten.
- 211f-212w-213s.* Seminar. For students who are prepared for advanced work along particular lines. 1, 2, or 3 cred. per quarter. Mr. Luyten.

BACTERIOLOGY AND IMMUNOLOGY

Professors Winford P. Larson, M.D., Head, Robert G. Green, M.A., M.D., H. Orin Halvorson, Ch.E., Ph.D.; Associate Professor Milward L. Bayliss, M.D., Ph.D.; Assistant Professor Charles E. Skinner, 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 16 and 145.

COURSES

- 102s. Medical Bacteriology. See *Bulletin of the Medical School*. Prereq.: Course 101. 4 cred. Dr. Larson.
- 103s. Soil Microbiology. Studies of the microscopic inhabitants of the soil. Prereq.: Course 53, and 15 cred. in chemistry. 5 cred. Dr. Skinner.
- 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.: Course 53, and 15 cred. in chemistry. 4 cred. Dr. Skinner.
- 114s.* Molds, Yeasts, and Actinomycetes. Introduction to mycology: study of lower fungi important in medicine and industry. Prereq.: Course 53 or 101. 4 cred. Dr. Skinner.
- 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. Dr. Larson.
- 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. Dr. Green.

- 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, and 8 cred. in organic chemistry or biochemistry. 3 cred. per quarter. Dr. Halvorson.
- 123s. Applied Bacteriology. Industrial fermentations; bacteriology of water and sewage; interpretations of bacteriological data. Prereq.: Course 121-122. 3 cred. Dr. 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. Dr. Green.
- 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. Dr. Larson, Dr. Green, Dr. Halvorson, Dr. Skinner.
- 203f,w,s. Seminar in Bacteriology. 1 cred. Staff.
- 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. Dr. Halvorson.

BIOPHYSICS

*Courses Offered at the Medical School and in the Departments of Physics,
Physiology, Radiology, and Zoology*

Professors K. Wilhelm Stenstrom, Ph.D., Alfred O. Nier, Ph.D., John T. Tate, Ph.D., Joseph Valasek, Ph.D., John H. Williams, Ph.D.; Associate Professor Otto H. Schmitt.

Prerequisites—For work in biophysics, a Bachelor's degree with a major in physics is required.

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

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

COURSES

- 105su,s. Roentgen Rays, Light, and Radium. The physical and physiological basis of physical therapy. 1 cred. Dr. Stenstrom.
- 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. Dr. Stenstrom.
- 110w†-112s.‡ Modern Experimental Physics. Radioactivity. Dr. Schmitt.
- 134f,w,‡ Experimental Optics. Dr. Valasek.
- 136w,s,‡ Spectrum Analysis. Dr. Valasek.
- 152s. X Rays. Dr. Valasek. (Not offered in 1946-47.)

Other courses listed under Physics may be considered for credit in biophysics.

- 104f. Roentgen and Radium Therapy. (See Radiology 104.) Dr. Stenstrom.
- 106s. Physical Therapy. (See Radiology 106.) Dr. Stenstrom, Dr. Knapp.
- 155w. Physiology in Relation to Physics. (See Zoology 155.) Application of the principles of physics to the investigation and interpretation of physiological phenomena. Lect. and demonstration. 3 cred. Ar.

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

The physiology courses below may be taken for credit in biophysics:

- Physiol.103w.¶ Physiology of Muscle, Circulation, Respiration, Digestion, Metabolism, and Nutrition. Several lectures on the medical aspects of genetics are included. Prereq.: organic chemistry and zoology. 9 cred. Dr. Visscher, Dr. Keys, Dr. King and others.
- Physiol.104s. Physiology of Endocrines, the Nervous System, and Special Senses. Prereq.: Physiol. 103, or organic chemistry and neurology. 6 cred. Dr. Visscher, Dr. Scott, Dr. King.
- 204f,w,s,su. Research in Biophysics. Students who want to carry out more extensive and independent investigations should register for this course instead of for Course 170. Hours and cred. ar. Dr. Stenstrom.

BIOSTATISTICS

Professor Richard E. Scammon, Ph.D., LL.D.; Associate Professor Alan E. Treloar, Ph.D.; Assistant Professor Margaret P. Martin, Ph.D.

Prerequisites—Courses in mathematics, economic statistics, and those sciences deemed necessary to a broad understanding of biological measurement, may be required in individual cases at the discretion of the adviser as part of the major program.

Language requirement—Substitutions for the general requirements of the Graduate School are permitted in special cases by petition.

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 in accordance with the general requirements of the Graduate School.

COURSES

- P.H.110f,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.: 18 cred. in biological science *or* mathematics through analytical geometry; Course 111 to be taken concurrently. 3 cred. Mr. Treloar.
- P.H.111f,s.‡ Biostatistics Laboratory. Practical training in machine calculation and statistical techniques discussed in Course 110, which is to be taken concurrently. 2 cred. Miss Martin.
- 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 consent of instructor; Course 121 to be taken concurrently. 3 cred. Miss Martin.
- P.H.121s.‡ Correlation Laboratory. Practical training in techniques of correlation analysis. Prereq.: Course 120 to be taken concurrently. 2 cred. Miss Martin.
- 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 consent of instructor; Course 131 should be taken concurrently. 3 cred. Mr. Treloar.
- P.H.131w.‡ Sampling Laboratory. Study of the distributions of statistics derived from small samples by practical tests. Prereq.: to be taken concurrently with Course 130. 2 cred. Miss Martin.

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

¶ Students may register for lectures without laboratory.

- P.H.140f. Vital Statistics. Study of official sources of vital statistics, including population changes, calculation of rates, graphical exposition of trends, and tests of significance. Prereq.: permission of instructor. 3 cred. Mr. Treloar.
- P.H.150w.‡ Life Tables. Mortality rates and the construction of the life table. Laboratory course with discussions, offered when sufficient demand exists. Prereq.: permission of instructor. 3 cred. Mr. Treloar. (Not offered in 1946-47.)
- P.H.200f,w,s.* Research in Biometry. Prereq.: permission of instructor. Cred. ar. Mr. Treloar, Miss Martin.
- 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. Mr. Treloar, Miss Martin.
- P.H.211f,w,s.* Seminar in Biometry. Prereq.: permission of instructor. 1 cred. per quarter. Mr. Treloar.

BOTANY§

Professors Ernst C. Abbe, William S. Cooper; Associate Professors A. Orville Dahl, C. Stacy French; Assistant Professors Donald B. Lawrence, Rolla M. Tryon, Jr.

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).

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. An intensive study of lycopods, ferns, and their allies, their structure and history, with special attention to the classification of living forms. Lect., reference reading, and lab. work. Prereq.: Course 54. 5 cred. (Not offered in 1946-47.)
- 110w. Gymnosperms. An intensive study of cycads, conifers, and their allies, their structure and history, with special attention to the classification of living forms. Lect., reference reading, and lab. work. Prereq.: Course 54. 5 cred. (Not offered in 1946-47.)
- 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 consent of instructor. 3 cred. Mr. Tryon.
- 114w.‡‡ Phyletic Taxonomy of Angiosperms. Survey of angiosperms, systems of classification, phyletic principles. Lect., lab., and reference reading. Prereq.: Course 52 or permission of instructor. 3 cred. (Not offered in 1946-47.)
- 115s.‡‡ Spring Flora of Minnesota. Same as 113f but with particular reference to the spring flora. Lect., lab., and reference reading. Prereq.: Course 1-2-3 or 4-5 or permission of instructor. (Not offered in 1946-47.)
- 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. 3 cred. Mr. Tryon.

* 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.

‡‡ A fee of \$1.50 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.

- 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 1946-47.)
- 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. Mr. 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. Mr. 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.: Course 1-2-3 or 4-5, and permission of instructor. 3 to 5 cred. Mr. Dahl, Miss Hansen.
- 121s.‡ Morphogenesis. Experimental and developmental morphology, with emphasis on genetical and other factors associated with the development of form. Lect., lab., and reference reading. Prereq.: Course 1-2-3 or 4-5, and permission of instructor. 3 cred. Mr. Abbe. (Not offered in 1946-47.)
- 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. Course 1-2-3 or 4-5, and permission of instructor. 3 to 5 cred. Mr. Abbe, Miss Hansen.
- 127f.‡ Anatomy of Vascular Plants. The microscopic structure of vascular plants with particular attention to the development and evolution of the vascular system in the root, stem, and leaf. Lect., lab., and reference reading. Prereq.: Course 1-2-3 or 4-5. 5 cred. Mr. Abbe.
- 130f.‡* General Plant Ecology. An introductory course; plants in relation to environment. In order to obtain graduate credit for this course an acceptable term paper must be completed. Prereq.: Course 1-2-3 or 4-5 or equiv. 3 cred. Mr. 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. Mr. Cooper.
- 132w.‡ Morphological Ecology. Adaptation in the plant kingdom, from algae to angiosperms. Lect., lab., reference reading. Prereq.: Course 50 or 130 or Forestry 2, 3, 4. 5 cred. Mr. 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. Mr. 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. Prereq.: 18 cred. in plant science including Course 50 or 130. 5 cred. Mr. 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 discovery of the reasons for the occurrence of a given plant in a particular habitat. Field work, lab., lect., reading, and class reports. Prereq.: 18 cred. in plant science including Courses 50 or 130, and 51. 5 cred. Mr. Lawrence.

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

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

- 140w. Advanced Survey of Plant Physiology. An advanced survey of the whole field of plant physiology. Lect., reference reading, and class reports. Prereq.: Course 51 or its equiv., and elementary inorganic chemistry. 3 cred. Mr. French. (Not offered in 1946-47.)
- 141f. Physicochemical Principles and Measurements in Plant Physiology. Properties of solutions, chemical kinetics, buffers, membranes, osmosis, transpiration, transport, electrometric measurements. Lect., reference reading, and class reports. Prereq.: 20 cred. in chemistry or biochemistry or permission of instructor. 3 cred. Mr. French.
- 142w. Photosynthesis and Other Effects of Radiation. A detailed discussion of the present state of knowledge of the assimilation of carbon dioxide and other effects of light on green plants. Lect., reading, and class reports. Prereq.: 20 cred. in chemistry or biochemistry or permission of instructor. 3 cred. Mr. French.
- 143s. Plant Metabolism. Mineral nutrition: carbohydrate, nitrogen and fat metabolism in plants; biological oxidation; plant enzymes, their nature and functions; the growth of plants. Lect., reading, and class reports. Prereq.: 20 cred. in chemistry or biochemistry or permission of instructor. 3 cred. Mr. French.
- 146f,147w,148s. Advanced Physiology Laboratory. To be taken with or after Courses 141, 142, 143 respectively. 2 cred. per quarter. Mr. French.
- 154f. Spectroscopy and Photochemistry Applied to Biology. Principles of absorption and emission spectroscopy, light measurements, and photochemistry. Practice in the use of these methods for investigation of light effects in biological material, in the study of metabolism, and in the identification and determination of pigments and enzymes. Lect., lab., class reports. Prereq.: 20 cred. in chemistry or biochemistry or permission of instructor. 3 to 5 cred. Mr. French.
- 165s. Introduction to Pollen Analysis. The ontogeny, comparative morphology, preparation of reference collections, and identification of pollen grains; applications of pollen analysis to allergy, ecology, and phylogeny; practice in atmospheric analysis. Lect., lab., reference reading. Prereq.: permission of instructor. 3 cred. Mr. Dahl.
- 196su,*197f,*198w,*199s. Problems. Advanced work in a specialized field. Prereq.: 20 cred. in plant science and permission of the instructor. 1 to 5 cred. per quarter. Staff.
- 201f,*202w,*203s,*204su.* Research Problems in the Morphology of Vascular Plants. Cred. ar. Mr. Abbe.
- 205f,*206w,*207s,*208su.* Research Problems in Taxonomy. Cred. ar. Mr. Tryon.
- 221f,*222w,*223s,*224su.* Research Problems in Ecology. Cred. ar. Mr. Cooper, Mr. Lawrence.
- 225f,*226w,*227s,*228su.* Research Problems in Plant Physiology. Cred. ar. Mr. French.
- 229f,*230w,*231s,*232su.* Research Problems in Cytology. Cred. ar. Mr. Dahl.
- 233f,234w,235s. Seminar. Students may register for one-hour seminar credit per quarter in any of the research subjects.

CHEMISTRY

Professor and Dean Samuel C. Lind; 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.

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

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

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.

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 both Plan A and Plan B.

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.

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. Mr. Meehan.
- 103s. Quantitative Inorganic Microanalysis. Representative methods of micro- and semi-micro-analysis, gravimetric, volumetric, and colorimetric. Prereq.: Course 1-2. 3 cred. Mr. 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. Mr. Sandell.
- 105w. Polarizing Microscope. Its use and application to chemistry. Identification of substances. Prereq.; Phys. Chem. 101. 3 cred. Mr. Sandell.
- 106f‡-107w‡-108s.‡ General Technical Analysis. Analysis of commercially important materials such as iron, steel, paper, and glass, and analysis of food materials. Use of microscope in technical problems. Quantitative analysis of heterogeneous mixtures, particle size determinations. Prereq.: Course 1-2. 2 or 3 cred. per quarter. Mr. 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. 1 or 2 cred. Mr. Meehan.

‡ A fee of \$2 per quarter is charged for this course. The student should purchase a \$3 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 \$2 course fee, laboratory material, and breakage will be charged against the deposit.

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

- 123f.†† Advanced Analytical Chemistry. Analysis of complex materials by modern methods. Prereq.: Course 1-2, or by permission of instructor. 3 cred. Mr. Meehan.
- 127s.*† Optical Methods in Analytical Chemistry. Prereq.: Phys. Chem. 103. 2 to 3 cred. Mr. Meehan.
- 131f.‡ Applications of Indicators in Neutralization Reactions and pH Determinations. Prereq.: Course 1-2, and Phys. Chem. 103. 3 cred. Mr. 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. Mr. 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 to 4 cred. Mr. Kolthoff.
- 134f-135w-136s.* Seminar: Modern Problems in Analytical Chemistry. Prereq.: Course 1-2, and Phys. Chem. 103. 1 cred. per quarter. Mr. Kolthoff.
- 137s. Advanced Volumetric Analysis. Prereq.: Course 131. 3 cred. Mr. Kolthoff.
- 140w.‡ Water Analysis. Analysis of potable water with interpretation of results. Prereq.: Course 1-2. 2 cred. Mr. Sandell.
- 201f-202w-203s.* Selected Topics in Analytical Chemistry. Cred. ar. Mr. Kolthoff.
- 301f-302w-303s.* Research in Quantitative Analysis. Cred. ar. Mr. Kolthoff, Mr. Sandell, Mr. Meehan.

CHEMISTRY, INORGANIC

Professors M. Cannon Sneed, Lloyd H. Reyerson; Associate Professors Hervey H. Barber, Gladstone B. Heisig, J. Lewis Maynard, Norville C. Pervier; Assistant Professor Thomas D. O'Brien.

COURSES

- 102s.†† Semi-micro 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. Mr. Barber.
- 103f*-104w*-105s.* Advanced Inorganic Chemistry. A discussion of selected topics in theoretical inorganic chemistry. Prereq.: Anal. Chem. 1-2, Org. Chem. 156 and 159. 3 cred. per quarter. Mr. Reyerson, Mr. Maynard, Mr. O'Brien.
- Fall—The Chemistry of the Less Common Elements.
Winter—Atomic Structure and the Chemical Bond.
Spring—Co-ordination Compounds.
- 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. Mr. Heisig.
- 115su. Commercial Products and Their Analysis. Study of current commercial products, their composition and methods of analysis. Prereq.: Anal. Chem. 1-2. Cred. ar. Mr. Barber.
- 134f-135w-136s. Seminar. Modern Problems in Inorganic Chemistry. Prereq.: Anal. Chem. 1, 2, and Phys. Chem. 103. 1 cred. per quarter. Mr. Sneed and others.

† A fee of \$2 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 \$2 course fee, laboratory material, and breakage will be charged against the deposit.

†† A fee of \$2.40 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 \$2.40 course fee, laboratory material, and breakage will be charged against the deposit.

301f,su-302w-303s. Research in Inorganic Chemistry. Cred. ar. Mr. Sneed, Mr. Reyerson, Mr. Heisig, Mr. Barber, Mr. Maynard, Mr. O'Brien.

CHEMISTRY, ORGANIC

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

Prerequisite—An approved course in Physical Chemistry is required as a prerequisite to a minor in Organic Chemistry.

COURSES

- 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 156 and 159 or equiv. 3 cred. per quarter. Mr. Smith.
- 110f.‡ Organic Qualitative Analysis. Reactions of typical functional groups, identification of pure organic compounds, separation and identification of constituents of mixture. Prereq.: Courses 156 and 159 or equiv. Registration limited to 20. 5 cred. Mr. Arnold.
- 116s. Heterocyclic Compounds. A discussion of the typical classes of heterocyclic compounds, ring-closures, and the like. Prereq.: Courses 156 and 159. 3 cred. Mr. Parham.
- 130s.‡‡ Organic Quantitative Analysis. Methods of proximate and ultimate analysis of organic compounds, with special attention to semi-micro methods. Prereq.: Courses 156 and 159 and Anal. Chem. 1-2. Registration limited to 15. 2 or 3 cred. Mr. Lauer.
- 132f-133w-134s.‡ Colloid Chemistry Laboratory. Prereq.: Course 128. 1 or 2 cred. per quarter. Mr. Reyerson.
- 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 156 and 159. Registration limited to 20. 2 to 5 cred. Mr. Koelsch.
- 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 156 and 159. 3 cred. Mr. Koelsch. (Offered in alternate years. Not offered in 1946-47.)
- 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 156 and 159. 3 cred. Mr. Koelsch. (Offered in alternate years. Offered in 1946-47.)
- 142w-143s.* The Chemistry of Natural Products. Discussion of the organic chemistry of important classes of natural products. Prereq.: Courses 156 and 159. 3 cred. per quarter. 142w, Mr. Lauer; 143s, Mr. Arnold. (Offered in alternate years. Not offered in 1946-47.)
- 156s. Elementary Organic Chemistry. (Lecture course.) Discussion of the important classes of organic compounds, both aliphatic and aromatic, together with some heterocyclic compounds. Prereq.: Course 54-55. 3 cred. Mr. Smith, Mr. Lauer.
- 159s. Elementary Organic Chemistry. (Laboratory course.) Preparation of typical substances; some original work. Courses 156 and 159 are prerequisites for all advanced courses in Organic Chemistry. Prereq.: Course 156 or registration in 156. 2 cred. Mr. Smith, Mr. Lauer, Mr. Parham.

‡ A charge of \$10 is made to cover special chemicals in this course.

‡‡ A charge of \$2 per quarter is charged 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. Mr. Smith, Mr. Lauer, Mr. Koelsch, Mr. Arnold.
- 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. Mr. Lauer. (Offered in alternate years. Offered in 1946-47.)
- 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 the instructor. 4 cred. Mr. Arnold (Offered in alternate years. Offered in 1946-47.)
- 301f-302w-303s. Research in Organic Chemistry. Prereq.: Course 110 and approval of the division. Cred. ar. Mr. Smith, Mr. Lauer, Mr. Koelsch, Mr. Arnold.

CHEMISTRY, PHYSICAL

Professors Frank H. MacDougall, Izaak M. Kolthoff, Samuel C. Lind, Robert S. Livingston, Lloyd H. Reyerson; Associate Professor Bryce L. Crawford, Jr.; 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 in partial or complete fulfillment of the course requirements for a minor in physical chemistry.

Physiol. Chem. 182, Colloids in Biology and Medicine. Prereq.: Physical Chem. 128, Mr. K. Sollner, may be approved as a course in the field of physical chemistry for undergraduate and graduate students.

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. Mr. MacDougall, Mr. Livingston, Mr. Lipscomb.
- 104f†-105w‡-106s.*† Physical Chemistry Laboratory. To accompany or follow Course 101-102-103. 1 or 2 cred. per quarter. Mr. Livingston, Mr. Lipscomb.
- 107f,su.‡ Elementary Physical Chemistry (Premed.). Prereq.: 2 years of college chemistry and 1 year of college physics. 6 cred. per quarter. Mr. Crawford, Mr. Lipscomb.
- 113f.* Fundamentals of Reaction Kinetics. Order of reaction, collision theory, equilibrium theory, chain reactions, flames and explosions in gases. Prereq.: Course 103. 3 cred. Mr. Livingston. (Not offered in 1946-47.)
- 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. Mr. Livingston. (Not offered in 1946-47.)
- 116f.* Advanced Physical Chemistry. Thermodynamics. Designed to cover the fundamentals with applications to chemical problems. Prereq.: Course 103. 3 cred. Mr. Crawford.
- 117w.* Advanced Physical Chemistry. Phase Rule. Thermodynamics of electrolytic solutions. Elements of reaction kinetics. Prereq.: Course 116. 3 cred. Mr. Livingston.

† A fee of \$2 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 \$2 course fee, laboratory material, and breakage will be charged against the deposit.

- 118s.* Advanced Physical Chemistry. Electrical conductance and other non-equilibrium properties of electrolytic solutions. Physical properties and chemical structure. Prereq.: Course 117. 3 cred. Mr. Lipscomb.
- 123w-124s. Crystal Analysis and Crystal Chemistry. Theory and methods of crystal analysis. X-rays. Crystal structure and chemical and physical properties of solids. Prereq.: Course 103. 3 cred. per quarter. Mr. Lipscomb.
- 128f.* Colloid Chemistry. The fundamental principles of colloid chemistry, surface chemistry, electrokinetic phenomena, lyophobic and lyophilic colloids. Prereq.: Course 103. 3 cred. Mr. 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. Mr. Reyerson.
- 130s.* Colloids in Industry. The important applications of colloid chemistry to many of the fields of chemical industry. Prereq.: Course 128. 3 cred. Mr. Reyerson.
- 131s.*‡ Colloidal Processes. A survey of the important colloidal processes: coagulation, sol-gel transformation, thixotropy, and dilatancy. Prereq.: Course 128. 3 cred. Mr. Reyerson. (Not offered in 1946-47.)
- 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. Mr. Norris.
- 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 and Physics 9. 3 cred. Mr. 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 and calculus. 4 cred. per quarter. (Not offered in 1946-47.)
- 204f-205w-206s. Kinetic Theory and Atomistics. Kinetic theory of gases and liquids, atomic structure, quantum theory. Prereq.: Course 103 and calculus. 4 cred. per quarter. Mr. MacDougall.
- 211f-212w-213s. Advanced Physical Chemistry Laboratory. To accompany or follow any of the advanced courses in physical chemistry. Prereq.: Course 103. Cred. ar. Mr. MacDougall and staff.
- 215w-216s. 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. Mr. Crawford.
- 221f-222w-223s. Colloid Seminar. 1 cred. per quarter. Mr. Reyerson.
- 231f,w,s. Radioactivity Laboratory. Use and standardization of electroscopes, radioactive measurements and quantitative determination of radium in ores, minerals, waters, and plant products. Prereq.: must be preceded or accompanied by Course 161. 1 or 2 cred. (Not offered in 1946-47.)
- 301f-302w-303s. Research in Physical Chemistry. Thermodynamics, electro-chemistry, photo- and radiochemistry, reaction kinetics, molecular structure, colloids, adsorption, crystal structure. Cred. ar. Mr. MacDougall, Mr. Kolthoff, Mr. Livingston, Mr. Reyerson, Mr. Crawford, Mr. Lipscomb, Mr. Norris.

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.

‡ A fee of \$2 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 \$2 course fee, laboratory material, and breakage will be charged against the deposit.

256. Ions in Solution.

A colloquium for graduate students in Physical, Analytical, and Inorganic Chemistry, carrying no credit, is held weekly. Mr. Livingston.

CHEMICAL ENGINEERING

Professors Charles A. Mann, Norman H. Ceaglske, Edgar L. Piret; Associate Professor Arthur E. Stoppel; Assistant Professor Richard L. 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 17 and 18.

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 only under Plan A.

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

COURSES

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

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. 6 cred. Mr. Stoppel, Mr. Stephenson, Mr. Ceaglske.

103s.*‡ Unit Operations. Continuation of Courses 101 and 102. Drying, distillation, absorption, extraction and crystallization, etc. Prereq.: Course 102. 6 cred. Mr. Stoppel, Mr. Stephenson, Mr. Ceaglske.

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. 4 cred. Mr. Stoppel, Mr. Jackson.

106f.* Petroleum and Petroleum Products. Technology and testing of petroleum products, principally gasoline, illuminating, fuel, and lubricating oils. Prereq.: Org. Chem. 156 and 159. 3 cred. Mr. Stoppel.

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

- 117w,118s.¶ Chemical Engineering Equipment Design. Fundamental principles in the design of chemical engineering equipment. Drawing lab. Prereq.: Course 103. Cred. ar. Mr. Jackson.
- 119w-120s. 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. Mr. Ceaglske, Mr. Madden.
- 121f.¶ Chemical Engineering Economics. Economic 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.: Course 131. 3 cred. Mr. Stephenson.
- 131s.*¶ 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 102. 4 cred. Mr. Mann.
- 132f.*¶ Organic Technology. Similar to 131 but covering organic field. Destructive distillation of coal and wood, petroleum and products, pulp and paper, organic processes, synthetic products, and industrial organic products. Lect. and recitations. Prereq.: for chem. engrs., Courses 103 and 131. 3 cred. Mr. Mann.
- 134s.* 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. 156. 3 cred. Ar.
- 136w.* Chemistry and Technology of Cellulose. Discussion on processes and industries based on the use of cellulosic materials including the chemical and technological considerations. Pulp and paper, plastics, esters, rayon, etc. Lect. and recitations. Prereq.: Org. Chem. 156 or equiv. 3 cred. Ar.
- 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. Lab. Prereq.: Courses 103 and 131. Cred. ar. Mr. Mann, Mr. Stoppel, Mr. Stephenson.
- 152w,su.* Chemical Manufacture (Organic). Similar to 151 but covering the organic unit processes. Lab. Prereq.: Courses 103, 131. 3 or more cred. Mr. Mann, Mr. Stoppel, Mr. Stephenson, Mr. Ceaglske.
- 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. Mr. 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.: Course 132, 152, and 134 or registration in 134. 3 or more cred.
- 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. 4 cred. per quarter. Mr. Mann, Mr. 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. 3 or more cred. Mr. Mann.
- 201f-202w-203s.* Seminar. Presentation and discussion of papers concerning the newer developments in chemical engineering. 1 cred. per quarter. Mr. Mann.

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

- 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. Mr. Piret, Mr. Ceaglske.
- 208f-209w-210s. Advanced Chemical Engineering. Prereq.: Course 103. 3 cred. per quarter. Mr. Piret, Mr. Ceaglske.
- 211f-212w-213s. Chemical Engineering Plant Design. Planning of plants and design of equipment based on collected data for the same. Classroom and drawing room work. Prereq.: Course 103. 3 cred. per quarter. Mr. Piret.
- 301f-302w-303s.* Research in Chemical Engineering. Unit operations, applied electro-chemistry and electric furnace work, and chemical manufacture. Cred. ar. Mr. Mann, Mr. Stoppel, Mr. Piret, Mr. Stephenson, Mr. Ceaglske.

CHILD WELFARE

Professors John E. Anderson, Florence L. Goodenough; Associate Professor Dale B. Harris; Assistant Professor Elizabeth M. Fuller; Instructors Harriet E. Blodgett, Pearl T. Cummings.

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 pages 20-21.

COURSES

- 130f. Motor, Linguistic, and Intellectual Development of the Child. Lectures, readings, and reports. Prereq.: 12 cred. in psychology or equiv. 3 cred. Mr. Anderson.
- 131w. Personality, Emotional, and Social Development of the Child. Lectures, readings, and reports. Prereq.: 12 cred. in psychology or equiv. 3 cred. Mr. Anderson.
- 132s. Later Childhood and Adolescence. Lectures, readings, and reports. Prereq.: 12 cred. in psychology or equiv. 3 cred. Mr. 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 equiv., including statistics, and permission of instructor. 2 cred. per quarter. Mr. Anderson.
- 140f,s. 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 or sociology. 2 cred. Miss Goodenough, Miss Blodgett.
- 141w. 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 or sociology. 2 cred. Miss Goodenough.
- 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 or sociology. 3 cred. Miss Goodenough.

- 150f-151w-152s. Childhood Education. Lectures and readings on the philosophy, organization, administration, methods and materials of early childhood education. Prereq.: 12 cred. in education. 2 cred. per quarter. Mrs. 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. Mrs. Smith.
- 166f. Maturity and Aging. Survey of scientific literature on changes in ability with advancing age. Prereq.: 12 cred. in psychology or equiv. 3 cred. Mr. Harris.
- 170w. Parent Education. History and survey of programs. Materials and methods. Administration and organization. Lectures, discussions, and reports. Prereq.: 15 cred. in child welfare, psychology, education, or sociology. 3 cred. Mrs. 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. Miss Templin.
- 186su. Laboratory in Childhood Education and Child Development (Same as Ed.C.I. 131). Workshop. Prereq.: 12 cred. in education or child welfare and permission of instructor. 9 cred. Mrs. Fuller.
- 190f. Principles of Mental Measurement of Young Children. Mental test methods and their interpretation. Lectures, demonstrations, readings, and reports. Prereq.: 12 cred. in psychology, educational psychology, or sociology. 2 cred. Miss Goodenough.
- 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. Mr. Anderson.
- 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 degree is required. 1 cred. per quarter. Miss Goodenough.
- 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 consent 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 and permission of instructor. Cred. ar. Mrs. 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. 290w, Minnesota, Merrill-Palmer, Arthur, and Primary Group Tests; 291s, Stanford-Binet. Registration limited. Prereq.: Ed.Psy. 142, 150 or equiv. and permission of instructor. 4 cred. per quarter. Miss Blodgett.

CIVIL ENGINEERING

Professors Lorenz G. Straub, Paul Andersen, Alvin S. Cutler, George J. Schroepfer; Associate Professors Chester A. Hughes, Joseph A. Wise; Assistant Professors Leonard F. Boon, Russell M. Cornell, Miles S. Kersten, John F. Ripken; Instructor Warren De Lapp.

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.

SURVEYING

- 109w,s. 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. Mr. Boon.
- 110f,s. Errors in Surveying. Study of the sources, importance, and reduction of errors in surveying. Prereq.: Course 23. 2 cred. Mr. Boon.
- 111w,s. Methods of Computation. Study of the methods used in various problems in precise and geodetic surveys and distribution of errors. Prereq.: Course 110. 2 cred. Mr. Boon.

RAILWAY ENGINEERING

- 121f. 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. Mr. Cutler.
- 122w.* 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. Signaling and interlocking. Prereq.: Course 22. 3 cred. Mr. Cutler.
- 123s. Railway Engineering. Design and construction of railroad buildings and structures: culverts, wooden trestles, switches, cross-overs, crossing frogs, etc. Earthwork computation, estimates and reports. Distribution of material by mass diagram. Prereq.: Course 22. 3 cred. Mr. Cutler.
- 124w. Transportation. Development of railway and inland waterway transport, railway regulation and control with special reference to the 1920 Railway Transportation Act, geographical, financial, and rate grouping of railways, Interstate Commerce Commission method of accounting, cost and value of service, present systems, and organization. Prereq.: Course 22. 3 cred. Mr. Cutler.
- 221f-222w-223s. Railway Administration. Analysis of railway organization and methods of management and operation. Special problems. Prereq.: Course 122. 3 cred. per quarter. Mr. Cutler.
- 224f.* Railway Terminals and Yards. Prereq.: Course 123. 3 cred. Mr. Cutler.

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.
- 137w,s. Structural Laboratory. Theoretical and experimental analysis of structural members and models. Prereq.: Courses 134, 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.

- 141f. Reinforced Concrete. Principles of reinforced concrete. Theory of beams, slabs, and columns and the application to ordinary structures. Prereq.: M.&M. 128. 3 cred. Ar.
- 142w. Reinforced Concrete Design. Continuation of 141 with special emphasis on the practical features of the design of buildings, bridges, retaining walls, etc. Prereq.: Course 141. 3 cred. Ar.
- 143s. Reinforced Concrete Arches. Analysis and design of reinforced concrete arches. Prereq.: Courses 134, 142. 3 cred. Ar.
- 146s. 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.
- 147w. 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, M.&M. 128. 2 cred.
- 148f-149w-150s. Advanced Concrete. Short research problems in concrete. Prereq.: Course 146. 2 cred. per quarter. Ar.
- 232s. Advanced Structural Problems in Sanitary Engineering. Theory of domes, tanks, dams, culverts, and elliptical sewer sections. Prereq.: Course 132. 3 cred. Ar.
- 233s.* Advanced Problems in Foundations. Lateral earth pressure theories. Design of sheet piling. Bearing piles and cofferdams. Prereq.: Courses 134, 147. 3 to 5 cred. Ar.
- 234f-235w. 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.
- 236s. Advanced Structural Design. Effects of shrinkage and plastic flow. Eccentrically loaded concrete sections. Non-symmetrical bending. Torsion. Prereq.: Course 135 or 142. 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.
- 241-242. Advanced Structural Laboratory. Experimental determination of principle 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. Ar.
- 243.* Dynamics or 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 134, 142. 3 to 6 cred. per quarter.

HIGHWAY AND SOILS ENGINEERING

- 151f,s.* Advanced Highway Laboratory. Investigations in co-operation with State Highway Department. Prereq.: Course 52. 3 to 5 cred. Mr. Kersten.
- 152s.* 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. Mr. Kersten.
- 153w,s. Soils in Highway Engineering. Classification, soil maps, physical tests, design of graded mixes, and soil stabilization. Prereq.: Course 52. 3 cred. Mr. Kersten.
- 155s. Field Soil Studies. Soil classification and mapping, analysis of soil conditions where road failures have occurred. Prereq.: Course 52. 2 cred. Mr. Kersten.

- 156w. Highway Traffic Engineering. Development, economic field, relation to other forms of transportation. Highway transport surveys, economics of location, economics of selection of type of surface, effect of vehicle on road and road on vehicle. Prereq.: Course 52. 3 cred. Ar.
157. Highway Economics. Annual highway costs; effect of highway location and design on motor vehicle operating costs. Economic significance of highway accidents. Allocation of highway costs to motor vehicle owners and general public. Economics of highway administration, finance, and taxation. 2 cred. Ar.
- 158s. Airport Design. Field layout, drainage, and studies of sub-bases, bases, and surfaces for aprons, runways, and taxiways. Prereq.: Course 52. 3 to 5 cred. Mr. Kersten.
- 159f. 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. Mr. 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.
- 161f. Hydrology. Elementary hydrology; precipitation, evaporation, transportation, runoff, storage and lake levels, types of water power development; dams, waterways, penstock, turbines, and accessory equipment. Prereq.: M.&M. 129. 4 cred. Mr. Cornell.
- 164f. 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.: M.&M. 129. 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 160 or 161. 3 cred. Mr. Cornell.

MUNICIPAL ENGINEERING

- 172s. 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. Mr. Cornell.
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.

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. Mr. Anderson.
- 162w. 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. Mr. Cornell, Mr. Schroepfer.

- 163s. 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 and industrial waste treatment. Laboratory problems in analysis and design. Inspection trips. Prereq.: Course 162. 3 cred. Mr. Cornell, Mr. Schroeffer.
- 165s. 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. Prereq.: P.H. 53. 3 cred. Mr. Pierce.
- 167s. 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. demonstration. 3 cred. Mr. Pierce.
- 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. Mr. Schroeffer.
- 174.* Sanitary Engineering Problems (Sewage and Industrial Wastes). Investigations of problems in sewage treatment and industrial waste 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. Mr. Schroeffer.
175. Industrial Waste Disposal. Investigation of quality of various types of industrial wastes and methods of disposal. Economic studies. Hours ar. Prereq.: Course 174. 3 cred. Mr. Schroeffer.
179. Sanitary Laboratory. The biological, bacteriological, physical, and chemical analyses of water, sewage, air, coagulant chemicals, disinfectants, sewage sludge, etc. 3 cred.
- 180-181-182. Sanitary Engineering Seminar. Required of sr. and grad. students. Attendance desirable for juniors in the curriculum, 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.
- 261*-262.* Water and Sewage Plant Design. Design of water purification and sewage disposal works. Prereq.: Course 163. 3 to 5 cred. per quarter. Mr. Schroeffer.
264. Sanitary Engineering Unit Operations. Lectures, laboratory studies, and plant-scale studies on screening, sedimentation, chemical coagulations, aeration, filtration, disinfection of water with chlorine, disinfection of air, heat transfer, handling of material, drying, incineration, and digestion. 3 cred. Ar.
- 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. Mr. Schroeffer.
- 277.* Advanced Sanitary Engineering (Sewage and Industrial Wastes). Principles of sewage collection and treatment, and of industrial waste disposal. Inspections and investigations of sewage works systems. Advanced study of certain phases of sewage treatment. Hours ar. Prereq.: Course 174. 3 to 5 cred. Mr. Schroeffer.

GENERAL

- 280*-281*-282.* Civil Engineering Research. Original work in concrete, structural steel, 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. 129, 143. 3 cred. Ar.
- 184-185-186.* Advanced Hydraulic Problems. Special problems in hydraulic design. Prereq.: Course 130 or registration in 130. 2 cred. per quarter. 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, 129 or permission of instructor. 3 cred. Ar.
- 191w. Hydraulic Motors and Pumps. Study of the hydraulic theory of the ram, impulse wheel, reaction turbine, and centrifugal pump. Prereq.: M.&M. 129. 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 130 or permission of instructor. 3 cred. Ar.
- 193w. Hydraulic Measurements. Detailed study of the current meter. Venturi meter, weir, orifice, Parshall flume, traveling screen, chemical methods of gaging, etc. Prereq.: M.&M. 129. 3 cred.
- 194f-195w-196s.* Advanced Hydraulic Laboratory. Special experimental studies concerning the characteristics of turbines, pumps, etc. Hydraulic models. Prereq.: M.&M. 129, 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 consent of instructor. 3 cred. Ar.
- 290-291-292. Advanced Fluid Mechanics. Prereq.: Course 190. 3 cred. per quarter. Ar.
- 293-294-295. Hydrodynamics. Prereq.: M.&M. 129, 153. 3 cred. per quarter. Ar.
- 296-297-298. Advanced Hydrodynamics. Prereq.: Course 295. 3 cred. per quarter. Ar.

CLASSICS

Professor Marbury B. Ogle; Associate Professors Robert V. Cram, John L. Heller.

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.

Doctor's degree—For the degree of doctor of philosophy, candidates will be expected to spend at least three years in preparation. A knowledge of Greek and Roman history, Greek and Roman literature, and a special knowledge of a particular Latin or Greek author, or group of authors, will be required.

Students majoring in Latin will be expected generally to carry a minor in Greek.

GREEK

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

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.

Mr. Heller. (Not offered in 1946-47.)

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

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. Mr. Heller.

211f-212w-213s. Seminar: Greek Epic. 3 cred. per quarter. Mr. Heller. (Not offered in 1946-47.)

221f-222w-223s. Seminar: Greek Drama. 3 cred. per quarter. (Not offered in 1946-47.)

231f-232w-233s. Seminar: Greek Philosophy. 3 cred. per quarter. (Not offered in 1946-47.)

LATIN

Prerequisites—Any four of Courses 51 to 83, and 6 credits in addition selected from the 100 series.

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. A minor is to be carried throughout the year in one of the following departments: Comparative Philology, English, German, Greek, History, Romance Languages, Education, or Scandinavian.

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.

COURSES

111f-112w-113s.† Advanced Prose Composition. Prereq.: Course 73-74-75 or equiv. 3 cred. per quarter. Mr. Ogle.

121f. Advanced Vergil. *Eclogues*, *Georgics*, and *Aeneid*. Prereq.: any 2 of the courses with numbers between 50 and 100. 3 cred. Mr. Ogle.

131f. Juvenal: Selected Satires. Prereq.: any two of the courses with numbers between 50 and 100. 3 cred. Mr. Cram. (Not offered 1946-47.)

133s. Vulgar Latin. Development of Latin into Romance. Prereq.: for advanced students of either Latin or Romance, consent of the instructor. 3 cred. Mr. Ogle.

142w. Tacitus. Readings in the *Annales* and *Historiae*. Prereq.: any two of the courses numbered between 50 and 100. 3 cred. Mr. Ogle.

151f. Advanced Cicero. Prereq.: any two of the courses with numbers between 50 and 100. 3 cred. Mr. Ogle. (Not offered 1946-47.)

152w. Lucretius. Prereq.: any two of the courses with numbers between 50 and 100. 3 cred. (Not offered in 1946-47.)

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

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

Courses for Which No Latin or Greek Is Required

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

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. Mr. Ogle. (Not offered in 1946-47.)
- 211f,212w,213s.* Seminar: Latin Epic. 3 cred. per quarter. Mr. Ogle.
- 221f,222w,223s.* Seminar: Latin Poetry. 3 cred. per quarter. (Not offered in 1946-47.)
- 231f,232w,233s.* Seminar: Latin Historiography. 3 cred. per quarter. Mr. Ogle. (Not offered in 1946-47.)
- 241f,242w,243s.* Seminar: Introduction to Classical Philology. 3 cred. per quarter. Mr. Cram.

DAIRY HUSBANDRY

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

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.

COURSES

- 101f. Milk Production. Problems of the dairy farmer. 3 cred. Mr. 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. Mr. Macy, Mr. Olson.
- 103w. Dairy Stock Feeding. Application of the principles of nutrition to special problems of feeding the dairy cow and growing the young animals. 3 cred. Mr. Fitch.
- 104f. Dairy Stock Selection.* Selection of dairy animals on the basis of type, pedigree, production, and progeny performance. 2 cred. Mr. 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. Mr. Petersen.
- 110w. Dairy Products: Ice Cream and Frozen Desserts. Similar to Course 111 with special application to ice cream. 3 cred. Mr. Combs, Mr. Thomas.
- 111f. Dairy Products: Butter. The chemical, bacteriological, and economic problems in the manufacture and marketing of butter. 3 cred. Mr. Coulter, Mr. Thomas.
- 112s. Dairy Products: Cheese. Similar to Course 111 with special application to cheese. 3 cred. Mr. Combs, Mr. Thomas.
- 113s. Technical Control. Chemical and bacteriological laboratory methods used in technical control of milk and its products. Prereq.: Course 2 or equiv., Course 110, 111, or 112. 3 cred. Mr. 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. Mr. 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. Mr. Macy, Mr. 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. Mr. 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. Mr. Petersen.
- 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. Mr. Fitch, Mr. Petersen, Mr. Gullickson, Mr. Gilmore.
- 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. Mr. Combs, Mr. 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. Mr. Macy.

DENTISTRY

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

ECONOMICS AND BUSINESS ADMINISTRATION

Professor and Dean Richard L. Kozelka; Professors Roy G. Blakey, Francis M. Boddy, George Filipetti, Frederic B. Garver, Ernest A. Heilman, Arthur W. Marget,§ Bruce D. Mudgett, John J. Reighard, J. Warren Stehman, Arthur R. Upgren, Roland S. Vaile, Dale Yoder; Associate Professors Arthur M. Borak, Yale Brozen,

§ Military leave.

Helen G. Canoyer, Walter W. Heller, Walter R. Myers, Harry J. Ostlund, Clare L. Rotzel; Assistant Professor Edmund A. Nightingale.

NOTE—For information on work in International Relations see pages 19-20; for work in Statistics see pages 22-23.

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.

Examinations—Both written and oral examinations are required.

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 or Business Administration 101-102, unless either of these courses 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, labor, money and banking, public finance, or statistics.

4. 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 or Business Administration 101-102, unless either of these courses 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 180-181C, 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.

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 R. G. Blakey.

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, either Italian or Swedish may be substituted for French.

6. The written examination in the major field will cover the course material in Economics 203-204, 207, 208, and in the three groups selected from A, B, C, and D under 2 above.

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 Commerce Algebra (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 pro-

gram, 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 tho 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, advanced money and banking, advanced general accounting or cost accounting, corporation finance, survey of marketing, business statistics, production management, advanced general economics, 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.

4. All candidates will be required to pass written and oral examinations in the fields covered by the core group courses and the field of specialization.

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 180-181C, 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.

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.

COURSES

- 103-104.† Advanced Economics. Prereq.: 20 cred. in social science including Econ. 6-7 or 83. 3 cred. per quarter. Mr. Garver.
105. History of Economic Ideas: The Classical Economists. Prereq.: B.A. 101-102 or Econ. 103-104 or consent of instructor. 3 cred. Mr. Garver.
106. History of Economic Ideas: The Critics of the Classical Economists. Prereq.: B.A. 101-102 or Econ. 103-104 or consent of instructor. 3 cred. (Not offered in 1946-47.)
108. Applications of Economic Theory. Prereq.: B.A. 101-202 or Econ. 103-104. 3 cred. Ar.
110. Cartels: Origins, Structures, and Price Policies. Prereq.: Econ. 6-7 or 83 and 15 additional cred. in economics and/or business administration. Econ. 155 is a desirable preceding course. 3 cred. Mr. Garver.
111. City Planning. Same as Architecture 104, Political Science 123, and Sociology 104. General survey of the economic, governmental, social, and technical phases of city planning and group housing. 3 cred. Mr. Jones, Mr. Anderson, Mr. Filipetti, Miss Canoyer, Mr. Sletto.

- 121-122*†-123.* Theory of Statistics. Prereq.: Econ. 5. 3 cred. per quarter. Mr. Mudgett.
- 124.* Comparative Banking: British Systems. Prereq.: Econ. 141 or B.A. 142. 3 cred.
126. Economic Problems of Latin America. Prereq.: Econ. 6-7 or 83. 3 cred. Mr. Myers.
127. Comparative Banking: South American Systems. Prereq.: Econ. 103-104 and B.A. 112. 3 cred. (Not offered in 1946-47.)
129. Statistical Economics. Prereq.: Econ. 103-104 and B.A. 112. 3 cred. Ar.
- 140w. The Co-operative Movement. Prereq.: Econ. 6-7 or 83. 3 cred. Miss Canoyer.
141. Monetary and Banking Policy. Prereq.: Econ. 3 and either Econ. 6-7 or 83. 3 cred. Mr. Myers. (Not offered in 1946-47. For the current year B.A. 142 may be substituted for Econ. 141.)
- 149.* Business Cycles. Prereq.: Econ. 141 or B.A. 142 or consent of instructor. 3 cred. Mr. Myers.
155. Corporation Finance. Prereq.: Econ. 3 and 6-7. 3 cred. Mr. Stehman, Mr. Borak.
161. Labor Problems and Trade Unionism. Prereq.: Econ. 6-7 or 83. 3 cred. Mr. Yoder.
162. Labor and Socialist Movements. Prereq.: Econ. 161. 3 cred. Ar.
- 164.* Labor Legislation and Social Insurance. Prereq.: Econ. 161. 3 cred. Ar.
172. Economics of Transportation. Prereq.: 20 cred. in social science including Econ. 6-7 or 83. 3 cred. Mr. Nightingale.
175. Government Regulation of Business. Prereq.: 20 cred. in social science including Econ. 6-7 or 83. 3 cred. Mr. Garver, Mr. Boddy.
176. International Commercial Policies. Prereq.: Econ. 6-7 or 83. 3 cred. Mr. Blakey.
178. Economics of Consumption. Prereq.: Econ. 6-7 or 83; not open to majors in economics or business administration. 3 cred. Miss Canoyer.
- 179.§ Economic Problems of the Far East. Prereq.: Econ. 6-7 or equiv. 3 cred. Mr. Vaile. (Not offered in 1946-47.)
185. Economics of Marketing. Prereq.: Econ. 6-7 or 83. 3 cred. Mr. Vaile, Miss Canoyer.
- 191-192.*†¶ Public Finance. Prereq.: Econ. 6-7 or 83. 3 cred. per quarter. Mr. Blakey.
193. State and Local Taxation. Prereq.: Econ. 191-192 or B.A. 58. 3 cred. Mr. Blakey.
- 203-204.* Seminar in Economic Theory. 3 cred. per quarter. Mr. Garver.
- 206.* Seminar in Market Prices. 3 cred. Mr. Vaile. (Offered in alternate years. Offered in 1947-48.)
- 207.* Theory of Demand. 3 cred. (Not offered in 1946-47.)
- 208.* Production and Distribution. 3 cred. (Not offered in 1946-47.)
- 233-234.* Seminar in Public Finance. 3 cred. per quarter. Mr. Blakey.
- 243-244.* Seminar in Money and Banking. 3 cred. per quarter. Mr. Marget. (Offered in alternate years. Offered in 1946-47.)
- 251*-252.* Seminar in Industrial Relations. 3 cred. per quarter. Mr. Yoder.
- 257.* Seminar in Accounting Theory. 3 cred. Mr. Heilman.

BUSINESS ADMINISTRATION

- 101-102.† Advanced General Economics. Prereq.: Econ. 6-7. 3 cred. per quarter. Mr. Garver, Mr. Boddy.
109. Business Policy. Prereq.: B.A. 101-102. 3 cred. Mr. Reighard.
- 112.‡ Business Statistics. Prereq.: Econ. 5 or B.A. 70. 3 cred. Mr. Mudgett.
118. Auditing Procedure. Prereq.: B.A. 139 or 151 or consent of instructor. 3 cred. Ar.
119. Correlation. Prereq.: Econ. 5 or B.A. 70. 3 cred. (Not offered in 1946-47.)
120. Index Numbers. Prereq.: Econ. 5 or B.A. 70. 3 cred. (Not offered in 1946-47.)
- 130.‡ Cost Accounting Survey. Prereq.: Econ. 25-26. 3 cred. Mr. Ostlund.

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

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

¶ Credit may not be received for both Economics 191-192 and B.A. 58.

133. Standard Costs. Prereq.: B.A. 130 or 153. 3 cred. Mr. Ostlund.
134. Income Tax Accounting. Prereq.: B.A. 139 or 151. 3 cred. Mr. Reighard.
135. Auditing and Public Accounting. Prereq.: B.A. 118. 3 cred. Mr. Reighard.
136. Internal Auditing and Accounting Control. Prereq.: B.A. 139 or 151. 3 cred. Mr. Reighard.
- 139.*†§ Advanced General Accounting. Prereq.: Econ. 25-26. 3 cred. Mr. Heilman.
142. Advanced Money and Banking. Prereq.: Econ. 3 and 6-7. 3 cred. Mr. Marget, Mr. Myers.
145. Foreign Exchange. Prereq.: B.A. 142. 3 cred. Mr. Myers.
146. Investments. Prereq.: Econ. 155. 3 cred. Mr. Stehman.
147. Bank Administration. Prereq.: B.A. 142. 3 cred. (Not offered in 1946-47.)
148. The Securities Market. Prereq.: B.A. 146 and Econ. 149. 3 cred. Mr. Upgren. (Not offered in 1946-47.)
- 150†§-151.‡ Intermediate Accounting. Prereq.: Econ. 25-26. 3 cred. per quarter. Mr. Heilman.
- 152-153. Cost Accounting. Prereq.: Econ. 25-26. 3 cred. per quarter. Mr. Ostlund.
- 156.* Finance Management. Prereq.: Econ. 155. 3 cred. Mr. Stehman.
157. C.P.A. Problems. Prereq.: B.A. 135 and 151 or consent of instructor. 4 cred. Ar.
158. Governmental Railroad and Utility Accounting. Prereq.: B.A. 139 or 151. 3 cred. Mr. Heilman.
- 165.* Economics of Public Utilities. Prereq.: Econ. 3 and 6-7. 3 cred. Mr. Garver.
167. Introduction to Industrial Relations. Prereq.: Econ. 161. 3 cred. Mr. Yoder.
- 170.‡‡ Motion Economy. Prereq.: B.A. 184. 3 cred. Mr. Filipetti.
- 171.‡‡ Production Standards. Prereq.: B.A. 170. 3 cred. Mr. Filipetti.
177. Foreign Trade. Prereq.: Econ. 176. 3 cred. Mr. Blakey.
- 180-181-182. Senior Topics Courses. Intensive study of problems in respective fields of specialization.
- A. Accounting. 2 cred. per quarter. Mr. Rotzel, Mr. Reighard.
- B. Business Finance. 2 cred. per quarter. Mr. Stehman.
- C.* Marketing. 3 cred. per quarter. Mr. Vaile, Miss Canoyer.
- D.* Industrial Relations. 3 cred. per quarter. Mr. Yoder.
- F. Statistics. 3 cred. per quarter. Mr. Mudgett.
- G. Production Management.‡ 3 cred. per quarter. Mr. Filipetti.
- I. Public Utilities and Transportation. 3 cred. per quarter. Mr. Nightingale.
- 184.*¶ Scientific Management in Industry. 3 cred. Mr. Filipetti.
194. Advanced Advertising Procedure. 3 cred. Mr. Longstaff.

EDUCATION

Professors Wesley E. Peik, John Anderson, Charles W. Boardman, Guy L. Bond, Nelson L. Bossing, Theodore Brameld, Clara Brown, Leo J. Brueckner, Walter W. Cook, John G. Darley, Ruth Eckert, Marcia Edwards, Albert M. Field, Harriet Goldstein, Palmer O. Johnson, Wylle B. McNeal, Wilford S. Miller, Mervin G. Neale, Ruth Raymond, Ella Rose, Dora V. Smith, Homer J. Smith, Edgar B. Wesley, C. Gilbert Wrenn; Associate Professors G. Lester Anderson, Clifford P. Archer, Willis Dugan, M. Elizabeth Fuller, Ruth Grout, Marie Lien, William J. Micheels, Helen M. Starr, Tracy Tyler, Marvin J. Van Wagenen, Harold T. Widdowson; Assistant Professors

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

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

§ Credit may not be received for both B.A. 139 and B.A. 150.

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

Jean H. Alexander, Clifton Gayne, Paul Grim, Milo Peterson; Lecturers Naboth O. Pearce, M.D., Barbara Wright; Instructors Donovan A. Johnson, Marguerite Torbert.

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 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 11.)

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	Educational Psychology
Curriculum and Instruction	History and Philosophy of Education
Education	Home Economics and Education
Educational Administration	Industrial Education

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.
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	Educational Psychology
Curriculum and Instruction	History and Philosophy of Education
Education (in special cases)	Industrial Education
Educational Administration	

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 may be 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	Educational Psychology
Agricultural Education	History and Philosophy of Education
Curriculum and Instruction	Home Economics Education
Educational Administration	Industrial Education

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 master of education degree 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.]

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.

COURSES

Agr.Ed.101w. Adult Education in Agriculture. Instructional programs for rural young men not regularly enrolled in school. Analysis of rural youth situations and placement problems. Prereq.: Course 81. 3 cred. Ar.

Agr.Ed.103w. 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 82. 3 cred. Ar.

Agr.Ed.104s. 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. Mr. Field. (Not offered in 1946-47.)

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. Mr. Field.

Agr.Ed.191f,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. No cred. Mr. Field.

- Agr.Ed.221f,w,s. Field Problems. Making investigations, gathering data, and formulating plans regarding agricultural education. 3 cred. per quarter. Mr. Field.
- 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. 2 to 9 cred. Mr. Field.
- Agr.Ed.286su. 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. 2 to 3 cred. (Not offered in 1946-47.)

ART EDUCATION

- ArtEd.150w. Advanced General Design: Commercial design and the consumer. Prereq.: permission of instructor. 3 cred. Miss Lien.
- ArtEd.151f. Advanced General Design: Industrial design and the consumer. Prereq.: permission of instructor. 3 cred. Miss Lien.
- ArtEd.153w. Home Design in Society and Education. Prereq.: permission of instructor. 3 cred. Mrs. Torbert.
- ArtEd.154w. Development of Personality and Its Expression in Costume. Prereq.: permission of instructor. 3 cred. Miss Raymond.
- ArtEd.155f. Painting and Sculpture in Society and Education. Prereq.: permission of instructor. 3 cred. Ar.
- ArtEd.156w. Intercultural Education through Art. 3 cred. Miss Lien.
- ArtEd.157s. Art Movements of Twentieth Century Scandinavian. Prereq.: permission of instructor. 3 cred. Miss Lien.
- ArtEd.183s. Philosophy of Art Education. The developing by each individual of an art philosophy integrated in a wider philosophy of life. A course in which teaching experience and professional education courses are synthesized in the light of the dynamic characteristics of life and art today. 3 cred. Miss Raymond.
- ArtEd.184s.‡ Advanced Course in Methods and Supervision of Art in the Elementary School. Prereq.: Course 51C-A-B or 61A-B, or equiv. 3 cred. Mr. Gayne.
- ArtEd.185w.‡ Methods of Teaching Art in Secondary Schools. This course is designed for teachers of art and for advanced students who are planning to teach art in secondary schools or in colleges. It emphasizes the philosophy, research, and procedures of the new secondary art education in connection with the current practices of the general education movement. 3 cred. Miss Lien.
- ArtEd.189w. Application of Esthetic Theory to Public Education. A scrutiny of the varying claims made for art in its wider functional aspects; the validity of the claims tested in everyday living; findings applied to education. 3 cred. Miss Raymond.
- ArtEd.284f,w,s. Reading and Research in Art Education. Provides for guided reading in areas of the student's need and choice with training in valid research techniques. Cred. ar. Ar.
- ArtEd.295f,w,s.* Special Problems in Art Education. The content of this course is determined by the individual specialization and creative projects selected. These projects may include advanced studio practice or technical solution of problems involving research in a chosen field. Registration by special permission of major adviser. 9 to 15 cred. Ar.
- ArtEd.296f. Seminar in Art Education. No cred. Miss Lien and staff.

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

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.105s.‡ 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. 2 cred. Mr. 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. Mr. 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.: Ed.T. 83. 3 cred. Miss Starr.
- Ed.C.I.117f.‡ Rural Education for Administrators and Teachers. Prereq.: consult instructor. 3 cred. Mr. Archer.
- Ed.C.I.129.‡ Principles and Problems of Teaching Social Hygiene. Emphasis will be placed on methods of teaching social hygiene in the public schools and materials for instructional use in the elementary and secondary schools. Prereq.: 9 cred. in education. 3 cred. Dr. Pearce, Miss Biester.
- 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 or research, projects, and observations of remedial techniques. Same as Ed.Psy. 145. Prereq.: Course 143 or 144 or 159. 3 cred. Mr. 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. Mr. 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 170 or consent of instructor. 2 to 6 cred. Mr. Bossing, Mr. Cook, Mr. Archer.
- Ed.C.I.174f-175w-176s.†‡§ Clinical Methods in Lip-reading and 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 adults in the University Speech Clinic. Prereq.: Sp. 1, 2, 3, 61, 67, 162, and Ed.Psy. 142. 3 cred. per quarter. Mr. Bryngelson and staff.

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

§ Taking the speech and psychological examinations and a C+ average (1.5 honor points per credit) in the major or the subject in which student teaching is done are prerequisite to registration in this course.

- 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. Seminars may be arranged from time to time for discussion and criticism of individual projects. Prereq.: Course 107. 1 to 3 cred. per quarter. Mr. Tyler.
- Ed.C.I.215f,w,s.*‡ Problems in the School Health Education Program. For advanced students who wish to pursue independent study and experimentation in school health education. Prereq.: permission of instructor. Cred. ar. Miss 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. Miss 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. Miss Grout.
- Ed.C.I.227f,w,s.*‡ Problems in Rural Education. Cred. ar. Mr. 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: Ed.C.I. 113, 119, 170 or consent of the instructor. 2 to 3 cred. per quarter. Mr. Bossing, Mr. Cook, Mr. 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 Ed.C.I. 143 or 144 or equiv. Cred. ar. Mr. Bond.

Elementary Education

- Ed.C.I.102f.‡ The Teaching of the Social Studies in the Elementary School. Prereq.: Ed. 61A-B-C or equiv. 3 cred. Mr. Wesley.
- Ed.C.I.119f,w.‡ 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. 61C or equiv. 3 cred. Mr. Cook.
- 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. Mrs. Fuller.
- Ed.C.I.143w.‡ 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 61A. 3 cred. Mr. 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. 61A-B-C or equiv. Not open to students who have had Ed.C.I. 64. 2 cred. Miss Smith. (Not offered 1946-47.)

‡ A fee of \$1 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 lecturers 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. 61A-B-C or equiv., 2 cred. Miss Smith, Mr. Bond.
- Ed.C.I.149s.‡ 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. 61A-B-C or equiv. Not open to students who have had Ed.C.I. 62A or B. 2 cred. Mr. Brueckner.
- Ed.C.I.150f,s.‡ 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. 61C or equiv. 3 cred. Mr. Brueckner.
- Ed.C.I.153s.‡ 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. 61A-B-C or equiv. 2 cred. Mr. 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. Mr. 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 consent of instructor. 3 cred. (Not offered in 1946-47.)
- 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 equiv. 3 cred. Mr. 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. Prereq.: 9 cred. in education. 3 cred. Mr. 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 1946-47.)
- Ed.C.I.226f,w,s. Seminar in Elementary School Problems. No cred. Mr. Bond, Mr. Brueckner, Mr. Cook, Mr. 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. 51A or equiv. 3 cred. per quarter. Mr. Brueckner.

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

- Ed.C.I.263f.*‡ Research in Arithmetic Instruction. A study of recent research in curriculum, gradation of subject matter, methods, materials, and supervision of arithmetic. Prereq.: Course 148 or 149 or equiv. 3 cred. Mr. Brueckner.
- Ed.C.I.264w.*‡ 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. 2 cred. Mr. 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. Mr. 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 jr.-sr. high school teaching experience. 2 cred. Miss Smith.
- Ed.C.I.135s.‡ Teaching of Occupations and Group Guidance. Problems of group work in guidance in the secondary schools. Content and materials for home room groups, occupations classes, and other guidance courses in junior and senior high schools. Prereq.: Ed.Psy. 33 or permission of instructor. 2 cred. Miss Edwards, Miss Wright.
- Ed.C.I.144s.‡ 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. 2 cred. Mr. 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. Mr. 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.: 10 cred. in education, including Ed. 51A. 2 cred. Mr. 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 and 170 or permission of instructor. 3 cred. Mr. 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 cred. Mr. Bossing.
- Ed.C.I.191s.‡ Advanced Course in the Teaching and Supervision of Secondary School Mathematics. Evaluation of present practices in methods, content, and administration of junior and senior high school mathematics. Prereq.: Ed. 51C or permission of instructor. 2 cred. Mr. Donovan Johnson.
- Ed.C.I.198.‡ Recent Literature in Methods and Curriculum in 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 1946-47.)
- Ed.C.I.201f,w,s.*‡‡ Problems in Teaching the Social Studies. Prereq.: permission of the instructor. 3 cred. per quarter. Mr. Wesley.

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

- Ed.C.I.204s.‡ Social Studies Curriculum. A review of the techniques and practices of curriculum-making in the social studies at all grade levels. Prereq.: Ed.T. 69A-B-C or equiv. 2 cred. Mr. Wesley.
- 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. With or without cred. Mr. Bossing, Mr. Johnson, Miss Smith, Mr. 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. Mr. Boardman.
- 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. Prereq.: Ed. 61A-B-C or equiv. 2 cred. (Usually offered alternate years. Not offered in 1946-47.)
- 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. Prereq.: 10 cred. in education including Ed.Psy. 293. Mr. 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. Prereq.: Ed. 51C. 2 cred. Mr. 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. Mr. Johnson.
- Ed.C.I.294w.*‡ 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. Miss 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. Miss Smith.

Higher Education

- Ed.C.I.184f.‡ Supervision of Student Teaching. A course primarily for teachers engaged in the direction of student teachers in secondary education. 2 cred. Ar.
- 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.: Ed.C.I. 250 or 285 or the permission of the instructors. 3 to 9 cred. Mr. Peik, Mr. Cooper, Miss Eckert.
- 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

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

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.: 15 cred. in education or permission of instructor. 3 cred. Miss Eckert.

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. 2 cred. Mr. Peik.

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. Mr. Neale.
- Ed.Ad.210s.* Financial Aspects of Public 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, 125. 3 cred. Mr. Neale.
- Ed.Ad.225w. 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. Mr. Neale.
- 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. Mr. Neale.
- Ed.Ad.227f.* 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. Mr. Neale.
- 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. Mr. 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. Mr. Neale. (Not offered in 1946-47.)
- Ed.Ad.235f,w,s. Seminar in Educational Administration. Enrolment limited to candidates for Master's degrees under Plan A and candidates for Ph.D. degrees in educational administration. No cred. Mr. 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.: 10 cred. in education. 3 cred. Mr. Neale.

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

Secondary Education

- Ed.Ad.133f. Guidance in Secondary Schools. Basic principles and current practices in educational and vocational guidance in junior and senior high schools. Application of principles through case discussions. Same as Ed.Psy. 133. Prereq.: 9 cred. in education. 3 cred. Mr. Dugan, Miss Wright.
- Ed.Ad.167f. Junior High School. Sources of the movement; purposes, functions, and limitations; types of reorganization; fundamental problems of reorganization; reorganization of subject matter. Prereq.: 10 cred. in education, including Ed. 51A-B. 3 cred. Mr. Bossing.
- Ed.Ad.218f,w,s. Recent Literature in Secondary Education. A seminar concerned with current problems and literature in secondary education. Cred. ar. Mr. Boardman, Mr. 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. Mr. 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. Mr. Boardman.
- Ed.Ad.265s. Administration of the Non-Instructional Activities of the Secondary School. Problems relating to housing, forms and records, marks, finance, public relations. 3 cred. Mr. 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. Mr. Boardman, Mr. Bossing.

Higher Education

- Ed.Ad.174w. The Junior College. Prereq.: Ed. 51A-B-C. 3 cred. Mr. Boardman.
- Ed.Ad.253w. 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. Mr. Neale.

EDUCATIONAL PSYCHOLOGY

NOTE—For information on work in Psychometrics see page 20.

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. Mr. Cook.
- Ed.Psy.133f. Guidance in Secondary Schools. (See Ed.Ad. 133.) Prereq.: 9 cred. in education. 3 cred. Mr. Dugan, Miss Wright.
- 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. Mr. 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. Mr. Miller.

- 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. Mr. Bond.
- Ed.Psy.143f. Individual Mental Testing Laboratory. Prereq.: Course 142. 2 cred. Mr. Bond.
- Ed.Psy.150w,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 to 6 cred. Mr. Bond.
- Ed.Psy.159f,s. Personality Adjustments in Education. 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. Mr. Wrenn.
- Ed.Psy.208w.* Methods in Educational Research. A study of the methods 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. Mr. 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. Mr. 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 and 216 or equiv. 2 cred. per quarter. Mr. 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.: Courses 140 and 133 or equiv. Cred. ar. Mr. Wrenn.
- Ed.Psy.233f,w,s.* Problems in Guidance and Personnel Work. Investigation of particular problems in the personnel field. Weekly seminar on college personnel topics. Prereq.: permission of instructor. Cred. ar. Miss Edwards, Mr. Wrenn.
- Ed.Psy.240f,w,s.* Problems of Measurement. Intensive study and individual research in problems of educational and vocational measurement. Cred. ar. Mr. 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. Mr. Johnson.
- Ed.Psy.253f,w,s.* Research Problems. Prereq.: consult instructor. Cred. ar. Mr. Miller, Mr. Anderson, Mr. Bond, Mr. Cook, Mr. Van Wagenen, Mr. Wrenn.
- 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. Prereq.: Course 225, or to be taken concurrently, and permission of instructor. 2 to 3 cred. per quarter. Mr. Darley, Mr. Dugan, Miss Edwards, Mr. Wrenn.

- Ed.Psy.290f-291w. Individual Differences. A study of group and individual differences and their relations to educational practice. Prereq.: Course 60 or equiv. and permission of instructor. 3 cred. per quarter. Mr. Miller.
- Ed.Psy.292s.* Recent Literature in Educational Psychology. Readings and reports on problems in educational psychology. Prereq.: permission of instructor. 3 cred. Mr. Miller.
- 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. Mr. Anderson.
- Ed.Psy.294s.* Recent Theory and Research in Human Learning. Prereq.: consult instructor. 3 cred. Mr. Anderson.

Elementary Education

- Ed.Psy.113f-114w-115s. Psychology of Elementary School Subjects. A discussion of the research studies in the field of the psychology of elementary school subjects. Prereq.: 10 cred. in education and psychology. 2 cred. per quarter. Mr. Van Wagenen.
- Ed.Psy.146-147. Child Guidance. The understanding and treatment of all forms of behavior problems in children of school age. Didactic lectures, reading, and presentation of clinical case records. Prereq.: 15 cred. in psychology and education. 2 cred. per quarter. (Not offered in 1946-47.)
- Ed.Psy.182w. Education of Handicapped Children. Prereq.: Ed. 51A or 61A or equiv. 2 cred. Mr. Van Wagenen.
- Ed.Psy.183f. Education of Gifted Children. A study of the abilities and characteristics of intellectually gifted children and adults. Prereq.: Ed. 51A or equiv. 2 cred. Mr. 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 equiv. 2 cred. Mr. Van Wagenen.

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 equiv. 3 cred. Miss Edwards.

See also Courses 182 and 183 under Elementary Education.

Higher Education

- Ed.Psy.252w. Student Personnel Work in College and University. An advanced course for students who have had at least one earlier course in higher education and who wish to become familiar, as college personnel workers or college teachers, with student personnel functions. The course will consider the philosophy of student personnel work, the specific personnel services with particular regard to the work of the counselor and the faculty adviser, and the student personnel administration. Prereq.: permission of instructor. 3 cred. Mr. 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. Mr. Johnson.

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. Miss 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. Miss 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 1946-47.)
- H.Ed.110s. Intercultural Education. A study of racial, religious, and nationality problems with special reference to their importance for the schools. 3 cred. Mr. Brameld, Miss Lien.
- H.Ed.140w. Philosophies of Modern Education. Emphasis will be placed upon the essential derivations of current educational philosophy with a view to placing the latter in clearer relation to modern life and society, and with some effort to frame a satisfactory educational philosophy for prospective teachers. 3 cred. Mr. Brameld.
- 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. Miss Alexander.
- H.Ed.176f. Conflicting Issues in Modern Education. A critical survey of major issues confronting education today. Prereq.: 6 cred. in psychology. 2 cred. (Not offered in 1946-47.)
- H.Ed.178f. Education and Problems of American Democracy. A study of the conflicts and tensions in current American life as these affect the program of the public schools and colleges. Concern will be given such issues as the role of education in social reconstruction, the function of teacher organizations in political life, the meanings of academic freedom and indoctrination in relation to democracy, etc. Prereq.: 6 cred. in social science. 3 cred. Mr. Brameld.
- H.Ed.179. Critical Thinking for Teachers. Through the practical examination of typical educational materials, this course aims to increase the ability of prospective teachers to think more logically, to read and listen more critically, and to convey something of this ability to their students. Besides this constructive feature, emphasis will be placed also on the detection of common fallacies and propaganda devices as these appear in educational literature, pressure groups, and in the schools. Prereq.: 6 cred. in psychology. 3 cred. (Not offered in 1946-47.)
- 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 will be weighed as the relation of education and the state, etc. Prereq.: 6 cred. in social science. 3 cred. Mr. Brameld.
- H.Ed.181. Tutorial Work in Educational Philosophy and Sociology. This course will be designed on an individualized basis for students who have developed a special interest in problems raised by some previous courses in educational philosophy and sociology. Prereq.: 2 cred. from Courses 73, 74, 76, 176, 177, 178, 179, 180. 3 cred. (Not offered in 1946-47.)
- 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. Mr. Wesley, Mr. Brameld, Miss Alexander.

Elementary Education

H.Ed.103s. History of Modern Elementary Education. See above under General Courses. 3 cred. Miss Alexander.

Secondary Education

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

HOME ECONOMICS EDUCATION

See Home Economics Education, pages 111-112.

INDUSTRIAL EDUCATION

Ind.100s. Industrial Education. For graduate students who have not had Ind. 70. 3 cred. Mr. Smith.

Ind.101f. Tests in Industrial Subjects. Study of principles of achievement test construction. Application of known techniques in remedial teaching to the work of shop and drawing teachers. Critical evaluation and planning. Prereq.: Ed. 51A. 3 cred. Mr. Micheels.

Ind.102w. 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. Special attention to planning for individual school situations of those enrolled. Prereq.: Course 80 or equiv. 2 or 3 cred. Mr. Micheels.

Ind.103w. Instructional Aids. Analysis of various instructional aids; preparation of instruction sheets; work plans for their use. Prereq.: permission of instructor. 2 cred. Mr. Micheels.

Ind.104. Defense Training. Purposes, plans, practices, and problems of defense training. Laws, rulings, contracts, reimbursements, records. Minnesota program, state and national data, current policies and difficulties. Consult instructor. 2 cred. (Not offered in 1946-47.)

Ind.105s. 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. Mr. 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 consent of instructor. 2 cred. Mr. Widdowson.

Ind.108w. 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. Mr. Widdowson.

Ind.109s. 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. Mr. Widdowson.

- Ind.110w. Guidance in the Schools. 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. Prereq.: Ed. 51A. 3 cred. Mr. 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. Mr. Micheels.
- Ind.125f. Philosophy and Practice of Industrial Education. Reasons advanced for the school provision of industrial courses, both general and vocational; types and functions of industrial schools and classes; identification of needy groups; aids and rulings; analysis of current concepts and practices. Prereq.: permission of instructor. 3 cred. Mr. Smith.
- Ind.170. Day Industrial Schools. National, state, and local organization and types; buildings and equipment; promotion and advertising; co-operative relationships; teaching staff; pupil guidance, training, and placement, and follow-up. Prereq.: Courses 60, 61. 2 cred. (Not offered in 1946-47.)
- Ind.171. Evening Industrial Schools. Development of the after-training of adults: agencies and scope of the movement; national and state legislation; qualification of instructors; problems and difficulties; records and certification, fees and charges; buildings, equipment, and instruction facilities. Prereq.: Course 170. 2 cred. (Not offered in 1946-47.)
- Ind.172. Part-time Education. A study of the new movement 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.: Courses 170, 171 or consent of instructor. 3 cred. (Not offered in 1946-47.)
- 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. No class sessions. 3, 6, or 9 cred. per enrolment; 9 cred. required. Mr. Smith, Mr. Micheels.
- Ind.250f-251w. Literature of Industrial Education. Survey of printed reports; critical analysis; selection of thesis problems; formulation of work plans; reports of progress; organization and presentation; acquaintance with types of literature. Limited to those with full status as candidates for the Master's degree. Prereq.: consent of instructor. 3 cred. per quarter. Mr. 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, 200 Eddy Hall, will be pleased to confer or to correspond regarding the entrance requirements and program patterns for such a degree. A mimeographed explanation is available.

ELECTRICAL ENGINEERING

Professors Henry E. Hartig, Elmer W. Johnson, John H. Kuhlmann; Associate Professors Loyst C. Caverley, Sidney C. Larson.

Prerequisites—For major work, Courses 121 to 126 or their equivalent; for minor work, 6 credits in physics, integral calculus, and one of the following: Courses 38, 45, 47, or 125.

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

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

COURSES ACCEPTABLE BOTH FOR COMMUNICATION AND POWER ENGINEERING

111. Electrical Engineering. Alternating current circuits and machinery. Prereq.: Courses 15 and 16. 5 cred. Staff.
112. Electrical Engineering Laboratory. Experimental study of alternating current circuits and machinery. Prereq.: registration in Course 111. 2 cred. Staff.
- 113-115. Electrical Engineering. Alternating current circuits and machinery. 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.
- 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 and direct current machinery. Prereq.: Courses 115, 116, 119. 3 cred. per quarter. Staff.
- 122-124-126. Electrical Engineering Laboratory. Operating characteristics of alternating and direct 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.
- 176-177-178. Electronics. Theoretical and laboratory study of the following subjects with aspects of their engineering applications. Electron emission from hot bodies. Richardson's equation, Langmuir-Childs equation, secondary electron emission, ionization and resonance potentials, external and internal photo-electric effect, positive ion emission, shot effect, discharge of electricity through gases, "getter" action. Barkhausen-Kurtz effect, ionization due to radioactivity, etc. Heaviside layer as a reflecting and refracting medium, long period echo effect, electron waves, vacuum gauges, vacuum technique, etc. Prereq.: permission of instructor. 2 cred. per quarter. Ar.
- 183-184-185. Special Electrical Laboratory. Efficiency tests and special problems. Prereq.: Course 116. Cred. ar. Ar.
- 191-192-193. Seminar. Weekly discussion of current electrical periodicals. Prereq.: Course 111. 1 or 2 cred. per quarter. Ar.
- 194-195-196. Electronic Applications and Servomechanisms. A study of commercial thermionic vacuum, vapor, and gas tubes including a detailed study of their scientific and industrial applications. Study of servomechanisms, follow-up systems, and automatic control devices. Prereq.: registration in Course 121-123-125. 3 cred. per quarter. Mr. Caverley, Mr. Larson.
- 227-228-229. Transients in Electrical Machinery and Transmission Lines. Theoretical and laboratory study of transients in electric power machinery and of lightning surges and lightning protection. Prereq.: Course 127-128-129. 3 cred. per quarter. Ar.
- 255-256-257.* Electrical Engineering Applications. Special investigation of electrical engineering applications. This course requires laboratory study, library study, and research both in residence and in the field, to be followed by complete written reports with oral presentation and discussion. 1 to 3 cred. per quarter. Ar.
- 275-276-277.* Electrical Engineering Research. Investigation of special problems in laboratory or library. 2 to 6 cred. per quarter. Mr. Hartig, Mr. Johnson, Mr. Kuhlmann.

- 284-285-286. Precise Electrical Engineering Measurements. Measurements of resistance, voltage, current, self-induction, and capacity; standardization of measuring instruments. Prereq.: Course 122. 2 cred. per quarter. Ar.
- 291-292-293.* Graduate Seminar. Discussions of problems and results of research work. 1 cred per quarter. Ar.
- 294-295-296. Vacuum Tube Circuit Analysis. Prereq.: Course 194-195-196 or equiv. 3 cred. per quarter. Mr. Hartig.

POWER ENGINEERING

130. Electric Control. Study of methods of control and control devices for direct and alternating current motors and generators. Prereq.: Course 37, 44, 46, or 123. 2 cred. Mr. Kuhlmann.
- 132-134-136. Electrical Design. The 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. Mr. 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. Mr. Johnson, Mr. Caverley.
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. Mr. Johnson.
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. Mr. Johnson.
143. Valuation of Public Utility Properties. Factors affecting value depreciation. Taxation and regulation of public utility properties. Elements of engineering economics, cost analysis, economic investigations, rate making. Prereq.: registration in Course 121. 3 cred. Ar.
144. Power Transmission Line Design. Preparation of detailed plans and specifications for the construction of high voltage transmission lines and distributing systems. Prereq.: Course 142. 3 cred. Mr. Johnson.
145. Railway Electrical Engineering. Principles of mechanics applied to electric train movement. Prereq.: Course 36, 43, 46, or 115. 2 cred. Mr. Johnson.
146. Railroad Electrification. Reasons for electrification. Study of European and American systems. Results of electrification. Prereq.: Course 145. 2 cred. Mr. Johnson.
151. Illuminating Engineering. Nature of light. Laws of vision, principles of illumination, photometry, sources of light, and their characteristics. Lighting equipment. Illumination requirements and calculation for various fields of use. Prereq.: Physics 9. 2 cred. Ar.
152. Photometric Laboratory. Photometric practice. Distribution curves of lamps with reflectors. Measurement of lighting installations. Prereq.: registration in Course 151. 1 cred. Ar.
- 153-154. Illumination Problems. Illumination design and specifications applied to problems in street, residence, industrial, commercial, and other kinds of lighting. Prereq.: Course 151. 1 to 3 cred. per quarter. Ar.

- 173-174-175. High Voltage Engineering. Study of insulation and generating equipment for high voltage; measurements of electrical quantities at high voltage; surges and surge proof equipment. 2 or 3 cred. per quarter. Mr. Caverley.
- 197-198-199. Advanced Electrical Design. Special problems. Prereq.: Course 132-134-136. Cred. ar. Mr. Kuhlmann.
- 211-212-213. Advanced Circuit Analysis. Circuit analysis by classical and operational methods. Prereq.: M.&M. 151. 2 cred. per quarter. Ar.
- 251-253.* Advanced Illuminating Engineering. Methods of determining location, kind, and quality of lights for obtaining desired illumination. Lect. and lab. work. Prereq.: Course 151. 2 cred. per quarter. Ar.

COMMUNICATION AND RADIO ENGINEERING

- 161-162-163. Radio Communication. Theoretical and laboratory study of radio transmitting and receiving circuits and apparatus. Amplifiers, detectors, oscillators. Electromagnetic waves in free space and on antenna systems. Prereq.: registration in Course 121-123-125. 3 cred. per quarter. Staff.
- 164*-165*-166.* Electric Communication. Telephone circuits at audio and carrier frequencies. Theoretical and laboratory study of circuits having distributed constants. Use of hyperbolic functions. Wave filters, balancing networks, equalizers, repeaters. Prereq.: Course 66. 4 cred. per quarter. Mr. Hartig, Mr. Larson, Mr. Becklund.
167. Radio Transmission. Design and operation of modern transmitting equipment, with special emphasis on broadcast transmission. Prereq.: registration in Course 161. 3 cred. Ar.
168. Radio Receiver Design. Detailed study of the problems arising in broadcast receiver design. Prereq.: registration in Course 162. 3 cred. Ar.
169. Television and U. H. Frequency Techniques. Problems in television, U. H. frequency transmission and reception, microwaves, wave guides, velocity modulation, klystrons, and magnetrons. Prereq.: registration in Course 163. 3 cred. Ar.
181. Communication Frequency Measurements. Vector treatment of network. Bridge circuits for measuring resistance, inductance, and capacity at audio and carrier frequencies. Prereq.: Course 126. 2 cred. Mr. Hartig.
- 187-188-189. Special Communication Laboratory. Special problems in electrical communication. Open by permission to qualified students. Includes weekly seminar meeting. Prereq.: registration in Course 164-165-166. 1 to 3 cred. per quarter. Ar.
- 261-262-263.* Advanced Radio Communication. Theoretical and laboratory study of the transmission of electromagnetic waves. Design and testing of radio transmitting and receiving apparatus. Theory of electron tubes and their use in radio circuits. High frequency measurements. Prereq.: permission of instructor. 3 cred. per quarter. Ar.
- 267-268-269. Telephone Transmission. Advanced transmission theory at communication frequencies. Class and lab. Prereq.: permission of instructor. 2 or 3 cred. per quarter. Mr. Hartig.
- 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. 3 cred. per quarter. Mr. Hartig.
- 281-282.* Advanced High Frequency Measurements. Vector treatment of circuit networks. Bridge circuits for the measurement of resistance, inductance, and capacity at audio and radio frequencies. Prereq.: Course 126. 2 cred. per quarter. Ar.

287-288-289.* Advanced Communication Laboratory and Seminar. Special problems in communication. Study and discussion of current articles on communication. Prereq.: permission of instructor. 2 or 3 cred. per quarter. Ar.

ENGLISH

Professors Joseph W. Beach, Huntington Brown, James T. Hillhouse, Theodore Hornberger, Tremaine McDowell, Cecil A. Moore, Robert P. Warren; Associate Professors William P. Dunn, Elizabeth Jackson; Assistant Professors Harold B. Allen, Elizabeth Atkins, Eric R. Bentley, John W. Clark, Anna H. Phelan, Mary Turpie.

NOTE—Students interested in major work in American Studies will find a description of this work on page 16.

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 courses 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, Miss Jackson (1946-47).

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, and 123-124-125). 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), the 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, Old and 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 p. 11). The preliminary examination will be devoted to the five divisions of the field designated by the candidate, and to the minor subject (see p. 12).

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 thoroly 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 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. Old English prose and poetry. The relation to modern English is particularly emphasized. Prereq.: 6 cred. above Course 50. 4 cred. Mr. Allen.
- 102w. Old English Poetry. Critical reading of poems. Prereq.: Course 100. 3 cred. Ar.
- 103s. Beowulf. An introduction to the Old English poem, with reading of considerable portion of the text. Prereq.: Course 100. 3 cred. Mr. Clark.
- 105w-106s. Eighteenth-Century Poetry. From Pope to Burns, with special reference to the rise and growth of romanticism. Prereq.: 6 cred. above Course 50. 3 cred. per quarter. Mr. Moore. (Offered biennially. Not offered in 1946-47.)
- 107w-108s. Eighteenth-Century Prose. Special study of fiction and the essay. Prereq.: 6 cred. above Course 50. 3 cred. per quarter. Mr. Moore. (Offered biennially. Offered in 1946-47.)
- 109f-110w. The Romantic Poets of the Nineteenth Century. From Wordsworth to Keats. Prereq.: 6 cred. above Course 50. 3 cred. per quarter. Miss Atkins.
- 111f-112w. Seventeenth-Century Prose. General survey of the prose of the century to 1660. Prereq.: 6 cred. above Course 50. 3 cred. per quarter. Mr. Moore. (Offered biennially. Not offered in 1946-47.)
- 113s. American Short Story. Prereq.: Course 73-74. 3 cred. Mr. McDowell.
- 114f. The Midwest in Literature. Prereq.: Course 73-74 or History 70-71-72. 3 cred. Mr. Hornberger.

§ Candidates who began their work for the doctorate before September, 1946, may fulfill the previous requirement of three quarters in Old English.

- 115w-116s. The Development of English Prose Style. Intensive study of short selections from both literary and scientific texts, from Caxton to the present day. Prereq.: 6 cred. above Course 50. 3 cred. per quarter. (Offered biennially. Not offered in 1946-47.)
117. American Essay. Prereq.: Course 73-74. 3 cred. (Offered biennially. Not offered in 1946-47.)
- 118f-119w. Nineteenth-Century Prose. 118f: The literature of social criticism—Carlyle, Ruskin, Arnold, and others; 119w: 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. (Not offered in 1946-47.)
- 120f-121w. The Interpretation of Poetry. Prereq.: 6 cred. above Course 50. 3 cred. per quarter. Mr. Warren.
- 123f-124w-125s. The Technique of the Novel. Special studies in novels of the late nineteenth and twentieth centuries, with particular regard to structure. Prereq.: 6 cred. above Course 50 and permission of the instructor. 3 cred. per quarter. Mr. Beach.
- 126f-127w. Drama, 1660-1880. Prereq.: 6 cred. above Course 50. 3 cred. per quarter. (Not offered in 1946-47.)
- 129s. Modern Drama. Contemporary drama from 1880 to the present. Prereq.: Course 55-56 or 126-127. 3 cred. Mr. Hillhouse.
133. Ballads. A study of a large number of traditional ballads, English and foreign, and of ballad style and origins. Prereq.: 6 cred. above Course 50. 3 cred. (Offered biennially. Not offered in 1946-47.)
135. Spenser. A study of his poems. Prereq.: 6 cred. above Course 50. 3 cred. (Offered biennially. Not offered in 1946-47.)
- 136s. Advanced Shakespeare. Shakespeare's development traced to the end. A careful analysis of four plays. Problems in the interpretation of Shakespeare's dramatic methods. Prereq.: Course 55-56. 3 cred. Ar.
- 137s. Late Eighteenth-Century Poetry. Principal figures are Crabbe, Cowper, Burns, and Blake. Prereq.: 6 cred. above Course 50. 3 cred. Mr. Moore. (Offered biennially. Offered in 1946-47.)
- 140w. Advanced Chaucer. The more important poems (except those read in Course 75). The treatment will be primarily literary and historical, linguistic proficiency being presumed. Prereq.: 6 cred. above Course 50, including 75. 3 cred. Mr. Clark.
- 143f-144w-145s. American Folklore (The same as History 143-144-145). 3 cred. per quarter. Mr. 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.: 6 cred. above Course 50 including 75. 3 cred. per quarter. Mr. Clark. (Offered biennially. Not offered in 1946-47.)
150. Victorian Poetry. The poetry of the Victorian era, apart from Browning's and Tennyson's. The principal names are: Matthew Arnold, the Rossettis, Fitzgerald, Morris, Swinburne, Hardy, and Meredith. Prereq.: 6 cred. above Course 50. 3 cred. (Offered biennially. Not offered in 1946-47.)
- 151s. Recent Poetry. Poetry in England and America since the death of Queen Victoria. The main tradition and tendencies now prevailing. Prereq.: 6 cred. above Course 50. 4 cred. Miss Jackson.
- 152f. Medieval and Early Elizabethan Drama. Mysteries, moralities, farces; school and court drama; Shakespeare's earlier contemporaries. Prereq.: Course 55-56. 3 cred. (Offered biennially. Not offered in 1946-47.)

- 153f. Seventeenth-Century Lyrists. Prereq.: 6 cred. above Course 50. 3 cred. Mr. Moore. (Offered biennially. Offered in 1946-47.)
- 154w-155s. § The American Novel. The history of the American novel from the beginning to the present. Prereq.: Course 73-74 or 52-53. 3 cred. per quarter. (Not offered in 1946-47.)
156. The American Drama. Survey of American drama in the eighteenth and nineteenth centuries. Prereq.: Course 73-74 or 126-127. 3 cred. (Not offered in 1946-47.)
- 157f-158w. Elizabethan Non-Dramatic Literature. A survey of prose and poetry, 1558-1603. Prereq.: 6 cred. above Course 50, including 55-56 or 170. 3 cred. per quarter. Ar.
- 159f-160w. Colonial Literature in America. Covers the period from 1608 to 1783. Prereq.: Course 73-74. 3 cred. per quarter. Mr. Hornberger.
162. Restoration Non-Dramatic Literature. Prereq.: 6 cred. above Course 50. 3 cred. Mr. Moore. (Offered biennially. Not offered in 1946-47.)
- 163f-164w. Restoration Drama. Prereq.: 6 cred. above Course 50. 3 cred. per quarter. Mr. Moore. (Offered biennially. Offered in 1946-47.)
- 165w. The Historical Study of Modern English. Prereq.: 6 cred. above Course 50. 3 cred. Mr. 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. above Course 50, 3 cred. per quarter. Mr. Warren.
- 169s. Browning and Tennyson. Most of the time will be spent on Browning. Prereq.: 6 cred. above Course 50. 3 cred. Ar.
170. Elizabethan Drama. Shakespeare's later contemporaries. Special attention to Dekker, Jonson, Beaumont, and Fletcher, Webster, Middleton, and Ford. Prereq.: Course 55-56. 3 cred. Mr. Brown. (Offered biennially. Not offered in 1946-47.)
- 171f-172w-173s. The Rise and Development of Standard English. Prereq.: Course 100. Required for Ph.D. in English. 3 cred. per quarter. Mr. Allen.
- 174s. American English. Prereq.: 6 cred. above Course 50. 3 cred. Mr. Allen.
- 175f-176w. § The History of English Verse. Prereq.: 6 cred. above Course 50. 3 cred. per quarter. Miss 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 1946-47.)
- 184f-185w-186s. The Technique of the Drama. A general study of dramatic types in several periods, including Greek tragedy, Elizabethan tragedy, and modern drama, European and American. Prereq.: 6 cred. above Course 50 with 55-56 recommended, and permission of the instructor. 3 cred. per quarter. Mr. Bentley.
- 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. Mr. Brown. (Not offered in 1946-47.)
- 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. Mr. Moore. (Not offered in 1946-47.)
- 231f-232w-233s. Shakespeare's Tragic and Comic Art. 3 cred. per quarter. Mr. Brown. (Not offered in 1946-47.)
- 234f-235w-236s. Medieval Seminar. A literary and linguistic study of selected Middle English texts. 3 cred. per quarter. (Not offered in 1946-47.)
- 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 1946-47.)

§ Students may enter either quarter.

- 240f-241w-242s. The Canterbury Tales. 3 cred. per quarter. (Not offered in 1946-47.)
- 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. Mr. Brown. (Not offered in 1946-47.)
- 253f-254w-255s. American Romanticism I: New England. 3 cred. per quarter. Mr. McDowell. (Offered in 1946-47.)
- 256f-257w-258s. Spenser and Milton. 3 cred. per quarter. Mr. Brown. (Not offered in 1946-47.)
- 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. Mr. Hillhouse. (Not offered in 1946-47.)
- 262f-263w-264s. Studies in 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. Mr. Hillhouse.
- 265f-266w-267s. American Romanticism II: Poe, Whitman, and Melville. 3 cred. per quarter. Mr. McDowell. (Not offered in 1946-47.)

COMPOSITION

- 101f-102w-103s. Seminar in Writing. 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 the instructor. 3 cred. per quarter. Mrs. Phelan, Mr. Warren.
- 200f-201w-202s. Graduate Seminar in Writing. 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 the instructor. 3 cred. per quarter. Mr. Warren.

ENTOMOLOGY AND ECONOMIC ZOOLOGY

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

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. For certain foreign students to whom English is an acquired language, exemption from a specific language 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.

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. Mr. Haydak.
- 117f.‡ Animal Ecology. General ecology stressing ecological principles and land communities. Prereq.: 15 cred. in zoology or entomology. 3 cred. Mr. Eddy, Mr. Hodson.
- 118w. Animal Ecology. Experimental approach to the study of environmental factors affecting animal populations. Prereq.: 15 cred. in zoology or entomology. 3 cred. Mr. 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. Mr. Eddy.
- 120s. General Ecology of Insects. Special emphasis on its application to problems in economic entomology. Lect., field trips, and reading. Prereq.: Courses 117, 118. 3 cred. Mr. Hodson.
- 121f.‡ Ichthyology. A study of the taxonomy and habits of the fresh water fishes of northern North America. Prereq.: 15 cred. in zoology or entomology. 3 cred. Mr. 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. Mr. 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. Mr. Richards.
- 140s. Histology and Embryology of Insects. Primarily histology and histochemistry, but with a brief resumé of the special features of insect embryology. Prereq.: Courses 125, 126, 127, or equiv. 4 cred. (Given in alternate years. Not given in 1946-47.) Mr. Richards.
- 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. Mr. J. J. Christensen, Mr. Granovsky.
- 144f.‡ Medical Entomology. A study of the principal arthropods obnoxious to man and animals. Special emphasis is placed on those arthropods which serve as vectors of pathogenic organisms of man and animals. Lect. and lab. Prereq.: 9 cred. in zoology or entomology. 3 cred. Mr. Burroughs.

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

- 145w‡-146s.‡ Animal Parasites and Parasitism. Origin and biological significance of parasitism; the structure, life history, and economic relations of representative parasites. Lect. and lab. Prereq.: 9 cred. in zoology. 3 cred. per quarter. Mr. Wallace.
- 150s. Introduction to Aphidology. The biology and taxonomy of the Aphididae. Prereq.: Course 52 or equiv. or permission of instructor. 3 cred. Mr. Granovsky.
- 162su. Ecology of Terrestrial Vertebrates. Detailed studies of the ecological relationship of northern Minnesota terrestrial vertebrates. Prereq.: Course 68 or Zool. 46-47, and Course 63 or equiv. and Bot. 20. 3 cred. Mr. 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. 46-47, Bot. 50 and Pl.Path. 53. 3 cred. per quarter. Mr. 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. Mr. 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 management, fish pond management. Lect. and lab. Prereq.: Zool. 53, 117, 118, 119, and 121, Bot. 57 or equiv., Agr.Econ. 90 or equiv., or permission of instructor. 3 cred. per quarter. Mr. 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.: Course 168, 169 or permission of instructor. 3 cred. Mr. Smith.
- 175f. Principles of Economic Entomology. Methods and principles of insect control. Lect. and demonstration lab. Prereq.: 15 cred. in entomology including Course 5 or equiv., or permission of instructor. 4 cred. Mr. Daggy.
- 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. Mr. Aamodt.
- 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 consent of instructor; inorganic and organic chemistry. 4 cred. (Given only in alternate years.) Mr. Richards.
- 197f,w,s,su. Introduction to Research. Special problems involving library and laboratory research in various lines of entomology and economic zoology. Mr. Mickel, systematic entomology; Mr. Granovsky, insect transmission of plant diseases, soil insects; Mr. Hodson, insect ecology, forest entomology; Mr. Richards, insect physiology, insecticides, insect histology; Mr. Marshall, wildlife management; Mr. Smith, fishery management; Mr. Haydak, apiculture; Mr. Daggy, economic entomology; Mr. Burroughs, medical entomology.
- 200f,w. Seminar. Assigned topics dealing with some special fields of work of the division. Cred. ar. Mr. Mickel and staff members.
- 201-204. Research in Systematic Entomology. Cred. ar. Mr. Mickel.

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

- 205-208. Research in Insect Transmission of Plant Diseases. Cred. ar. Mr. Granovsky.
 209-212. Research in Soil Insect Ecology. Cred. ar. Mr. Granovsky.
 213-216. Research in Insect Ecology. Cred. ar. Mr. Hodson.
 217-220. Research in Forest Entomology. Cred. ar. Mr. Hodson.
 221-224. Research in Economic Entomology. Cred. ar. Mr. Granovsky, Mr. Hodson, Mr. Daggy.
 225-228. Research in Insect Physiology. Cred. ar. Mr. Richards.
 229-232. Research in Insect Histology. Cred. ar. Mr. Richards.
 233-236. Research in Economic Vertebrate Zoology. Cred. ar. Mr. Marshall.
 237-240. Research in Fish Management. Cred. ar. Mr. Smith.
 261-264. Research in Medical Entomology. Cred. ar. Mr. Burroughs.
 265-268. Research in Insecticides. Cred. ar. Mr. Richards.
 269-272. Research in Apiculture. Cred. ar. Mr. Haydak.

FARM MANAGEMENT AND AGRICULTURAL ECONOMICS

For courses and staff see Agricultural Economics, on page 33.

FINE ARTS

Prerequisites—A minimum undergraduate preparation of 18 Senior College credits in fine arts or its equivalent. §

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 thoroly 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.

Doctor's degree—The subject of the thesis may be chosen from either the historical, theoretical, or creative (i.e., practical studio) fields. Should it be specifically creative in nature, it is expected that the various theoretical, compositional, and technical problems involved will not only be thoroly integrated with their historical antecedents, but will also show the results of independent research, a knowledge of sources and of literary aspects.

NOTE—Students interested in major work in American Studies will find a description of this work on page 16.

COURSES

- 154f. Italian Painting and Sculpture of the Early Renaissance. The development of painting and sculpture in Italy from Masaccio and Ghiberti to Donatello and the great painters of the fifteenth century in Florence, Rome, and Venice. Prereq.: 9 cred. in fine arts, or 9 cred. in history or literature with permission of instructor. 3 cred. Ar.
 155w. Great Masters of the High Renaissance. A study of the sources and the important works of Leonardo da Vinci, Raphael, Michelangelo, Titian, and Correggio, with a survey of their influence in the Renaissance art of Spain, France, and Flanders. Prereq.: 9 cred. in fine arts, or 9 cred. in history or literature with permission of instructor. 3 cred. Ar.

§ To be determined by comprehensive examination.

- 156s. Renaissance Art in Northern Europe. The development of painting and sculpture in Flanders, Northern 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 influence and contributions to the culture of the Renaissance. Prereq.: 9 cred. in fine arts, or 9 cred. in history or literature with permission of instructor. 3 cred. Ar.
- 201f-202w-203s. Seminar. Special problems in the art of Minnesota and the Northwest. Prereq.: 18 cred. in Senior College courses in fine arts or permission of instructor. 3 cred. per quarter. Ar.

FORESTRY

Professors Henry Schmitz, John H. Allison, Edward G. Cheyney, Frank H. Kaufert; Associate Professors Randolph M. Brown, Ralph Hossfeld, Louis W. Rees, Thorwald Schantz-Hansen; Instructor John A. Zivnuska.

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 forest experiment station at Cloquet and the fishery and biological experiment 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 lumber merchandising and construction.

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.]

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. Mr. Rees.
- 111f,w,s-112w,s. Advanced Forest Mensuration. Continuation of Course 9 with special emphasis on the application of alinement charts and statistical methods in forest mensuration. Prereq.: Course 9 or permission of instructor. 3 cred. per quarter. Mr. 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. Mr. 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. Mr. Rees.
- 115w-116s. Mechanical and Physical Properties of Wood. Laboratory methods in timber testing. Use of timber-connectors in heavy construction. Lab., reading, and reports. Prereq.: Course 114. 3 cred. per quarter. Mr. Rees.
- 119s. Advanced Wood Structure. The microtechnique of woody tissues. Lect., reading, and lab. work. Prereq.: Course 53-54. 4 cred. Mr. Kaufert.
- 120s. Estimating. A general course in building cost estimating. 3 cred. Ar.

- 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. Mr. 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. Mr. Cheyney.
- 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. Mr. Cheyney.
- 128s. Silvicultural Laboratory. Nursery practice and field planting. Preparation of a silvicultural plan for a small tract of timber and the application of that plan. Given at the Cloquet Forest Experiment Station. 6 cred. Mr. Cheyney.
- 130f. Forest Valuation. The business of forest management. A study of the different factors entering into the valuation of forest property. 5 cred. Mr. 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. Mr. Allison.
- 132s. Forest Regulation Laboratory. Field work. Collection of data necessary for a forest management plan. Includes timber estimating, growth studies, and map making. Given at the Cloquet Forest Experiment Station. 6 cred. Mr. 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. Mr. Allison.
- 137w. Seeding and Planting. Principles of seeding and planting and the nursery practices used in the different forest regions of the United States. Prereq.: Course 3-4. 3 cred. Mr. Cheyney.
- 140f. Forest Management. Methods of regulating and allotting the cut from a forest under management. Lect. and reports. Prereq.: Courses 128, 132. 5 cred. Mr. Allison.
- 141w. Principles of Silvics. Principles underlying the silvical characteristics of trees and the reactions of trees to their environments. Prereq.: Course 126. 3 cred. Mr. Cheyney.
- 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, Org.Chem. 55. 3 cred. Mr. 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. Mr. Cheyney.
- 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 or 115. 3 cred. Ar.
- 145su. Conservation of Natural Resources. A general course surveying our natural resources, past treatment, and changes in the public attitude toward their use. Designed principally as an informational course for those who will teach conservation in junior high school. Suitable exercises for junior high school students will be demonstrated and carried out. Prereq.: one year of biological science. 1 cred. Mr. Schantz-Hansen.
- 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. Mr. Zivnuska.

- 152s. Wood Seasoning. Theory and practice of air seasoning and kiln drying of wood. Prereq.: Course 53-54. 3 cred. Mr. Rees.
- 155f. Forest Protection. Fire prevention and fire suppression. The causes of forest fires and their elimination, climate and fires, fire fighting and fire legislation. 3 cred. Mr. Zivnuska.
- 156-157. Major Report. Open only to master of forestry candidates. 2 cred. per quarter. Staff.
- 158-159. Forestry Seminar. Open only to master of forestry candidates. 1 cred. per quarter. Staff.
- 200f-201w-202s. Research Problems in the Science and Practice of Silviculture. Cred. ar. Mr. Cheyney.
- 203f-204w. Research Problems in Forest Management and Forest Management Plans. Cred. ar. Mr. Allison.
- 205f-206w. Research Problems in Forest Economics. Cred. ar. Mr. Allison.
- 207f-208w-209s. Research Problems in Wood Technology. Cred. ar. Mr. Kaufert, Mr. Rees, Mr. Hossfeld.
- 213f-214w-215s. Special Problems in Forest Utilization. Cred. ar. Mr. Kaufert, Mr. Rees, Mr. Hossfeld.
- 218f-219w. Research Problems in Forest Mensuration. Cred. ar. Mr. 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. Mr. Schmitz, Mr. Kaufert.

GEOGRAPHY

Professors Darrell H. Davis, Ralph H. Brown, Samuel N. Dicken; Assistant 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.: 8 cred. or permission of instructor. 3 cred. Mr. Dicken.
- 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. Mr. Dicken.
- 103w. Geography of Africa. A study of the geographic regions and economic activities of the continent of Africa. Prereq.: 8 cred. in geography or permission of instructor. 3 cred. Mr. Brown.
- 104s. Geography of Australasia. A consideration of the physical environment and economic activities of Australasia. Prereq.: 8 cred. in geography or permission of instructor. 2 cred. Mr. 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.: 8 cred. in geography or permission of instructor. 3 cred. Mr. Brown.

- 120s. Geography of Asia. Areal differentiation in the major geographic regions of Asia. Special consideration of China, Japan, and India. Prereq.: 10 cred. or permission of instructor. 3 cred. Mr. Davis.
- 125w. Geography of the Polar Areas. Prereq.: 8 cred. 3 cred. Mr. Weaver.
- 251f-252w-253s. Seminar in Geography. A survey of current literature, with reports and discussion on assigned topics. Prereq.: 20 cred. in geography or permission of instructor. Cred. ar. Mr. Davis and staff.
- 301f,w,s. Research Problems in Geography. Cred. ar. Mr. Davis and staff.

GEOLOGY AND MINERALOGY

Professors George A. Thiel, Frank F. Grout, John W. Gruner, George M. Schwartz; Associate Professor Robert P. Sharp; Assistant Professors W. Charles Bell, Frederick M. Swain.

Prerequisites—For major work in geology: Elementary courses in geology, such as Course 1-2 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, Invertebrate Paleontology (Course 91-92-93), and elementary zoology, such as Zool. 1-2-3 or its equivalent, are required. Students who have not had the necessary 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.

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. Mr. Gruner, Mr. Thiel.
- 101f-102w.* Sedimentation. The origin of sedimentary rocks and their primary structures; interpretation of sediments in relation to paleogeography. Lect., lab. work, and assigned readings. Prereq.: Course 23-24. 3 cred. per quarter. Mr. Thiel.
- 103w-104s. Micropaleontology. The study and classification of Foraminifera, diatoms, and other small fossil organisms and their use for purposes of correlation in oil fields. Prereq.: Courses 51 or 91-92-93, and 105. 3 cred. of lab. work per quarter. Mr. 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. Mr. Grout.

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

- 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. Mr. Grout.
- 107f-108w-109s. Stratigraphic Paleontology. The collection, preparation, and study of materials, with a view to gaining a working knowledge of groups of fossils, and the use of literature. Prereq.: Course 91-92-93. 3 cred. per quarter. Mr. Bell.
- 110f-111w. Economic Geology. The nature, genesis, and distribution of mineral deposits; relation of mineral deposits to structure and their surficial alteration. Prereq.: Courses 2 and 105. 3 cred. per quarter. Mr. Schwartz.
- 112s. Geology of Petroleum. The nature, origin, and distribution of petroleum and the geology of the various oil fields of the world. Prereq.: Course 125. 3 cred. Mr. 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. Mr. 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, glaciers, waves and currents, vulcanism, and diastrophism. Prereq.: Course 2. 3 cred. Mr. Sharp.
- 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.: Course 2. 3 cred. Mr. Sharp.
- 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. Mr. Sharp.
- 121f. Crystallography. The symmetry relations in the thirty-two crystal classes. Crystal drawings and measurements. Projections and mathematical calculations. Prereq.: Math. 7 and Inorg.Chem. 6-7 or 9-10. 3 cred. Mr. Gruner.
- 124w.* Metamorphic Geology. Conditions, processes, and results of weathering and metamorphism. Prereq.: Course 105. 3 cred. Mr. Schwartz.
- 125f.* Structural Geology. Study of the principles and applications of geologic structures. Prereq.: Course 105. 3 cred. Mr. Sharp.
- 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. Mr. Grout.
- 137f. Testing Economic Minerals. Laboratory tests of clay, oil, building stone, metallic ores, and other mineral resources. Prereq.: Courses 2 and 105. 3 cred. Mr. 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. Mr. Grout.
- 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. Mr. Sharp.
- 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. Mr. Sharp.
- 146f,w-147w,s. Soil Mineralogy. Prereq.: one year of college chemistry. 4 cred. per quarter. Mr. Gruner.

- 150su.*§ Field Geology. Detailed, systematic work, conforming to official surveys. For prerequisites see members of the department. Cred. ar. Mr. Gruner, Mr. Schwartz. June 15 to July 15, approximately.
- 151f-152w-153s.* Stratigraphy. Principles of stratigraphic interpretation and correlation, illustrated by regional stratigraphic studies. Prereq.: Course 2. 3 cred. per quarter. Mr. Bell.
- 161w. Crystal Structures of Minerals. Use of X-rays for identification and classification of minerals. Isomorphism and polymorphism. Application to mineral synthesis and mineral deposits. Prereq.: Course 121, elementary physics, and trigonometry. 3 cred. Mr. 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. Mr. Schwartz.
- 170f,*w,*s.* Geologic Problems. Prereq.: permission of major adviser. 3 cred. Staff.
- 211f-212w-213s.* Advanced Paleontology. Selected groups of fossils. Field work supplemented by reference reading and thesis. Prereq.: Course 93. 3 cred. per quarter. Mr. Bell, Mr. Swain.
- 214.* Seminar in Ore Deposits. Prereq.: Course 111. 3 cred. Mr. Grout, Mr. Schwartz.
- 215.* Advanced Principles of Ore Deposits. Prereq.: Course 111. 3 cred. Mr. Schwartz.
- 216s.* Geology of the Ore Deposits of the Western Hemisphere. Prereq.: Course 111. 3 cred. Mr. 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. Mr. Grout, Mr. Gruner, Mr. Schwartz, Mr. Thiel.
- 245-246.* Research Course in Sedimentation. Methods of Course 101-102 applied to sedimentary petrography. Prereq.: Course 102. 3 cred. per quarter. Mr. Thiel.
- 251-252.* Original Mineralogical Problems. Morphology and physical measurements of minerals. Prereq.: Course 24. 3 cred. per quarter. Mr. 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. Mr. Grout, Mr. Gruner, Mr. Schwartz.
- 263-264.* Research Course in Petrology. Methods of Course 243-244 applied to petrology. 3 cred. per quarter. Mr. Grout.

GERMAN

Professor Oscar C. Burkhard; Associate Professor Alan Holske; Assistant Professors Lynwood G. Downs, Fred Genschmer, 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.

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

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. Course 110-111-112 is required of all candidates. To complete the minimum requirement, one of the following sequences is suggested: (a) 113-114-115; (b) 113-125-126.

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 68 or 70 and 11 cred. above Course 59 or equiv. 3 cred. per quarter. Mr. Genschmer. (Not offered in 1946-47.)
- 143bf-144bw-145bs.* The Classical Period. Prereq.: Course 68 and 11 cred. above Course 59 or equiv. 3 cred. Mr. Holske.
- a. Lessing, Wieland, Herder.
 - b. Goethe.
 - c. Schiller.
 - d. Goethe and His Literary Relations to France, England, and the United States.
- 150af-151aw-152as.* Studies in German Literature of the Nineteenth Century. Prereq.: Course 68 and 11 cred. above 59 or equiv. 3 cred. Mr. Burkhard.
- a. Die Novelle.
 - b. Austrian Drama.
- 153f-154w-155s.* The Modern Drama. From Hauptmann to the present. Prereq.: Course 68 and 11 cred. above 59 or equiv. 3 cred. per quarter. (Not offered in 1946-47.)
- 156f-157w-158s.* History of the German Drama. Prereq.: Course 68 and 11 cred. above 59 or equiv. 3 cred. per quarter. Mr. Burkhard.
- 160f-161w-162s.* Lyric Poetry. Prereq.: Course 68 or equiv. and 11 cred. above 59. 3 cred. Ar.
- 160f. From the Renaissance through *Sturm und Drang*.
 - 161w. From Goethe through Romanticism.
 - 162s. From Heine to Rilke. (Not offered in 1946-47.)
- 163f-164w-165s.* The German Novel. Prereq.: Course 68 and 11 cred. above 59 or equiv. 3 cred. per quarter. Mr. Pfeiffer.
- a. The Development of the Novel.
 - b. The Nineteenth Century Novel.
 - c. The Modern Novel. (Not offered in 1946-47.)

- 173f-174w-175s.* German and English Literary Relations in the Seventeenth, Eighteenth, and Nineteenth Centuries. Prereq.: Course 68 and 11 cred. above Course 59 or equiv. 3 cred. per quarter. Mr. Pfeiffer. (Not offered in 1946-47.)
- 253f-254w-255s.* Seminar: Literary Problems. Prereq.: Course 68 and 9 cred. in literature. 3 cred. per quarter.
- German Baroque Literature: from the Renaissance to the Age of Reason. Mr. Downs.
 - Goethe and the Middle-class Tradition. Mr. Holske.
 - Romanticism. Mr. Pfeiffer.
 - Nineteenth Century Drama: Kleist, Grillparzer, and Hebbel. Mr. Burkhardt.
 - The Problem of Tragedy in Modern Drama. (Not offered in 1946-47.)

II. GERMANIC LINGUISTICS AND PHILOLOGY

- 110f-111w-112s.*† Middle High German. Linguistic introduction and readings in Middle High German literature. Prereq.: Course 68 and 11 cred. above Course 59 or equiv. 3 cred. per quarter Mr. Reichardt. (Not offered in 1946-47.)
- 113f-114w-115s. Gothic and Old High German. Prereq.: Course 68 and 11 cred. above Course 59 or equiv. (Same as Scandinavian 113-114-115.)
- Gothic. The course is designed as an introduction to Germanic linguistics and to a comparative study of Indo-European languages. 4 cred. Mr. Reichardt.
 - Gothic Texts. 2 cred. Mr. Reichardt.
 - Old High German. 3 cred. Mr. Downs.
- 125s. History of the German Language. Prereq.: Course 68 and 11 cred. above Course 59 or equiv. 3 cred. Mr. Downs. (Not offered in 1946-47.)
- 126s. Historical German Grammar. Prereq.: 110-111-112. or 113-114-115. 3 cred. Mr. Downs. (Not offered in 1946-47.)
- 176f-177w-178s. Problems and Research Trends in Germanic Philology. Prereq.: two Germanic dialects.
- The Germanic Languages. 3 cred. Mr. Reichardt.
 - The Germanic Literary Tradition. A comparative discussion of the native and foreign records of the Old Germanic Period. Mr. Reichardt.
 - Linguistic Geography. 3 cred. Mr. Downs. (Not offered 1946-47.)
- 180w. Old Norse Literature. (The same as Scandinavian 180.) 4 cred. Mr. Reichardt.
- 182s. Germanic Mythology. (The same as Scandinavian 182.) 3 cred. Mr. Reichardt. (Not offered in 1946-47.)
- 183s. Germanic Heroic Poetry. (The same as Scandinavian 183.) 3 cred. Mr. Reichardt. (Not offered in 1946-47.)
- 194s. Old Saxon. *The Heliand*. 3 cred. Mr. Downs. (Not offered in 1946-47.)
- 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. 4 cred. Mr. Reichardt. (Not offered in 1946-47.)
- 196s. Eddic Poetry. (The same as Scandinavian 196.) Philological interpretation of Old Norse poems. 3 cred. Mr. Reichardt. (Not offered in 1946-47.)
- 218bf-219bw-220bs.* Seminar: Germanic Languages and Literature. Prereq.: at least two Germanic dialects. 3 cred. per quarter. Mr. Reichardt.
- Problems in Middle High German Literature. (Not offered in 1946-47.)
 - Texts in Germanic Dialects: Runic inscriptions.
 - Old High German. Linguistic interpretations of texts.

GREEK

For courses and staff see Classics, pages 62-63.

HISTORY

Professors August C. Krey, Theodore C. Blegen, 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, Alice F. Tyler, John B. Wolf; Assistant Professors Rodney C. Loehr, Faith Thompson.

NOTE—For information on work in International Relations see page 19; for work on American Studies see page 16.

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 p. 6 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 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 11-15.

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

§ 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.

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. 1 cred. per quarter. Required of candidates for advanced degrees in history who do not present evidence of similar training elsewhere. (S IV; 339 Lib.) Mr. 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. 9 cred. Mr. Jones.
- 104f-105w-106s.† Medieval History. Student does the work of History 53-54-55 or History 53a-54a-55a. 9 cred. Mr. 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. 9 cred. Mr. Deutsch, Mr. Steefel, Mr. Willson.
- 110f-111w-112s.† English History. Student does the work of History 70-71-72 or History 73-74-75. 9 cred. Mr. Willson, Miss Thompson.
- 113f-114w-115s.† Canada and Canadian-American Relations. Student does the work of History 76-77-78. 9 cred. Mr. Burt.
- 116f-117w-118s.† American Economic History. Student does the work of History 83-84-85. 9 cred. Mr. Loehr.
- 119f-120w-121s.† European Economic History. Student does the work of History 80-81-82. 9 cred. Mr. Heaton.
- 122f-123w-124s.† West in American History. Student does the work of History 90-91-92. 9 cred. Mr. Osgood.

- 125f-126w-127s.† American Diplomatic History. Student does the work of History 93-94-95. 9 cred. Ar.
- 128f-129w-130s.† Minnesota and the Northwest. Student does the work of History 90a-91a-92a. 9 cred. Mr. Jordan.
- 131f-132w-133s.† The American Colonies. Student does the work of History 86-87-88. 9 cred. Mrs. Tyler.
- 135f-136w-137s.† Selected Readings in Ancient History. Cultural history of Egypt. (The same as Anthropology 135-136-137.) 9 cred. Mr. Jones, Mr. Cline.
- 143f-144w-145s. American Folk Lore (The same as English 143-144-145). 3 cred. per quarter. Mr. Jordan.
- 146f-147w-148s. Social and Intellectual History of the United States. 3 cred. per quarter. Mrs. 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 *Combined 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.

- 153f-154w-155s.† Selected Readings in Medieval and Renaissance History. 9 cred. Mr. Krey, Miss Thompson.
- 156f-157w-158s.† Selected Readings in Modern European History. 9 cred. Mr. Steefel, Mr. Deutsch, Mr. Willson, Mr. Wolf.
- 170f-171w-172s.† Selected Readings in English History. 9 cred. Mr. Willson, Miss Thompson.
- 176f-177w-178s.† Selected Readings in Canadian History. 9 cred. Mr. Burt.
- 180f-181w-182s.† Selected Readings in European Economic History. 9 cred. Mr. Heaton.
- 183f-184w-185s.† Selected Readings in American Economic History. 9 cred. Mr. Loehr.
- 190f-191w-192s.† Selected Readings in American History. 9 cred. Mr. Blegen, Mr. Stephenson, Mr. Osgood, Mrs. Tyler, Mr. Jordan.
- 204f-205w-206s.*† Seminar in Medieval History. 9 cred. Mr. Heaton, Mr. Krey.
- 208f-209w-210s.*† Seminar in American History. 9 cred. Mr. Blegen, Mr. Stephenson, Mr. Osgood, Mr. Jordan, Mr. Loehr.
- 221f-222w-223s.*† Seminar in Economic History. 9 cred. Mr. Heaton.
- 224f-225w-226s.*† Seminar in Modern European History. 9 cred. Mr. Steefel, Mr. Deutsch, Mr. Wolf.
- 230f-231w-232s.*† Seminar in Ancient History. 9 cred. Mr. Jones.

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 Professor Scammon before registering. Cred. ar.
- 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 al-

lowed unless specifically permitted in advance by the dean of the medical sciences. Cred. ar. Mr. Scammon.

HOME ECONOMICS

Professors Wylle B. McNeal, Alice Biester, Clara M. Brown, Harriet Goldstein, Jane Leichsenring, Isabel Noble, Ella J. Rose; Associate Professor Ethel L. Phelps.

Prerequisites—Students desiring to major in home economics must present undergraduate subject-matter 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.

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,s. 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. 4, Agr.Econ. 3 or parallel. 3 cred. Miss 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. 2. 3 cred. Miss 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 and principles of economics.) 3 cred. Ar.
- 116f,su. Family Clothing Problems. The buying of clothing. Governmental controls of clothing production: 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. Miss H. Goldstein, Miss 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. Miss H. Goldstein.
- 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 and 180 or parallel or permission of instructor. 3 cred. Miss H. Goldstein, Miss 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 4, or permission of instructor, and 22, 25 recommended. 3 cred. Miss H. Goldstein.
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. Experimental Cookery. An intensive study of problems in foods and food preparation with individual laboratory problems. Prereq.: Course 40 and organic chemistry. 3 cred. Miss Noble.
- 146s. Special Food Problems. Class problems in foods and food preparation. Prereq.: Course 142. 3 cred. Miss Noble.
150. 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 for new information. 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. 4, Physiol. 4. 3 cred. Miss Biester, Miss Leichsenring.
- 171w,s. Child Nutrition. Lectures, discussions, and field work dealing with the principles of child nutrition and with the formation of desired food habits. Prereq.: Course 170, H.E.Ed. 90. 3 cred. Miss Leichsenring.
- 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. 3 cred. Miss Biester.
- 176w. Advanced Nutrition. Selected quantitative methods applicable to investigations relating to digestion and metabolism. Prereq.: Course 35, Agr.Biochem. 2. 4 cred. Miss Biester.
- 177s. Digestion and Metabolism. An intensive study of problems relating to digestion and metabolism involving lectures, reading, and laboratory work. Prereq.: Course 35. 3 cred. Miss 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 35, 170 or parallel. Limited to 8. 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. Miss Leichsenring.
- 180f,w,s. 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. Miss H. Goldstein, Miss V. Goldstein.
- 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. Miss Studley. (Not offered in 1946-47.)

- 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, 170, Agr.Econ. 126 or parallel. 3 cred. Miss Studley.
195. Development of Home Economics. A discussion of the development of home economics with emphasis upon current problems. 2 cred. Miss McNeal. (Not given 1946-47.)
202. 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.: organic chemistry, advanced textiles. 2 cred. Miss Phelps.
204. 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, organic chemistry, advanced textiles. 2 cred. Miss Phelps.
208. Microanalysis of Textile Fibers. Laboratory applications of histological and microchemical methods in the study of textile materials. Prereq.: botany, zoology, organic chemistry, advanced textiles. 2 cred. Miss 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. Miss 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, organic chemistry. 3 cred. Miss 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 the instructor. 1 or 2 cred. Miss Noble.
- 270-271. Principles of Human Nutrition. An advanced course dealing with certain aspects of digestion, metabolism, excretion, and food requirements under various conditions. Prereq.: Course 170. 3 cred. per quarter. Miss Biester, Miss Leichsenring.
- 279f,w,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 the instructor. 1 cred. Miss Biester, Miss Leichsenring.
- 295-296.* 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. Miss Biester, Miss H. Goldstein, Miss Leichsenring, Miss Noble, Miss Phelps, Miss Rose, Miss 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. 1 cred. Miss McNeal, Miss H. Goldstein, Miss Rose, Miss Studley.

HOME ECONOMICS EDUCATION

Professors Wylle B. McNeal, Clara M. Brown, Ella J. Rose.

Prerequisites—For a major in Education or 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.

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. and permission of instructor. 3 cred. Miss Brown.
- 193Af,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. 3 cred. Miss Brown, Miss Rose.
- 193Bw. 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. Miss Brown.
- 194Af. 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. Ar.
- 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. Ar.
- 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.: permission of the instructor. 1 to 3 cred. Miss 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. 3 cred. Miss Rose.
- 292s.* Problems in Evaluation. Special emphasis upon individual problems. Prereq.: Course 192 and permission of instructor. 3 cred. Miss Brown.
- 293f,w,s.* Problems in Home Economics Education. Designed to meet the needs of advanced students for independent study. Prereq.: Course 294 recommended and permission of instructor. 1 to 9 cred. Miss Brown, Miss 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. Prerequisite: Course 192 or equiv. and permission of instructor. 3 to 6 cred. Miss Brown, Miss Rose.
- 295f,w,s.* Seminar in Home Economics Education. Discussion and reports on problems in the field of home economics education. 1 to 3 cred. Miss Brown, Miss Rose.

HORTICULTURE

Professors William H. Alderman, Wilfrid G. Brierley, Fred A. Krantz; Associate Professor Troy M. Currence, Arthur N. Wilcox; Assistant Professors Arthur E. Hutchins, 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 advisers and the Division of Horticulture Graduate Committee that graduate study in this field may be satisfactorily undertaken. In certain cases further foundation courses may be required without credit.

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

Language requirement—The graduate committee in horticulture may, in individual cases, waive the foreign language requirement under Plan B by petition, but under Plan A a reading knowledge of a foreign language will be required.

Major—With the approval of the advisers, courses in agricultural biochemistry, agronomy and plant genetics, botany, plant pathology, plant physiology, and soils 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

- 107s. 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. Mr. Brierley.
- 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. Mr. 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. Mr. Brierley. (Offered in 1946-47 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 and 9 cred. in botany or equiv. 3 cred. Mr. Brierley.
- 135f. Potatoes. Culture, handling, storage, seed maintenance, varieties, improvement, and physiology of the potato plant. Prereq.: Course 32, 9 cred. in botany. 3 cred. Mr. 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. Mr. Currence.
- 138w. Vegetable Crops I. Lectures and assigned reading on the relation of light, temperature, moisture, nutrients, and other factors to the growth and culture of vegetable crops. Prereq.: Course 32, 9 cred. in botany or equiv. 3 cred. Mr. Nylund.
- 139s. Vegetable Crops II. A continuation of Course 138w. Prereq.: Course 32, 9 cred. in botany or equiv. 3 cred. Mr. Nylund.
- 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. Mr. Longley. (Offered in 1946-47 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 consent of instructor. 3 cred. Mr. Longley, Mr. Phillips. (Offered in 1946-47 and alternate years.)
- 190f-191w-192s. Special Problems. Supervised reading or experimentation upon special horticultural problems. Written report required. 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. Mr. Alderman, Mr. 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. Mr. Alderman, Mr. Brierley, Mr. Krantz, Mr. 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. Mr. Currence.

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. Mr. Hayes, Mr. Krantz, Mr. Currence, Mr. Wilcox.
- 246w.* Genetics Seminar. Important contributions to genetic theory and practice. 2 cred. Mr. Hayes, Mr. Krantz, Mr. Currence, Mr. Wilcox, Mr. Winter.
- 249f,w,s,su.* Research in Horticultural Crop Breeding. Cred. ar. Mr. Krantz, Mr. Currence, Mr. Hutchins, Mr. Wilcox.

INTERNATIONAL RELATIONS AND AREA STUDY

For general statement see page 19.

JOURNALISM

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

Prerequisite—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. Additional credits to make up the 27 credits should include either courses in English, among them a sophomore English composition course, or 12 credits in either political science, economics, history, or sociology. Freshman composition will not satisfy the requirement in the English option.

For minor work, 12 credits, or their equivalent, in journalism. A candidate offering a graduate minor in journalism is advised that he may best satisfy this requirement by electing courses from among the following: 101, 103, 109-110, 111, 112, 114, 115, 130-131, 140-141, 150, 205, 210, and Summer Session offerings.

Language requirement—A reading knowledge of at least one foreign language for the Master's degree.

Fees—A typewriter fee of \$1 is charged each quarter to all students registered for one or more journalism courses other than Journalism 5.

Master's degree—Work for the Master's degree is offered under 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 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.* The Reporting of Public Affairs. Instruction and practice in reporting the civil and criminal courts; municipal, county, state, and federal offices and agencies, legislative and administrative; politics, and labor. News articles are written by student reporters who attend trials, hearings, and legislative sessions. Students are required to gain some expertness in judicial procedures and methods. Prereq.: Course 51-52 and 9 cred. in political science. 3 cred. Mr. Nafziger.
- 103s.* Literary Aspects of Journalism. Established authors are considered in this course. Among others, the following are included: Defoe, Addison and Steele, Franklin, Freneau, Bryant, Whitman, Dickens, Mark Twain, Bret Harte, Howells, Bierce, Crane, Kipling, Lafcadio Hearn, Dreiser, and Hemingway. Weekly sketches are written by students. The purpose of this writing assignment is to encourage creative work other than that required for informative articles of timely interest. Prereq.: permission of instructor. 3 cred. Mr. Ford.
- 109w-110s.* History of Journalism. The first term of this course deals with the early history of the press: the forerunners of the newspaper on the Continent and in England and the seventeenth- and eighteenth-century newspaper in England, journalism in the American colonies, in the Revolutionary period and during the early days of the Republic. The emphasis in the second term is on the major social influences that have shaped the pattern of the American press down to the present. The effects of the democratic movement, population growth, the advances of technology, mass production and distribution, and urbanization are analyzed. The contributions of significant publishers and editors are discussed. Prereq.: Course 15. 3 cred. per quarter. Mr. Ford.
- 111f.* International Communication and the Foreign Press. The channels of international communication and the network of international news-gathering agencies. The problems created by the nationalistic control of cables, wireless, and radio facilities and the struggle for supremacy of communication facilities in peacetime and in war. An examination is made of foreign news and the methods by which it is obtained, transmitted, and processed for American readers. Techniques, problems, and responsibilities of the foreign correspondent. The press in European, Far Eastern, and Latin-American countries. The factors affecting the content and flow of news from these countries. Prereq.: Course 41 or 51 and a history or political science course in international relations or permission of instructor. 3 cred. Mr. Nafziger.
- 112s.* Current Newspaper Problems. Important problems of the press that have arisen out of the economic and social nature of the press and that have their roots in the physical basis of the newspaper; ownership and management, chains and publisher organizations, advertising and circulation. The changing pattern of the press brought about by its adjustment to new social conditions is studied. Prereq.: Course 140-141. 3 cred. Mr. Casey, Mr. Gerald, Mr. Nafziger, Mr. Charnley, Mr. Emery.
- 113su.* The Press and Foreign Affairs. This course is similar in content to Journ. 111. Prereq.: permission of instructor. 3 cred. Mr. Nafziger.

- 114.* Influence of the Press. This course considers the influence that the contents of the newspaper, including advertisements, may exert on the tastes, morals, English style, standards of living, and attitudes on social questions of its readers. The principles that guide news, editorial and business staffs in their work. The course emphasizes innovations and reforms that may be effected in the policies and techniques of the press in order to raise the level of public thinking and behavior. Prereq.: Course 15 or 41. 3 cred. Mr. Ford. (Not offered in 1946-47.)
- 115s.* Communication Media Analysis. Methods developed in recent years by professional media analysts and government experts for the analysis of the content of newspapers, periodicals, radio broadcasts, and motion pictures. Reader and audience-interest survey techniques and polling procedures. Research in these problems. Prereq.: Course 41 or 51 or permission of instructor. A course in elementary statistics is recommended. 3 cred. Mr. Nafziger.
- 121su.* The Newspaper in a Dynamic Society. The political environment of the newspaper, past and present, and the economic climate in which it lives. Industrialization, urbanization, changes in the social structure and their effects on the newspaper. Patterns of newspaper ownership—private, co-operative, and subsidized—and their evaluation. The newspaper of the future. 3 cred. Mr. Gerald.
- 130f-131w.* Communication Agencies and Public Opinion. Theories of what constitutes public opinion and how popular attitudes are formed. A study of the agencies that are dominant in the creation of "opinion," with emphasis on the newspaper, periodical, radio, and motion picture. Propaganda activities—hidden, camouflaged, and open—of various pressure groups and other organizations or individuals seeking to control mass behavior by the use of symbolic stimuli. Techniques of propaganda and publicity in the political and economic field, national and international, in peacetime and wartime. The relationship of propaganda and censorship. Prereq.: 15 cred. in the social studies or psychology. 3 cred. per quarter. Mr. Casey.
- 133su.* Propaganda and Censorship in the Modern World. This course is similar in content to Course 130. 3 cred. Mr. Casey.
- 140f-141w.*† Interpretation of Contemporary Affairs. A study of important state, national, and world problems about which the journalist must be informed and concerning which he serves as an interpreter. The course aims to relate background studies in the social studies to current problems and journalistic practice. Editorials and interpretative articles are written after careful initial study of political, economic, or social problems. Structure of editorial articles, editorial direction, and leadership and the conduct of an editorial page. Prereq.: Course 51 and 20 cred. in the social studies. 3 cred. per quarter. Mr. Casey, Mr. Gerald, Mr. Nafziger, Mr. Emery.
- 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 or 3 cred. Mr. Casey, Mr. Emery.
- 205f,w,s.* Topics in International News Communication. A seminar dealing with special problems concerning the rise and development of news communications and the news-gathering agencies of the world. Prereq.: permission of the director of the school. 3 cred. Mr. Nafziger.
- 210f,w,s.* Research in Newspaper Problems. Individual research in either historical or contemporary phases of newspaper, magazine, or advertising fields. Prereq.: permission of the director of the school. 3 cred. Mr. Casey, Mr. Charnley, Mr. Gerald, Mr. Nafziger.

LATIN

For courses and staff see Classics—Latin, page 63.

LINGUISTICS AND COMPARATIVE PHILOLOGY

Professors Konstantin Reichardt, Marbury B. Ogle; Associate Professor Emmert M. Brackney, Walter B. Cline, Robert V. Cram, Raymond L. Grismer; Assistant Professors Harold B. Allen, Lynwood G. Downs; Instructor Joseph H. Greenberg.

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 is required of all candidates. The course in Sanskrit, Ling. 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 thoroly 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. Mr. Greenberg.
 Linguistics 106f,107w. Introduction to the Study of Language. Prereq.: any two courses numbered above 50 in foreign languages. 3 cred. per quarter. Mr. Ogle.
 Linguistics 108s. Cultural Aspects of Language. Prereq.: any two courses numbered above 50 in foreign languages. 3 cred. Mr. Ogle.

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. Mr. Reichardt. (Not offered in 1946-47.)

CLASSICS

- Classics 133s. Vulgar Latin. Development of Latin into Romance. Prereq.: consent of the instructor. 3 cred. Mr. Ogle.
 Classics 242w.* Historical Latin Grammar. 3 cred. Mr. Cram.

ENGLISH

- English 100f. Old English. Prereq.: 6 cred. above English 50. 4 cred. Mr. Allen.
 English 102w. Old English Poetry. Prereq.: English 100. 3 cred. Mr. Clark.
 English 103s. Beowulf. Prereq.: English 100. 3 cred. Mr. Clark.
 English 165w. The Historical Study of Modern English. Prereq.: 6 cred. above English 50. 3 cred. Mr. Allen.
 English 171f-172w-173s. The Development of Standard English. Prereq.: English 100. 3 cred. per quarter. Mr. Allen.
 English 174s. American English. Prereq.: 6 cred. above English 50. 3 cred. Mr. Allen.

FRENCH

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

GERMAN

- German 110f-111w-112s.†* Middle High German. Linguistic introduction and readings in Middle High German literature. 3 cred. per quarter. Mr. Reichardt. (Not offered in 1946-47.)
- German 113f. Gothic. Introduction to Germanic linguistics and to a comparative study of the Indo-European languages. (The same as Scandinavian 113). 4 cred. Mr. Reichardt.
- German 114w. Gothic Texts. (The same as Scandinavian 114.) Prereq.: German 113. 2 cred. Mr. Reichardt.
- German 115s. Old High German. Prereq.: German 113. 3 cred. Mr. Downs.
- German 125s. History of the German Language. 3 cred. Mr. Downs. (Not offered in 1946-47.)
- German 126s. Historical German Grammar. 3 cred. Mr. Downs. (Not offered in 1946-47.)
- German 176f. The Germanic Languages. Problems and research trends. 3 cred. Mr. Reichardt. (Not offered in 1946-47.)
- German 178s. The German Dialects. 3 cred. Mr. Downs. (Not offered in 1946-47.)
- German 194s. Old Saxon. 3 cred. Mr. Downs. (Not offered in 1946-47.)
- German 218bf-219bw-220bs. Texts in Germanic Dialects. (The same as Scandinavian 230.) Prereq.: at least two early Germanic dialects. 3 cred. per quarter. Mr. Reichardt.
- German 218c-219c-220c. Old High German. 3 cred. per quarter. Mr. Reichardt. (Not offered in 1946-47.)

SANSKRIT

- Linguistics 131w-132s. Introduction to Sanskrit. Phonology and morphology from comparative point of view. Prereq.: at last two Senior College courses in early Indo-European languages, preferably Greek, Gothic, or Latin. 2 cred. per quarter. Mr. Reichardt.

SCANDINAVIAN

- Scandinavian 185.* History of the Scandinavian Languages. 3 cred. Mr. Reichardt. (Not offered in 1946-47.)
- Scandinavian 195.* Introduction to Old Norse. (The same as German 195). 4 cred. Mr. Reichardt. (Not offered in 1946-47.)
- Scandinavian 196.* Eddic Poetry. Philological interpretation. 3 cred. Mr. Reichardt. (Not offered in 1946-47.)

SEMITIC

- Linguistics 121f-122w-123s. Introduction to Arabic Grammar and Reading. Prereq.: two courses above 50 in any foreign language. 3 cred. per quarter. Mr. Greenberg.

SPANISH

- Spanish 241f-242w-243s.* Old Spanish Philology. 2 cred. per quarter. Mr. Grismer. (Not offered in 1946-47.)

MATHEMATICS AND MECHANICS

Professors Raymond W. Brink, William H. Bussey, Robert H. Cameron, Henry C. T. Eggers, William L. Hart, Edward L. Hill, Willem J. Luyten, George C. Priester, Royal R. Shumway, Stefan E. Warschawski, Hugh B. Wilcox; Associate Professors Harry D. Doeringsfeld, Forrest E. Miller, Hugh L. Turriffin; Assistant Professors Neal R. Amundson, Elizabeth Carlson, Gladys E. C. Gibbens, Gerhard H. Kalisch, Fulton Koehler, William B. McEwen, John M. H. Olmsted.

Mr. Bussey is chairman and Mr. Koehler is secretary of the group. Students majoring in mathematics or mathematics and mechanics should consult one of these two or should confer with Mr. Brink, chairman of the Department of Mathematics of the College of Science, Literature, and the Arts (119 Folwell Hall), or Mr. Priester, chairman of the Department of Mathematics and Mechanics of the Institute of Technology (208 Engineering Building).

Prerequisites—For major work 10 credits in calculus and 14 other credits in non-Junior College courses. For minor work, those courses specified as prerequisite to the chosen specific graduate courses.

Language requirement—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, in the University's *Combined Class Schedule*, 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 page 21.

COURSES

- 102f-103w.*‡ Advanced Analytic Geometry. Prereq.: differential and integral calculus. 3 cred. per quarter. Mr. Bussey.
- 105f,s.‡ Intermediate Calculus. Prereq.: differential and integral calculus. 5 cred. Mr. Brink.
- 106f.‡ Differential Equations. Prereq.: differential and integral calculus. 3 cred. Mr. Olmsted.
- 107w-108s.‡ Advanced Calculus. Prereq.: Course 105. 3 cred. per quarter. Mr. Olmsted.
- 109.*‡ Theory of Numbers. Prereq.: differential and integral calculus. 3 cred. Mr. Bussey. (Not offered in 1946-47.)
- 118-119-120.‡ Vectors and Matrices. Prereq.: Course 51. 3 cred. per quarter. Mr. Hart. (Not offered in 1946-47.)
- 121f-122w-123s.‡ Mathematical Theory of Statistics. Prereq.: Course 51. 3 cred. per quarter. Mr. Hart.

* 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 usually given by the Department of Mathematics in the College of Science, Literature, and the Arts.

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

- 125.¶ Theory of Geometrical Constructions. Prereq.: Course 30. 3 cred. (Not offered in 1946-47.)
- 127f,w,s.§ Technical Mechanics. Prereq.: Course 26 (a more elementary course in technical mathematics) or consent of instructor. 5 cred. Mr. Wilcox.
- 128f,w,s.§ Strength of Materials. Prereq.: Course 26 (a more elementary course in technical mathematics). 5 cred. Mr. Miller.
- 129f,w,s.§ Fluid Mechanics. Prereq.: Course 26 (a more elementary course in technical mathematics). 4 cred. Mr. 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. 5 cred. Mr. Doeringsfeld.
- 131s.¶ Advanced Algebraic Theory. Prereq.: Course 62 or 105. 3 cred. Ar.
- 132f-133w-134s.§ Industrial Statistics. Statistics as applied to engineering problems and quality control. Prereq.: Course 25. 3 cred. per quarter. Mr. McEwen.
- 136f.¶ Solid Analytic Geometry. Prereq.: differential calculus. 3 cred. Mr. Olmsted, Miss Carlson.
- 137s.*¶ Advanced Theory of Equations. Prereq.: Courses 51 and 62. 3 cred. Miss Carlson, Miss Gibbens.
- 139.¶ Limits and Series. Prereq.: Course 51. 3 cred. Ar. (Not offered in 1946-47.)
- 140.*¶ Projective Geometry. Prereq.: differential and integral calculus or consent of instructor. 3 cred. Mr. Bussey, Miss Gibbens. (Not offered in 1946-47.)
- 141f,w,s.§ Materials Testing Laboratory. Prereq.: Course 128 or registration in 128. 1 cred. Mr. Miller.
- 143f,w,s.§ Hydraulics Laboratory. Prereq.: Course 129 or 130 or registration in 129 or 130. 1 cred. Mr. Doeringsfeld.
- 144f-145w-146s.*¶ Topics in Analysis. Prereq.: differential and integral calculus. 3 cred. per quarter. Mr. Cameron. (Not offered in 1946-47.)
- 149.¶ Introduction to Group Theory. Prereq.: Courses 51, 62. 3 cred. (Not offered in 1946-47.)
- 150f.§ Calculus III: Intermediate Calculus. Partial differentiation, multiple integrals, infinite series, and other advanced topics. Prereq.: Course 25. 3 cred. Mr. Koehler.
- 151f,w,s.§ Differential Equations. Prereq.: differential and integral calculus. 3 cred. Mr. Koehler.
- 152w-153s.§ Advanced Calculus with Applications. Prereq.: differential and integral calculus. 3 cred. per quarter. Mr. Koehler.
- 154f.*§ Vector Analysis. Prereq.: Course 26 (a course in technical mechanics). 3 cred. Mr. Turrittin.
- 155w,*§ Vector Analysis and Dyadics with Applications. Prereq.: Course 154. 3 cred. Mr. Turrittin.
- 156s.*§ Elements of Tensor Analysis. Prereq.: Course 154. 3 cred. Mr. Turrittin.
- 161f-162w-163s.*§ Advanced Technical Mechanics. Prereq.: Course 127 or consent of instructor. 3 cred. per quarter. Mr. Wilcox.
- 164f-165w-166s.*§ Operational Methods and Operational Calculus. Prereq.: Course 151 or consent of instructor. 3 cred. per quarter. Mr. 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 usually given by the Department of Mathematics in the College of Science, Literature, and the Arts.

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

- 167f-168w-169s.§ Mathematics of Modern Engineering. Prereq.: Course 26, 3 cred. per quarter. Mr. Amundson.
- 170f-171w-172s.¶ Introduction to Modern Algebra. Prereq.: differential and integral calculus. 3 cred. per quarter. Mr. Olmsted, Mr. Kalisch. (Not offered in 1946-47.)
- 173f-174w-175s.§ Elementary Partial Differential Equations with Applications. Prereq.: Courses 151, 153. 3 cred. per quarter. Mr. Turrittin.
- 180f.§ Advanced Strength of Materials. Prereq.: Course 128. 3 cred. Mr. Miller.
- 181f-182w-183s.*§ Applied Elasticity. Prereq.: Course 128. 3 cred. per quarter. Mr. Priester.
- 184f-185w-186s.*§ Advanced Testing Materials Laboratory. Prereq.: Course 141. 2 cred. per quarter. Mr. Priester.
- 190f-191w-192s.§ Problem Seminar. Prereq.: permission of the instructor. 3 cred. per quarter. Mr. Warschawski.
- 206f-207w-208s.*§ Theory of Functions of Real and Complex Variables. Prereq.: advanced calculus. 3 cred. per quarter. Mr. Brink, Mr. Cameron.
- 232f-233w-234s.§ Mechanics of Continuous Media. Prereq.: Courses 127, 151, and 153. 3 cred. per quarter. Mr. Wilcox.
- 241f-242w-243s.¶ Series and Integral Solutions of Differential Equations. Prereq.: Course 208. 3 cred. per quarter. Mr. Cameron.
- 245f-246w-247s.*¶ Advanced Theory of Functions. Prereq.: Course 206-207-208. 3 cred. per quarter. Mr. Cameron. (Not offered in 1946-47.)
- 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.
- 261f-262w-263s.§ Functions of a Complex Variable. Elliptic functions and integrals with applications. Prereq.: Course 153. 3 cred. per quarter. Mr. Warschawski. (Not offered in 1946-47.)
- 264f-265w-266s.§ Conformal Mapping. Prereq.: Course 261 or by permission of instructor. 3 cred. per quarter. Mr. Warschawski.
- 271f-272w-273s.*¶ Theory of Linear Differential and Integral Equations. Prereq.: Course 206 or registration in 206. 3 cred. per quarter. Mr. Brink. (Not offered in 1946-47.)
- 274f-275w-276s.§ Partial Differential and Integral Equations of Applied Mathematics. Prereq.: Courses 151, 153. 3 cred. per quarter. (Not offered in 1946-47.)
- 277f-278w-279s.§ Partial Differential Equations of the First Order with Applications to Mechanics. Prereq.: Courses 127, 151, 153. 3 cred. per quarter. Mr. Amundson.
- 281f-282w-283s.§ Potential Theory. Prereq.: Courses 151, 153. 3 cred. per quarter. Mr. Warschawski.
- 284f-285w-286s.§ Non-linear Mechanics. Prereq.: Courses 127, 151, 153. 3 cred. per quarter. (Not offered in 1946-47.)
- 290f-291w-292s.§ Theory of Plates and Shells. Prereq.: Courses 153, 294. 3 cred. per quarter. Mr. Amundson.
- 294f-295w-296s.§ Mathematical Theory of Elasticity. Prereq.: Courses 128, 153. 3 cred. per quarter. Mr. Amundson.
- 297f-298w.*§ Vibration Problems. Prereq.: Course 127. 3 cred. per quarter. Mr. Wilcox.

* 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 usually given by the Department of Mathematics in the College of Science, Literature, and the Arts.

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

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.
 111.¶ Elliptic Functions and Integrals.
 114.¶ The Mathematics of Small Vibrations.
 115.¶ Differential Geometry.
 126.¶ Calculus of Finite Differences.
 135.¶ Introduction to the Theory of Small Samples.
 138.¶ Higher Plane Curves.
 142.¶ Theory of Invariants.
 212.*¶ Point Set Topology.
 213.*¶ General Theory of Integration.
 221.¶ Calculus of Variations.
 251-252-253.*¶ Functions in Hilbert Space and Related Topics.

The following courses given in the Department of Physics and the Department of Astronomy may count for credit in this department: Physics 201-202-203, 204-205-206, 207-208-209, 210-211-212, Astronomy 101, 140.

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. Mr. Eggers.
 118f,w,s. Short Course in Curve Fitting. Prereq.: Dr. 3, M.&M. 25. 3 cred. Mr. Eggers.
 152f,w,s-153w-154s.§ Nomography. Prereq.: Dr. 52, M.&M. 25. 3 cred. per quarter. Mr. Eggers.
 157f-158w-159s.§ Graphical Mathematics. Prereq.: Dr. 3, M.&M. 26. 2 cred. per quarter. Mr. Eggers.

MECHANICAL ENGINEERING

Professors Frank B. Rowley, John R. DuPriest, Richard C. Jordan, Charles A. Koepke, Burton J. Robertson; Associate Professors Axel B. Algren, Fulton Holtby, James J. Ryan; Assistant Professors Everett Laitala, Millard H. LaJoy, Otis Larsen, Herald K. Palmer, Adolph Lee, Thomas E. Murphy.

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).

* 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 usually given by the Department of Mathematics in the College of Science, Literature, and the Arts.

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

Master's degree—M.S. degree offered under either 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.

INDUSTRIAL LABORATORIES

- 110.‡ Foundry Control Methods. X-ray analysis of castings. Laboratory practice in metals analysis, ferrous and non-ferrous melting operations and control. Problems and reports. Prereq.: Course 12, Chem. 16. 3 cred. Mr. Holtby.
- 111.‡ Advanced Foundry Practice. Prereq.: Course 110, Phys. 9, Chem. 16. 3 cred. Mr. Holtby.
- 112.‡ Plastics Processing. A lecture and laboratory course dealing with the materials, equipment, and manufacturing processes used in fabricating plastic products, plastic product and mold design. Prereq.: Course 17 or approved. 3 cred. Mr. Holtby.
- 113.‡ Advanced Machine Shop Practice. Selection, tooling, and set-up of machine tools. Estimating machinery time and preparation of operating instructions for complete units. Prereq.: Course 15. 3 cred. Mr. 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. Mr. Hughes.
115. Control of Manufacturing Standards. Set-up and operation of the standards laboratory for the 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. Mr. 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. Prereq.: Course 23. 3 cred. Mr. LaJoy.

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 and 24. 2 cred. Mr. 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. Mr. 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. Mr. 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. Mr. Ryan.

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

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. Mr. 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. Mr. 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. Mr. 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. Mr. Ryan.
- 221-222-223.* Advanced Mechanical Engineering Design. Application of analysis by advanced strength of materials, statics, dynamics, and mathematics to special problems in design. Studies in elastic foundations, statically indeterminate structures, stresses in rotating machinery, welded machine structures, application of theories of failure and materials testing, advanced studies on special problems. Prereq.: Course 121. 3 cred. Mr. Ryan.
- 228.* Photoelasticity. Advanced studies in stress analysis by photoelasticity. Methods of determining principal stresses from measurements. Studies of stress patterns. Investigation of material constants and behavior. Frozen stresses. Solution of individual problems. Prereq.: Course 128. 3 cred. Mr. 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. Mr. Ryan.

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. Mr. Rowley.
196. Railway Technology. Systematic course of visits to the various railroad shops in the vicinity to study locomotive details and classification. Locomotive practice. Prereq.: Course 141 and M.&M. 127, 128, 129. 2 cred. Ar.
- 290-291-292.* Mechanical Engineering Research. Investigations in connection with lubrication, fuels, furnaces, boilers, steam engines, turbines, gas engines, heating and ventilation, industrial, and other engineering problems. Prereq.: permission of the division chief in charge of work. Cred. ar. Staff.
293. Graduate Seminar. Colloquium 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.

HEAT POWER

- 131-132. Thermodynamics. Critical study of the properties of gases and vapors and the fundamental laws for conversion of heat energy into mechanical energy in steam engines, gas engines, air compressors, refrigeration machines, steam turbines, etc. Prereq. M.&M. 25 and Physics 8. 3 cred. per quarter. Mr. DuPriest.
138. General Laboratory. (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. Mr. Lee.
142. Advanced Heat Power Engineering. Practice and economics relating to steam generators, prime movers, and plant auxiliaries. Specialized power plant cycles. Plant controls. Trends in power development. Prereq.: Course 141. 3 cred. Mr. Lee.
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. Ar.
145. Applied Thermodynamics. Laws of heat transmission, as applied to steam, air, and gas power units and auxiliary equipment including cooling towers, accumulators, stills, evaporators, intercoolers, preheaters, etc., flow of fluids through pipes, tube banks, nozzles, slots, labyrinths, etc. Prereq.: Courses 35, 132. 3 cred. Ar.
146. Fuels and Combustion. Fuels classification and analyses. Hand and stoker treatment; regulation; pulverized and liquid fuels. Types of burners, controls. Combustion; generation of heat; furnace gases; stratification; flame way; smoke prevention. Furnaces. Lect. and recitations. Prereq.: Course 142. 3 cred. Ar.
147. Design of Steam Machinery. Piping systems, furnace and gas passage dimensions, stokers, oil, gas, and pulverized fuel burners, superheaters, feed water heaters and pumps, air preheaters, automatic control, chimneys, etc. Prereq.: Course 142 or registration in 142. 2 cred. Mr. Lee.
148. Design of Power Plant Units. Treatment of condensers, air pumps, cooling towers, stage evaporators, reheaters, etc. Prereq.: Course 147. 2 cred. Mr. Lee.
149. Advanced Steam Laboratory. Tests of steam turbines, uniflow and compound steam engines, condensers, evaporators, and vacuum pumps. Tests of compound steam pump. Air compressor, boiler, superheater, and power plant. Studies of fluid flow meters and air-conditioning apparatus. Prereq.: Courses 132 and 35, 142 or registration in 142. 2 cred. Mr. Lee.
241. Advanced Thermodynamics. Reversible changes of state and efflux of wet and superheated vapors. Flow of compressible fluids in mains, moving channels, into receivers, and communicating vessels. Gas mixtures, critical points, liquefaction. Power plant cycles; regenerative, reheating, and bleeding. Prereq.: Course 145. 3 cred. Ar.
- 242-243.* Power Plant Design. Problems, designs, and estimates for power plants and central stations. Selection of motive powers, relative advantages of steam, producers, and gas plants. Choice of engines and boilers; pumps, piping, and accessories. Prereq.: Course 148. 2 cred. per quarter. Ar.

- 244.* Power Plant Management. Operation and maintenance of boilers, engines, steam turbines, and accessory apparatus. Smoke prevention, lubricants and lubrication. Power plant finance. Daily logs and power costs. Study of recent power researches. Prereq.: Course 141. 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. Mr. Robertson.
- 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. Mr. Robertson.
151. Advanced Internal Combustion Engines. Special reference to automobile, truck, and airplane engines. Theoretical consideration of fuels, combustion, detonation, lubrication, supercharging, carburetion, and fuel injection. Recent developments in automotive and airplane engines. Prereq.: Course 150. 3 cred. Mr. Robertson.
- 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. Mr. Robertson.
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. Mr. 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. Mr. Robertson.
154. 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. Mr. Murphy.
155. High Speed Engine Testing. Advanced laboratory procedure and instrumentation. Effect of fuel mixture, distribution, etc., upon general engine performance. Prereq.: Courses 158 or 159 and minimum honor point average of 1.5. 2 cred. Mr. Murphy.
156. Design of Internal Combustion Engines. Detailed study of design of automotive and stationary engines. Problems, including calculation of cylinders, bearing loads, stresses in moving parts, and valve mechanisms. Prereq.: Courses 121, 150. 2 cred. Mr. 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. Mr. Robertson.
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. Mr. Robertson.

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. Mr. Robertson.
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. Mr. Murphy.
- 251-252-253. Automotive Vehicles. Study of transmission systems, running gears, chassis, bodies, riding qualities of vehicles, and current developments. Lect. and problems. Cred. ar. Mr. Robertson.
- 254.* Automobile Fleet Maintenance. Study of available types of motor coaches and trucks, their design features from a maintenance view-point, a survey of service depot requirements with a study of fleet service methods and maintenance practice. Prereq.: Course 150. 3 cred. Mr. Robertson.
- 255-256-257.* Engine Testing and Research. Problems involving volumetric efficiency, manifoldng, friction losses, oil deterioration, cylinder corrosion, and other engine performance factors of current interest. Cred. ar. Mr. Robertson.
- 258.* Motor Truck and Bus Transportation. Problems involving motor truck transportation, capacity of trucks, trailers, drawbar pull. Efficiencies. Effect of road surface. Freight handling. Analysis of costs of truck operation and maintenance. Relative costs of transportation. Prereq.: Course 153. 3 cred. Mr. Robertson.

INDUSTRIAL ENGINEERING

170. Tool Design. The design of jigs and fixtures for manufacture of interchangeable parts products. Prereq.: Courses 72, 171. 2 cred. Mr. Crowder.
171. Elements of Industrial Engineering and Management. Basic functions in an industrial organization and their inter-relationship. 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. Mr. Koepke.
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. Mr. Koepke, Mr. Laitala.
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. Mr. Koepke.
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. Mr. Laitala.
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. Mr. Laitala.
176. Quality Control. Organization and operation of quality control department. Economics of inspection, selection of personnel, collecting, reporting, sorting, and analyz-

- ing of inspection results. Application of statistical methods and sampling theory to inspection. Prereq.: Course 171; 115 recommended but not required. 3 cred. Mr. Koepke, Mr. Laitala.
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. Mr. Laitala.
- 270.* Industrial Engineering Research. Course designed to apply engineering approach to research in management techniques and controls comparable to that applied to product research. Need for such function in organization structure. Contributions of research to control and guidance of enterprise. Prereq.: Courses 173, 175, 179. 3 cred. Mr. Koepke, Mr. Laitala.
- 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. Mr. Koepke, Mr. Laitala.

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.: Courses 131, M.&M. 127, 129. 3 cred. Mr. 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. Mr. 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. Mr. 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. Mr. Algren.
- 265,266,267.* Advanced Heating, Ventilation, and Air Conditioning. Advanced study dealing with problems involving the design, selection, and performance of heating, ventilating, and air conditioning equipment. Taken in connection with special reading assignments. Prereq.: Course 160. Cred. ar. Mr. Algren.

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. Mr. 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. Mr. 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. Mr. 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. Mr. Jordan.
- 280-281-282.* Advanced Refrigeration. Advanced study dealing with problems involving the design, selection, and performance of refrigeration equipment. Lect., assigned reading, and reports. Prereq.: Course 180. Cred. ar. Mr. Jordan.

MEDICAL SOCIAL WORK

For statement of prerequisites and of graduate courses and staff, see *Sociology and Social Work*, page 163.

MEDICINE

(Including Divisions of Internal Medicine, Dermatology and Syphilology)

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

- 150f. Metallography for Electrical Engineers. Principles of metallography, including pyrometry, thermal analysis, constitution diagrams, microscopic and photomicrographic technique; study of typical alloys with special reference to electrical resistance, conductivity, magnets, etc. Laboratory work and demonstrations. Two lect., three lab. hours per week. 3 cred. Mr. Mackay.
- 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. Mr. Dowdell, Mr. Mackay.

- 153f-154w-155s. Metallography. (Long course for metallurgical engineers.) Theory of metallic alloys. Metallographic technique. 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. Mr. 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. Mr. 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. Mr. 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. Mr. Jerabek.
- 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. 3 or 4 cred. depending on lab. Mr. 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. Mr. Jerabek.
- 163f. Advanced Metallography Seminar. Work on recent advances in metallography. Lect. and recitations, with outside reading and special reports. May be accompanied by laboratory work. Prereq.: 6 cred. in metallography. 3 cred. Mr. Dowdell.
- 164w. Advanced Metallography. Advanced consideration of the structures, properties, and uses of metals and alloys. May be accompanied by lab. work. Prereq.: 6 cred. in metallography. 3 cred. Mr. Dowdell.
- 165s. Advanced Metallography. Technical metallography as applied to industry. Lect. and special reports. May be accompanied by lab. work. Prereq.: 6 cred. in metallography. 3 cred. Mr. Dowdell.
- 170f-171w-172s. Special Problems in Metallography. Seminar work in metallographic problems. Cred. ar. Mr. Dowdell, Mr. Jerabek.
- 201f-202w-203s. Advanced Metallography. Intended primarily for research work. Cred. ar. Mr. Dowdell, Mr. Jerabek, Mr. Mackay.
- 204f-205w-206s. Metallographic Research. Special research problems in metallography. Cred. ar. Mr. Dowdell, Mr. Jerabek, Mr. Mackay.
- 210f-211w-212s. Thesis Courses. Intended primarily for research work. Cred. and hours ar. Mr. Dowdell, Mr. Jerabek, Mr. Mackay.

METALLURGY

Professors Thomas L. Joseph, Strathmore R. B. Cooke, Edward W. Davis; Assistant Professor Allen E. Martin.

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. Mr. Martin.
- 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. Mr. Martin.
- 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. Mr. Martin.
- 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. Mr. Cooke.
- 111w. Mineral Dressing. Principles of ore beneficiation by gravity methods. 2 lect. and 3 lab hours per week. Prereq.: Course 110. 3 cred. Mr. 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. Mr. Cooke.
- 121f. Ore Testing (Iron Ores). Methods of beneficiation, principles, methods and machines, concentration, formulae, metallurgical and economic considerations. 1 lect. and 3 lab. hours per week. Prereq.: Course 110. 2 cred. Mr. 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. Mr. 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. Mr. Cooke.
- 124f-125w-126s. Special Problems in Mineral Dressing. Detailed study of mineral dressing problems. Prereq.: Course 112. Cred. and hours ar. Mr. Cooke.
- 130f-131w-132s. Special Problems in Nonferrous Metallurgy. Seminar work on metallurgical problems. Prereq.: Course 108. Cred. and hours ar. Mr. Joseph, Mr. Martin.
- 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. Mr. 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. Mr. Joseph, Mr. 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. Mr. Joseph, Mr. 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. Mr. Martin.
- 140f. Advanced Ore Testing (Iron Ores). Metallurgical calculations and report writing. Prereq.: Course 121. 2 cred. Mr. Davis.

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

MINING AND PETROLEUM ENGINEERING

Professor Walter H. Parker; Associate Professor Louis S. Heilig; Instructor David W. Lacabanne.

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. Mr. Parker, Mr. Heilig.
- 112w. Exploration and Development. Explosives, blasting; timbering, timber treating; tunneling, drifting, and mine plant. Prereq.: Course 111. 4 cred. Mr. Parker, Mr. Heilig.
- 113s. Development and Exploitation. Shaft sinking, raising, stoping, mining methods; support of excavations. Prereq.: Course 112. 4 cred. Mr. Parker, Mr. Heilig.
138. The Stone Industries. Monumental and building stones, crushed stone, sand and gravel plants and operations. Prereq.: Course 112. 2 cred. Mr. Parker.
139. Practical Mining (Field Trip). Study of mining operations, mine plant, and mining in one or more mining camps. 6 cred. Mr. Parker.
- 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 112. 4 cred. Mr. Parker.
- 142w. Coal Mining. Coal mining methods, mechanization, tiple arrangements, and coal preparation. Mine gases. Compensation laws. Mining law and court interpretation. Prereq.: Course 113. 3 cred. Mr. 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. Mr. Parker.
146. Nonmetallic Minerals. Mining and preparation of industrial minerals, gypsum, refractories, ceramic materials, fillers, pigments. Prereq.: Course 112. 2 cred. Mr. Parker.
147. Earth Handling and Excavation. Excavation by shovels, draglines, dredges. Handling materials by railroad, trucks, conveyors, and sluices. Prereq.: Course 112. 2 cred. Mr. Parker.
- 151-152-153.* Special Problems in Mining. Seminar work on mining problems. Cred. ar. Mr. Parker, Mr. Heilig.
- 201-202-203.* Special Problems in Mining. Seminar work on mining problems. Cred. ar. Mr. 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. Mr. Parker, Mr. Heilig.
- 212-213-214.* Special Problems in Mining Economics. Intended primarily for research. Cred. ar. Mr. 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. 4 cred. Mr. 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. 4 cred. Mr. 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. 16, Phys. 7. 2 cred. Mr. 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. Mr. Lacabanne.
135. Field Work. Study of equipment and operations in one or more oil fields. Prereq.: Course 112. 6 cred. Mr. 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 107. 2 cred. Mr. 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. Mr. 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. Mr. Lacabanne.
- 155-156-157.* Special Problems in Petroleum Engineering. Seminar in petroleum problems. Prereq.: registration in Course 144-145. Cred. ar. Mr. Parker, Mr. Lacabanne.
- 201-202-203. Seminar Work on Petroleum Problems. Cred. ar. Mr. Parker, Mr. 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. Mr. Parker.
- 207-208-209.* Special problems in petroleum engineering, intended primarily for research. Cred. ar. Mr. Parker, Mr. 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 consent 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. Mr. 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. Mr. 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. Mr. 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. Mr. Oberg, Mr. 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 James S. McCartney, Jr., M.D., John F. Noble, M.D.; Assistant Professor Robert Hebbel, 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.

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 116 and 145.

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. Diagnosis of Tumors. Prereq.: Courses 101, 102. 2 to 5 cred. Dr. McCartney.

107f,w,s. Surgical Pathology. Prereq.: Courses 101, 102. 2 to 5 cred. Dr. Hebbel.

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

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

110f,w,s. Seminar in Pathology. Prereq.: Course 102. Dr. Bell.

111su,f,w,s. Conference on Autopsies. Prereq.: Course 102. Dr. 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., Charles O. Wilson, Jr., Ph.D.

Prerequisites—Graduate work 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 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 pharmaceutical chemistry.

COURSES

- 161f-162w-163s. Organic Medicinal Products. This course treats of the sources, methods of production, classification, properties, reactions, and uses of the natural and synthetic organic compounds used as therapeutic agents. Prereq.: Organ.Chem. 2. 3 cred. per quarter. Dr. 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. Mr. Wilson or Mr. Soine and assistants.
- 201f,w,s.* Pharmaceutical Chemistry Seminar. Required of all students majoring in pharmaceutical chemistry and pharmacognosy. 1 cred. per quarter. Dr. Gisvold.
- 202f-203w-204s.* Advanced Food, Drug, and Cosmetic Analysis. 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. Dr. Rogers, Dr. 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. Prereq.: Organ. Chem. 2 and Course 163 or permission of instructor. 3 to 6 cred. per quarter. Dr. Gisvold, Dr. Wilson.
- 208f. Carbohydrates and Glycosides. A consideration of the origin, isolation, characterization, and chemistry of the carbohydrates and glycosides. Prereq.: Course 163, or permission of the instructor. 3 to 5 cred. Dr. 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. Dr. Soine.
- 210f.* History of Pharmaceutical Chemistry. 3 cred. Dr. Netz.
- 211w.* Terpenes. 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. Dr. Wilson.
- 212s.* Sterols and Related Compounds. A consideration of the origin, isolation, characterization, and chemistry of the sterols and related compounds. Prereq.: Course 163, or permission of instructor. 3 to 5 cred. Dr. 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, oleo-resins, pigments, proteins, resins, vitamins, waxes, etc. Prereq.: Course 163, or permission of instructor. Cred. ar. Dr. Rogers, Dr. Gisvold, Dr. Hadley, Dr. Netz, Dr. Soine, Dr. Wilson.
- 214f,w,s,su. Research in Pharmaceutical Chemistry. Cred. ar. Dr. Rogers, Dr. Gisvold, Dr. Hadley, Dr. Netz, Dr. Soine, Dr. Wilson.

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. 6 cred. Dr. 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. Dr. Fischer.
- 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. Dr. 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. Dr. Fischer.
- 204f,w,s,su. Research in Pharmacognosy. Cred. ar. Dr. Fischer, Dr. Rogers.

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

- 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. Dr. Fischer, Dr. 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. Dr. Fischer, Dr. Rogers.

PHARMACOLOGY

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

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

- 101w.§ 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. Dr. Bieter, Dr. Wright.
- 102s.§ 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. 6 cred. Dr. Bieter, Dr. Wright.
- 103su,w. 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. 2 cred. Dr. Bieter, Dr. Wright.
- 104su,s. General Pharmacology, in continuation. Lectures on the salts of the metals, antiseptics, antisiphilitic drugs, chemotherapy, etc. 2 cred. Dr. Bieter, Dr. Wright.
- Courses 101, 102, 103, 104 are not acceptable for the minor in the case of graduates of medical colleges who are candidates for the degree of master of science.
- 108su,f. Prescription Writing. The principles of prescription writing. Fifth year. 1 cred. Dr. 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. Hours and cred. ar. Dr. Bieter, Dr. Wright.
- 110f,w,s. Poisons. Their detection, actions, and antidotes. 2 cred. Dr. Wright.
- 111f,w,su. Advanced Toxicology. Quantitative toxicological analysis. Hours and cred. ar. Dr. Wright.
- 123f,w,s,su. Special Topics in Pharmacology. Hours ar. 2 cred. Dr. Bieter, Dr. Wright.
- 201f,w,s. Seminar in Physiology and Pharmacology. Reviews of recent literature. 1 cred. Staff.

§ In the Summer Session, Courses 101 and 102 are combined and offered as 115su.

- 203su,f,w,s. Research in Pharmacology. Hours and cred. ar. Dr. Bieter, Dr. Wright.
 204f,w,s. Advanced Pharmacology. With collateral readings. Limited to six advanced students. Hours ar. 1 cred. Staff.
 205f,w. General Discussions in Pharmacology. With collateral readings. Hours and cred. ar. Dr. Bieter, Dr. Wright.

PHILOSOPHY

Professors George P. Conger, Theodore Brameld, Alburey Castell, Herbert Feigl; Associate Professor Mary Shaw; Assistant Professors Walter Cerf, Wilfrid Sellars.

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 250-251-252 (Seminar: Philosophy of the Cultural Sciences) before taking their preliminary examinations.

NOTE—Students interested in major work in American Studies will find a description of this work on page 16.

COURSES

- 101f-102w-103s. Principles of Philosophy. 101f, knowledge, meaning, and truth; 102w, reality, mind, and nature; 103s, human values and action. Open only to students who have not had Course 1 (Problems of Philosophy). 2 cred. per quarter. Mr. Sellars.
 106f-107w. Philosophy of Plato. Prereq.: 6 cred. including Course 50. 3 cred. per quarter. Mr. Sellars.
 110. Rationalism. Philosophies of Descartes, Spinoza, Leibniz. Prereq.: 2 courses from 50-51-52. 3 cred. (Offered biennially. Not offered in 1946-47.)
 111f. Empiricism. Prereq.: 2 courses from 50-51-52. 3 cred. Ar.
 112w. Kant. Prereq.: 2 courses from 50-51-52. 3 cred. Mr. Sellars.
 113s. Kierkegaard and Scandinavian Philosophy. Prereq.: 2 courses from 50-51-52 or permission of instructor. 3 cred. Mr. Holmer.
 114f. American Philosophy from Puritanism to Pragmatism. A study of Puritanism, the Revolutionary period, transcendentalism, evolutionism, idealism, and pragmatism. Prereq.: especially for students of American history and literature. 3 cred. Mr. 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.: 2 courses from 50-51-52. 3 cred. Mr. Cerf.
 116s. Philosophy of John Dewey. Prereq.: 2 courses from 50-51-52. 3 cred. Mr. Wiggins.
 123s. Comparative Philosophy. Prereq.: 2 courses from 50-51-52. 3 cred. Mr. Conger.
 135s. Philosophy in Modern Literature. A survey of the basic philosophical ideas in twentieth century civilization as they are expressed in major works of contemporary literature. Lectures on Spengler, Marx, Darwin, Freud, and others. Readings and discussions of Ibsen, Proust, Joyce, Tolstoy, Shaw, Huxley, Dostoevski, and others. Prereq.: permission of instructor. 3 cred. Mr. 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. Mr. 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. Mr. 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. Mr. Feigl.
- 155w. Metaphysics. Prereq.: 2 courses from 50-51-52. 5 cred. Mr. Conger.
- 164s. Ethical Theory. Prereq.: 2 courses from 50-51-52. 3 cred. Mr. Sellars.
165. Political and Social Ethics. Prereq.: 6 cred. 3 cred. (Not offered in 1946-47.)
- 170f. Philosophy of History. Prereq.: 6 cred. in philosophy or 10 cred. in history. 3 cred. Mr. Holmer.
- 180f. History of Religions. Prereq.: 6 cred. 3 cred. Mr. Conger.
- 181w. Psychology of Religion. Prereq.: 6 cred. 3 cred. Mr. Conger.
- 182s. Philosophy of Religion. Prereq.: 6 cred. 3 cred. Mr. Conger.
- 191f-192w-193s. Seminar in Philosophy. Individual investigation, with topics to be determined after consultation with the department. Prereq.: 9 cred. in philosophy and permission of instructor. 3 cred. per quarter. Mr. Conger, Mr. Feigl, Mr. Castell, and others.
- 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 1946-47.)
- 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. (Not offered in 1946-47.)
- 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. Mr. 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. Mr. Feigl.
- 350f-351w-352s. Research in History of Philosophy. Prereq.: permission of instructor. Cred. ar. Mr. Castell and others.
- 360f-361w-362s. Research in Philosophy of Science. Prereq.: permission of instructor. Cred. ar. Mr. Feigl and others.
- 370f-371w-372s. Research in Philosophy of Culture. Prereq.: permission of instructor. Cred. ar. Mr. Conger and others.

PHYSICS

Professors J. William Buchta, Edward L. Hill, Alfred O. C. Nier, John T. Tate, Joseph Valasek, John H. Williams; Associate Professor Clifford N. Wall.

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 consulting 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 in general under Plan A. By petition Plan B may be offered.

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

COURSES

- 101f-103w-105s. Theoretical Physics. An analytical survey of fundamental principles of mechanics, sound, heat, light, electricity, and magnetism designed to supplement the general courses and to prepare students for more specialized courses. Five lect. a week. Prereq.: 15 cred. in physics, Math. 106 or registration in Math. 106. 5 cred. per quarter. Mr. 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. Mr. Wall.
- 110w*-112s.*‡ Modern Experimental Physics. An experimental study of various topics in modern physics. Prereq.: Course 144. 3 cred. per quarter. Mr. Williams.
- 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. Mr. Buchta. (Not offered in 1946-47.)
- 114f*-116w*-118s.* Elementary Physical Investigation. The experimental or theoretical study of physical phenomena, the laws of which are not as yet completely understood. A written report on the work accomplished is required. Prereq.: registration by permission of department chairman. 3 cred. Staff.
- 131f. Geometrical Optics. Theory of mirrors, prisms, and lenses. Optical instruments. Prereq.: 15 cred. in physics, Math. 51. 3 cred. Mr. 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. Mr. Valasek.
- 134f,w.*‡ Experimental Optics. Special experimental work in spectrometry, optical instruments, photometry, absorption, polarized light. 2 three-hour lab. periods a week. Prereq.: 15 cred. in physics. 3 cred. Mr. 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. Mr. Valasek. (Not offered in 1946-47.)
- 136w,s.*‡ Spectrum Analysis. An experimental course 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. Mr. Valasek.
- 144s.‡ Electrical Measurements. Devoted mainly to the study of potentiometer methods, capacity, inductance, magnetic flux. Prereq.: 15 cred. in physics, Math. 51. 3 cred. Mr. Wall.

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

146w.*‡ Physics of Vacuum Tubes and Associated Circuits. Thermionics. Prereq.: Course 144, permission of instructor. 3 cred. Ar. (Not offered in 1946-47.)

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. Mr. Tate.

191f-192w-193s. Introduction to Mathematical Physics. Prereq.: Course 101-103-105, registration in Math. sequence 106-107-108 or equiv. 3 cred. per quarter. Mr. 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 in the following fields before admission to the preliminary examination:

1. Mechanics, Hydrodynamics, and Elasticity.
2. Kinetic Theory, Statistical Mechanics, and Thermodynamics.
3. Electromagnetic Theory and Optics.
4. Atomistics and Elementary Wave Mechanics.

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. Mr. Hill.

204f-205w-206s. Kinetic Theory, Statistical Mechanics, and 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. Mr. Hill.

207f-208w-209s. Electrodynamics and Theoretical Optics. General field equations, electron theory, and the special theory of relativity. Dielectric and magnetic properties of matter. Mathematical theory of the optical behavior of isotropic, anisotropic, and metallic media. 3 cred. per quarter. Mr. Valasek.

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. Mr. Hill.

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. Mr. Hill.

The following courses will be offered whenever there is sufficient demand for them:

The Partial Differential Equations of Mathematical Physics.

Advanced Topics in Electron Theory and the Special Theory of Relativity.

General Theory of Relativity.

Advanced Quantum Theory.

Advanced Hydrodynamics and Theory of Sound.

Advanced Thermodynamics and Statistical Mechanics with Applications to Chemical Physics.

Theory of Electrical Circuits.

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

PHYSIOLOGICAL CHEMISTRY

Professor Wallace D. Armstrong, M.D., Ph.D.; Associate Professors Cyrus P. Barnum, Ph.D., David Glick, Ph.D., Walter O. Lundberg, Ph.D., Karl Sollner, 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. Physical and organic chemistry are required of all students.

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

- 100w,s-101f,su. Physiological Chemistry. The components of the animal body; foods, digestion, excreta, and metabolism. Prereq.: physics, organic chemistry. 13 cred. Dr. Armstrong, Dr. Barnum, Dr. Glick, Dr. Holman.
- 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. Dr. Armstrong, Dr. Barnum, Dr. Glick, Dr. Lundberg, Dr. Sollner, Dr. Cohen, Dr. Frame.
- 154f,w,s. Conference in Physiological Chemistry. 1 cred. Dr. Armstrong, Dr. Barnum, Dr. Glick, Dr. Sollner, Dr. Cohen, Dr. 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. Dr. Armstrong.
- 182s. Colloids in Biology and Medicine. Prereq.: Physical Chem. 128. 3 cred. Dr. Sollner.
- 200s. Seminar in Physiological Chemistry. 1 cred. Staff.
- 205f,w,s,su. Research in Physiological Chemistry. Hours and cred. ar. Dr. Armstrong, Dr. Barnum, Dr. Glick, Dr. Lundberg, Dr. Sollner, Dr. Cohen, Dr. Frame.
- 206f,w,s. Advanced Physiological Chemistry. Prereq.: Course 100-101. 3 cred. Ar.

PHYSIOLOGICAL HYGIENE

Professor Ancel Keys, M.D., Ph.D.; Associate Professors Olaf Mickelsen, Ph.D., Ernst Simonson, M.D.; Assistant Professors Josef M. Brozek, Ph.D., Austin F. Henschel, 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 of Human Nutrition. Evaluation of nutritional status, surveys, under-nutrition and malnutrition, special dietetics in social relief and medical practice. Prereq.: 8 cred. in organic chemistry or biochemistry and Courses 91 and 92 or Physiol. 103 or equiv. and permission of instructor. 3 cred. Dr. Keys, Dr. Mickelsen.
- 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. and permission of instructor. 4 cred. Dr. Keys and staff.

- P.H.194f. Human Factors in Industry. Primarily for students in the Schools of Business Administration, and Public Health, and 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. Dr. Brozek, Dr. Simonson.
- P.H.202w. Nutrition in Public Health. Current developments in nutrition related to public health. Limited enrolment. 1 cred. Dr. Keys, Dr. Mickelsen. (To be offered in 1946-47 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. Dr. Simonson, Dr. Brozek, Dr. Henschel. (To be offered in 1946-47 and alternate years thereafter.)
- P.H.206w. Gerontology. Physiological and psychological problems of old age. Limited enrolment. 1 cred. Dr. Brozek, Dr. Taylor. (To be offered in 1947-48 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 1947-48 and alternate years thereafter.) Dr. Keys and staff.
- P.H.220f,w,s. Readings in Problems of Physiological Hygiene. Prereq.: permission of instructor. Cred. ar.
- A. Electrocardiographic Interpretation. Dr. Simonson.
 - B. Industrial Fatigue. Dr. Brozek.
 - C. Physical Training and De-training. Dr. Henschel.
 - D. Human Climatology. Dr. Taylor.
 - E. Circulatory Mechanics. Dr. Keys.
 - F. Vitamin Metabolism. Dr. Mickelsen.
 - G. State and Function of Human Muscle. Dr. 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.; Associate Professors Allan Hemingway, Ph.D., Joseph T. King, M.D., Ph.D., Nathan Lifson, 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. Dr. Visscher, Dr. Gellhorn, Dr. Hemingway, Dr. King, Dr. Lifson.
- 104f,su. Physiology of Excretion, the Endocrines, Nervous System, and Special Senses. Prereq.: Course 103 or organic chemistry and neurology. 6 cred. Dr. Visscher, Dr. Gellhorn, Dr. Hemingway, Dr. King, Dr. Lifson.
- 105su,s. Roentgen Rays, Light, and Radium. The physical and physiological basis of physical therapy. 1 cred. Dr. 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. Dr. Visscher, Dr. Gellhorn, Dr. Hemingway, Dr. King, Dr. Lifson.
- 135f,w,s.* Conference on Physiology, with qualified students. 1 cred. Dr. Visscher, Dr. Gellhorn, Dr. Hemingway, Dr. King, Dr. Lifson.
- 163f,164w,165s. Physical Chemistry and Biophysics in Biology and Medicine. Prereq.: Course 100-101 or Biochemistry 112. 3 cred. per quarter. Dr. Hemingway.
- 166f,167w,168s. Laboratory Work Related to Courses 163, 164, 165. Cred. ar. Dr. Hemingway.
- 201f,w,s,su.* Seminar in Physiology and Physiological Chemistry. For instructors and advanced students. Cred. ar. Dr. Visscher, Dr. 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. Dr. Visscher, Dr. Gellhorn, Dr. Hemingway, Dr. King, Dr. Lifson.
- 203f,w,s,su. Research in Physiology. Hours and cred. ar. Dr. Visscher, Dr. Hemingway, Dr. King, Dr. Lifson.
- 204f,w,s,su. Research in Physics and Physiology of Radiation. Cred. ar. Dr. Stenstrom.
- 206s.* Seminar in History of Physiology and Related Sciences. 1 cred. Dr. Visscher.
- 208f,w,s. Clinical Physiology and Physiological Chemistry. Hours and cred. ar. Dr. Wells, Dr. Glick, and others.

COURSES IN CANCER BIOLOGY

Professor John J. Bittner, Ph.D.

NOTE—For information on work in cancer biology, see page 16.

COURSES

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

PLANT PATHOLOGY AND BOTANY

Professors Elvin C. Stakman, Jonas J. Christensen; Associate Professors Carl J. Eide, Helen Hart; Assistant Professors Clyde M. Christensen, Louise Dossall, Raymond H. Landon, Alvin H. Larson, Erich O. Mader.

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 IN PATHOLOGY

- 104w. Industrial Mycology. Fungi in relation to industrial processes and products. Prereq.: Course 1, 10, or 56. 3 cred. Mr. 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. Miss Dossdall.
- 111w. Diseases of Field Crops. Symptomatology, etiology, and practical methods of control. Lab., lect., and greenhouse work. Prereq.: Course 1 or 10. 4 cred. Mr. J. J. Christensen.
- 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. Mr. Eide, Mr. Mader. (Offered in alternate years. Offered in 1946-47.)
- 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. Mr. 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. Mr. Eide. (Offered in alternate years. Not offered in 1946-47.)
- 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. Mr. Eide. (Offered in alternate years. Offered in 1946-47.)
- 119s. Principles of Plant Disease Control. A general consideration of principles and practices in controlling plant diseases. Prereq.: Course 1 or 10. 3 cred. Mr. Mader, Mr. 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. Mr. J. J. Christensen, Mr. Granovsky.
- 143f. Methods. Theoretical and practical consideration of methods used in mycological and pathological research. Prereq.: Course 1 or 10. 3 cred. Miss Hart, Mr. Moore.

- 203f-204w-205s-206su.* Research in Plant Pathology. Special assignment of work in laboratory and field problems in pathological research. Cred. ar. Mr. Stakman, Mr. J. J. Christensen, Mr. Eide, Miss Hart, Mr. C. M. Christensen, Miss Dosedall, Mr. Mader.
- 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. Mr. Stakman, Mr. C. M. Christensen, Miss Dosedall.
- 211w. History of Plant Pathology. The development of plant pathology as a science. 2 cred. Mr. Stakman.
- 213.* Seminar. Critical review of progress and problems in plant pathology. 2 cred. Mr. Stakman, Mr. J. J. Christensen, Mr. Eide, Miss Hart, Mr. C. M. Christensen, Miss Dosedall, Mr. Mader.
- 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. Mr. Stakman, Mr. J. J. Christensen. (Offered in alternate years. Offered in 1946-47.)
- 216f.§ Physiology of Plant Pathogens. The physical and chemical requirements and effects of plant pathogens in relation to their parasitism. 3 or 5 cred. Mr. Mader. (Offered in alternate years. Not offered in 1946-47.)
- 217s.§ Ecology of Plant Pathogens. The effect of environmental factors on the development of plant pathogens and plant disease epidemics. 3 cred. (Offered in alternate years. Not offered in 1946-47.)
- 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. Mr. Stakman, Mr. Eide.

COURSES IN 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. Mr. Stakman, Mr. 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. Mr. Landon, Mr. Larson.
- 160f. Plant Histochemistry. The localization, identification, and function of plant constituents. Lect., demonstration, and lab. Prereq.: Bot. 51 or equiv. 3 cred. Mr. Landon.
- 161f. Technology of Fruits and Vegetables. The effects of temperature, respiration, packing, etc., on storage life. Prereq.: Bot. 51. 3 cred. Ar.
- 162w. Temperature Relations of Crop Plants. Detailed study of hardiness and general temperature effects. Prereq.: 3 cred. in plant physiology. 3 cred. Mr. 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. Mr. 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. Mr. Landon.
- 251f-252w-253s.* Seminar in Applied Plant Physiology. 1 cred. Mr. Landon.

§ If there is sufficient demand for courses offered in alternate years, they will be given out of turn.

- 254f-255w-256s-257su.* Research Problems in Applied Plant Physiology. Special assignment of work in applied plant physiology. Cred. ar. Mr. 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. Mr. Landon.
- 260f,261w,262s,263su. Research Problems in Agricultural Botany. Special assignment of problems in agricultural botany. 3 or 5 cred. per quarter. Mr. Stakman, Mr. Larson.

POLITICAL SCIENCE

Professors William Anderson, Benjamin Lippincott, Clarence C. Ludwig, Lennox A. Mills, Harold S. Quigley, Lloyd M. Short; Associate Professors A. N. Christensen, Willmoore Kendall, Evron M. Kirkpatrick, Earl G. Latham; Assistant Professors Charles McLaughlin, Werner Levi, Herbert McClosky.

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, tho 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, which 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. The work leading to the degree of doctor of philosophy consists of at least three full years of graduate study. This may be estimated as amounting to 108 quarter credits distributed as follows: (1) not over 36 quarter credits for the satisfactory completion of the thesis; (2) at least 72 quarter credits in course work, of which 51 credits must be earned in courses and seminars in political science, and at least 21 must be earned in courses in the minor department, according to the requirements of that department. 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 must take at least 21 credits in courses or seminars in not more than two fields of specialization.

NOTE—For information on work in Public Administration see p. 21; for International Relations, see p. 19.

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. Mr. Latham.
- 102w. Principles of the American Constitution. Organization and powers of the national government. Prereq.: Course 101 or equiv. 3 cred. Mr. Latham.
- 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. Mr. Latham.
- 104f-105w.* 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 things 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. 3 cred. per quarter. Mr. McLaughlin.
106. American Constitutional Development—Part 3. (Not offered in 1946-47.)
- 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. Mr. Short.
- 116f.* Local Government: Areas and Organization. Prereq.: 9 cred. or permission of instructor. 3 cred. Mr. Weidner.

- 117w.* Local Government: Politics, Major Functions, Administration, and Central Supervision. Prereq.: Course 116 or permission of instructor. 3 cred. Mr. Weidner.
- 118s.* Local Government: Legal Status, Powers, and Responsibilities. Prereq.: Course 116. 3 cred. Mr. Weidner.
- 120f. Municipal Functions. A general survey of "line" functions: safety, health, welfare, works, utilities, etc. Prereq.: 6 cred. 3 cred. Mr. 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. Mr. Ludwig.
- 122s. Municipal Problems. Intensive consideration of selected topics: public works, police, public relations, etc. Prereq.: Course 121 or permission of instructor. 3 cred. Mr. 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, Economics 111, and Sociology 104.) 3 cred. Mr. Jones, Mr. Anderson, Mr. Filipetti, Mr. Vaile, Mr. Sletto.
- 124f-125w.* 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. Mr. 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. Mr. Latham.
- 131f.* Public Administration: Organization and Areas; Administrative Responsibility. Prereq.: 6 cred. 3 cred. Mr. Short.
- 132w.* Public Administration: Personnel Administration. Prereq.: Course 131 or permission of instructor. 3 cred. Mr. Short.
- 133s.* Public Administration: Financial Administration. Prereq.: Course 131 or permission of instructor. 3 cred. Mr. Short.
- 135s.* 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. Mr. Anderson. (Not offered 1946-47.)
- 137f.* 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. Mr. Christensen.
- 138w. 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 1946-47.)

- 141f. European Political Institutions. Description and evaluation of democratic government in Europe since about 1918; parliamentary government as contrasted with presidential government; structure, powers, and functions of the principal agencies of government—legislative, executive, and judicial; relations among such agencies; special problems. Prereq.: 6 cred. or 12 cred. in social science. 3 cred. Mr. McCloskey.
- 142w. European Parties and Politics. The development, policies, composition, organization, and activities of political parties in the principal European democracies since about 1918; the suffrage, nomination of candidates, electioneering practices, electoral systems; the role of parties in the democratic process. Prereq.: 6 cred. or 12 cred. in social science. 3 cred. Mr. McCloskey.
- 143s. Government of the U.S.S.R. and Adjacent States. Prereq.: 9 cred. 3 cred. Mr. McCloskey.
- 149f.* Government and Politics of the British Empire—India and the Tropical Colonies. Prereq.: 6 cred. or permission of instructor. 3 cred. Mr. Mills.
- 150w.* Government and Politics of the British Empire—Development of Dominion Status. Prereq.: 6 cred. or permission of instructor. 3 cred. Mr. 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. Mr. Mills.
- 153s.* Far Eastern Governments. Constitutional and political development in Japan and China; government, political parties, and problems. Prereq.: 9 cred. 3 cred. Ar.
- 155s. 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. Mr. 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. Mr. Kirkpatrick.
- 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. Mr. Kirkpatrick.
- 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. Mr. Kirkpatrick.
- 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. Mr. Kirkpatrick.
- 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. Mr. Kirkpatrick.
- 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. Mr. Kendall.
- 167f-168w-169s.† Readings in the Classics of Politics. Reading and discussion of some of the classical writers in political theory; includes such men as Plato, Aristotle, Machiavelli, Hobbes, Locke, Marx, and Lenin. Prereq.: Course 15 or 164-165, with which it may be taken simultaneously, or permission of instructor. 3 cred. per quarter. Mr. Lippincott.

§ No student may receive credit for both Political Science 162 and Philosophy 70.

- 171s. Political Psychology (the same as Psychology 141). Prereq.: Psy. 140. 3 cred. Mr. Bird.
- 180f-181w†-182s. International Law. Nature, sources, and sanctions of international law. The laws of peace, war, and neutrality. Prereq.: 9 cred. 3 cred. per quarter. Mr. McLaughlin.
- 184f.* International Organization. Nature and development of the international community. Principles, practices, and agencies which characterize the state system of international relations. The United Nations. Prereq.: 6 cred. or permission of instructor. 3 cred. Mr. Levi.
- 185w.* Problems of International Reconstruction. Analysis of the collapse of international co-operation. Contending ideologies of reorganization. Interim measures of order and security. Internationalism versus constitutionalism. Prereq.: 6 cred. or permission of instructor. 3 cred. Mr. Levi.
186. War in International Relations. Prereq.: 6 cred. or permission of instructor. 3 cred. (Not offered in 1946-47.)
- 187.* International Administration. Prereq.: 6 cred. or permission of instructor. 3 cred. (Not offered in 1946-47.)
- 192w.* International Relations in the Far East. Commercial and missionary relations in the sixteenth century. Oriental culture and its reaction to Western influence. Opening of the treaty era. Western imperialism in China. The rise of Japanese expansionism. The Open Door doctrine. China's struggle for independence. Prereq.: 6 cred. or permission of instructor. 3 cred. Ar.
- 193w.* Problems of the Pacific. Revolutionary forces in China; Japan's challenge to Western interests; naval rivalry; diplomatic revolution and equal treaties; intervention in Manchuria; policies of the powers; the second World War; postwar prospects in the Far East. Prereq.: Course 192 or permission of instructor. 3 cred. Ar.
- 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 1946-47.)
- 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 1946-47.)
- 204w-205s.*† Seminar in Public Law. Prereq.: 18 cred. or permission of instructor. 3 cred. per quarter. Mr. Latham.
- 210f-211w-212s.† Special Seminar in Public Administration. (Registration only with consent of staff.) 3 cred. per quarter. Mr. Ludwig, Mr. Short, Mr. Latham.
- 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. Mr. Anderson.
- 236w-237s.* Seminar in Federalism and Intergovernmental Relations. Prereq.: permission of instructor. 3 cred. per quarter. Mr. Anderson.
- 239s.* Topics in American Political Parties. Intensive study of selected problems of American politics; selected readings, supervised use of source materials, and individual reports. 3 cred. (Not offered in 1946-47.)
- 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. Mr. Mills.
- 245-246-247. Seminar in Far Eastern Government and International Relations; Prereq.: permission of instructor. 3 cred. per quarter. (Not offered in 1946-47.)

- 248f. Topics in International and Maritime Law I. Problems of belligerent occupation, military government, jurisdiction of war crimes. Prereq.: Course 180-181-182, or permission of instructor. 3 cred. Mr. McLaughlin.
- 249w. Topics in International and Maritime Law II. Legal problems in the organization of the United Nations. Prereq.: Course 180-181-182, or permission of instructor. 3 cred. Mr. McLaughlin.
- 250s. Topics in International and Maritime Law III. The interpretation of treaties and international conventions. Prereq.: Course 180-181-182, or permission of instructor. 3 cred. Mr. McLaughlin.

The following seminars, with credits arranged, offer opportunities for research and directed individual study:

- 251f-252w-253s.* Public Law. Mr. Latham.
- 254f-255w-256s.* American Government and Administration. Mr. Anderson.
- 257f-258w-259s.* American Constitutional Development. Mr. Kirkpatrick.
- 261f-262w-263s.* Local Government. Mr. Anderson.
- 264f-265w-266s.* Municipal Administration. Mr. Ludwig.
- 271f-272w-273s.* Comparative Modern Government and Politics. Mr. McClosky.
- 281f-282w-283s.* Political Theory. Mr. Lippincott, Mr. Kirkpatrick.
- 291f-292w-293s.* Far Eastern Diplomacy and Government. Mr. Quigley, Mr. Levi.
- 294f-295w-296s.* Colonization and Imperialism. Mr. Mills.
- 297f-298w-299s.* International Law and Relations. Mr. Quigley, Mr. McLaughlin.

PSYCHOLOGY

Professors Richard M. Elliott, Charles Bird, John G. Darley, William T. Heron, Howard P. Longstaff, T. Raymond McConnell, Donald G. Paterson, Miles A. Tinker; Associate Professor Starke R. Hathaway; Assistant Professors Kenneth E. Clark, Paul E. Meehl; Instructor Kenneth MacCorquodale.

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 *Combined 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 6 to 15) 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.

NOTE—For information on work in Psychometrics, see page 20.

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.: Course 1-2; and 4-5 or equiv. in another science. 3 cred. per quarter. Mr. Tinker.

- 108f.* *Systems of Psychology*. A comparative study of the problems, methods, and viewpoints of modern psychology. Tutorially directed reading. Prereq.: Course 1-2 and permission of instructor. 3 cred. Mr. Elliott.
- 114w. *Human Behavior*. An analysis of the background, development, and organization of human behavior. Consciousness and purpose are treated as properties of the living body. Prereq.: Course 102; 4-5 or Zool. 1-2-3, or Phil. 1. 3 cred. Mr. Elliott.
- 124f. *Psychology of Learning*. An analysis of associationism and the conditioning, bond, and field theories of learning with a consideration of the application of these theories to problems of normal and abnormal behavior. Prereq.: 9 cred. in psychology. 3 cred. Mr. Heron.
- 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.: Course 1-2; 4-5 or 5 cred. in statistics. 3 cred. per quarter. Mr. Paterson.
- 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. Mr. 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. Mr. McClelland.
- 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, and 9 cred. in social science. 3 cred. Mr. Bird.
- 141s. *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, and 9 cred. in social science. 3 cred. Mr. 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. Mr. 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.: Course 1-2; 4-5 or Zool. 1-2-3, or permission of instructor. 3 cred. Mr. Hathaway.
- 151f. *Animal Psychology*. The history of the subject and its philosophical and biological foundations; consciousness and its criteria; sensory processes. Prereq.: Course 1-2; 4-5 or equiv. in another science. 3 cred. Mr. Heron.
- 152w. *Animal Psychology*. Emphasis upon the motivation of behavior; learning; conditioning; insight; reasoning; thinking; judgment; social influences. Prereq.: Course 1-2; 4-5 or equiv. in another science. 3 cred. Mr. Heron.
- 153s.* *Individual Investigations in Animal Psychology*. Prereq.: Course 151 or 152. 3 cred. Mr. Heron.

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

- 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. Mr. 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. Mr. 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. Mr. Clark.
- 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. Mr. Meehl.
- 200f-201w-202s.† History of Psychology I. 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. Mr. Tinker. (Offered in alternate years. Not offered in 1946-47.)
- 203f-204w-205s.† History of Psychology II. Psychology in America. Development of laboratories, departments, apparatus, texts, and journals. Present status. Prereq.: permission of instructor. 1 cred. per quarter. Mr. Tinker. (Offered in alternate years. Offered in 1946-47.)
- 210f-211w-212s. Research Problems. Laboratory investigations. Cred. ar. Mr. Elliott, Mr. Bird, Mr. Heron, Mr. Longstaff, Mr. McConnell, Mr. Paterson, Mr. Tinker, Mr. Hathaway, Mr. Darley, Mr. Clark, Mr. Meehl.
- 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.
- 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. Written permission of instructor required to register for this course. Cred. ar. Mr. Paterson, Mr. Darley, Mr. Longstaff, and others.
- 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. Mr. Elliott, Mr. Bird, Mr. Longstaff, Mr. Paterson, Mr. Hathaway, Mr. Heron, Mr. Tinker, Mr. Darley, Mr. Clark, Mr. 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. Mr. 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. Mr. 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, and permission of instructor. 1 cred. per quarter. Mr. Hathaway, Mr. Meehl.
- 270f-271w-272s. 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. Mr. 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. Mr. Darley.
- 286s. Advanced Biographical Psychology. Lecture and basic text material the same as in Psy. 86s but graduate students must prepare under tutorial guidance a report based on recent literature in this field. 3 cred. Mr. Elliott.
- 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. Mr. Paterson.

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., Harold A. Whittaker, B.A.; Associate Professors Ruth E. Grout, Ph.D., C.P.H., George O. Pierce, M.S., C.P.H., Alan E. Treloar, Ph.D.; Assistant Professors Theodore A. Olson, M.A., Stewart C. Thomson, M.D., M.S., Myron M. Weaver, M.D., Ph.D.; Lecturer William A. Jordan, D.D.S., M.P.H.; Clinical Instructor Leslie W. Foker, M.D., M.P.H., Paul W. Kabler, M.D., Ph.D.

Committee on Curriculum for Physicians: Gaylord W. Anderson, Albert J. Chesley, Harold S. Diehl.

Committee on Curriculum for Engineers: Gaylord W. Anderson, Harold A. Whittaker.

Committee on Curriculum for Nurses: Gaylord W. Anderson, Ruth Freeman, Mellie F. Palmer.

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 degree of master of public health, and the course in Hospital Administration,

should be addressed to Dr. Gaylord W. Anderson, Millard Hall, University of Minnesota, Minneapolis 14, Minnesota.]

COURSES

- 102f. 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. Mr. Whittaker, Mr. Pierce, Mr. Olson.
- 103f,w,s.* Public Health Bacteriology. Bacteriologic and serologic diagnosis, public health laboratory administration and methods. Prereq.: Bact. 101-102, 116, and permission of instructor. 3 cred. Dr. Kabler.
- 104f.* Epidemiology I. 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 and permission of instructor; physicians, others by permission. Should be taken in conjunction with Course 140. 3 cred. Dr. Anderson.
- 105w. Epidemiology II. Epidemiology of special diseases; further statistical methods. Prereq.: Course 104. 3 cred. Dr. Anderson, Mr. Treloar.
- 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.: Courses 53, 100, or equiv., or to be taken simultaneously with any of these. 3 cred. Dr. 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. Dr. 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.: Course 53, 57, 58, or 100. 2 cred. Dr. Simons.
- 110f,s. Biometric Principles. See Biostatistics courses.
- 111f,s.‡ Biostatistics Laboratory. See Biostatistics courses.
- 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, 104. 4 cred. Mr. Pierce, Mr. Olson.
- 113w.§ 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. Mr. Pierce, Mr. Olson.
- 115s. 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, 104, 106. 3 cred. Mr. Olson, Mr. Adams.

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

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

§ Students who have taken Courses 112, 113, or 116 will not be given credit for Course 118.

- 116s.¶ Public Health Engineering Administration. Sanitary problems of urban and rural communities, administrative methods and procedures for their solution; organization of activities in the field of environmental sanitation. Lect., seminars, field, and lab. demonstrations. Prereq.: Courses 102, 106, and at least two of the following: Courses 112, 113, 115. 2 cred. Mr. Whittaker, Mr. Pierce, and special lecturers.
- 117s. Sanitary Biology. Plant and animal forms of importance in water supply, sewage disposal and bathing places; biology of shellfish, rodents, mosquitoes, flies, and other organisms as it pertains to public health. Lect. and lab. work. Prereq.: permission of instructor. Cred. ar. Mr. Olson.
- 118w.¶ 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. Mr. Whittaker, Mr. Pierce, Mr. Olson.
- 119f,w,s,su.‡‡ Field Practice in Environmental Sanitation. Prereq.: permission of instructor. Cred. allowed according to experience in this field. Mr. Whittaker, Mr. Pierce.
- 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. Ar.
- 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 104, and 106, or to be taken concurrently with 106. 3 cred. Miss 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, Chem. 1-2 or equiv., or permission of department. 3 cred. Dr. Foker, Miss Henriksen.
- 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. Miss Henriksen.
- 128w. Industrial Health Problems II. Special health hazards, use of toxic materials, specific diagnostic procedures, safety devices. Prereq.: Course 126. 3 cred. Dr. Foker.
- 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. Miss Henriksen.
- 130w. Random Sampling Distributions. See Biostatistics courses.
- 131w.‡ Sampling Laboratory. See Biostatistics courses.

‡ 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 118.

- 133w. Mental Hygiene Aspects of Public Health Nursing. 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. 3 cred. Dr. 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 62 or to be taken concurrently. 1 cred. Dr. 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 and 62 or to be taken concurrently. 1 cred. Dr. 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 and 62 or to be taken concurrently. 1 cred. Dr. Irwin, Dr. 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. Dr. Aldrich, Miss Mouw, 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. Dr. Weaver.
- 150w,‡ Life Tables. See Biostatistics courses.
- 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, 61, 63, and experience in public health nursing, or by permission. 3 cred. Miss 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. Miss Taylor and associates.
- 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. Miss 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. Ar.
- 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. Miss Grout and associates.

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

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

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

- 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. 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. Miss Grout and associates.

RADIOLOGY

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

ROMANCE LANGUAGES

Professors Francis B. Barton, Edward H. Sirich; Associate Professors Emmert M. Brackney, Herbert E. Clefton, Jaques A. Fermaud, Raymond L. Grismer, Emilio C. LeFort, Walter T. Pattison; Assistant Professor 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.

FRENCH

- 103f-104w-105s.† French Syntax and Composition. Special studies in characteristic problems of French syntax. Prereq.: Course 63 or registration in 63. 3 cred. Mr. Barton.
- 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. Mr. 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. Mr. Sirich.
- 121f-122w-123s.* French Literature: Sixteenth Century. 121f, the Rhétoriciens, 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 1946-47.)
- 130f. French Romantic Poetry: Victor Hugo. Prereq.: Course 70-71-72 or 73-74. 3 cred. Mr. Clefton.
- 131w. Parnassian Poetry. Prereq.: Course 70-71-72 or 73-74. 3 cred. Mr. Clefton. (Not offered in 1946-47.)
132. Baudelaire, Verlaine, and Rimbaud. Prereq.: Course 70-71-72 or 73-74. 3 cred. Mr. Clefton. (Not offered in 1946-47.)
- 146.* Contemporary French Dramatic Literature. Course 70-71-72 or 73-74. 3 cred. Mr. Barton. (Offered biennially. Not offered in 1946-47.)

‡ Students may enter any quarter with permission of instructor.

- 156s. French Realistic Novel. Prereq.: Course 70-71-72 or 73-74. 3 cred. Mr. Barton. (Offered in alternate years. Offered in 1946-47.)
- 157w. French Novel, France, Loti, and Bourget. Prereq.: Course 70-71-72 or 73-74. 3 cred. Mr. Brackney. (Not offered in 1946-47.)
- 158s. Contemporary French Novel I. Course conducted in French. Prereq.: Course 70-71-72 or 73-74. 3 cred. Mr. Fermaud.
159. Contemporary French Novel II. Continuation of Course 158. Prereq.: Course 70-71-72 or 73-74. 3 cred. (Not offered in 1946-47.)
- 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. Mr. 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. Mr. 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. Mr. Brackney.
- 207f-208w-209s. Old Provençal. Reading in early Provençal literature with special attention to the poetry of the troubadours. 2 cred. per quarter. (Not offered in 1946-47.)
- 222f-223w-224s.* French Seminar. Classical period. 2 cred. per quarter. Ar. (Not offered in 1946-47.)
- 225f-226w-227s.* French Seminar. Modern period. 2 cred. per quarter. Ar.
- 230-231-232. Research Methods and Material. 1 cred. per quarter.
- 259f-260w-261s.* Research in Romance Languages. Cred. depends upon amount of work accomplished. Staff.

ITALIAN

- 159f-160w.¶ Dante. The *Divina Commedia*. (Alternates with 161-162.) Prereq.: one course above 50. 3 cred. per quarter. Miss Nissen.
- 161f-162w. The Sixteenth Century. Reading of texts and study of literary influences. Prereq.: one course above 50. 3 cred. per quarter. Miss Nissen. (Not offered in 1946-47.)
- 164s.§ Dante (in English). Lectures, reading, and discussion of the *New Life*, and parts of the *Divine Comedy*. Prereq.: permission of instructor. 3 cred. Miss Nissen.

SPANISH

- 103f-104w-105s. Spanish Syntax and Composition. Prereq.: Course 60 or registration in Course 60. 1 cred. per quarter. Mr. Pattison.
- 110f-111w-112s. Spanish Literature: Nineteenth Century. Prereq.: Course 65-66-67 or 68-69. 3 cred. per quarter. Mr. 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. (Alternates with 155-156-157. Not offered in 1946-47.)
120. The Ballad. Prereq.: Course 65-66-67 or 68-69. 3 cred. (Not offered in 1946-47.)
130. Cervantes: Don Quijote. Prereq.: Course 65-66-67 or 68-69. 3 cred. (Not offered in 1946-47.)

‡ The prerequisite is Course 3 or Course 4; but for students beginning Italian in the Senior College it may be Course 1-2 with permission of the instructor.

¶ Students may enter any quarter with permission of instructor.

131. The Picaresque Novel. Prereq.: Course 65-66-67 or 68-69. 3 cred. Mr. Grismer. (Not offered in 1946-47.)
- 140f-141w-142s. Contemporary Latin-American Literature. Prereq.: Course 65-66-67 or 68-69 or 74-75-76. 3 cred. per quarter. Mr. Le Fort.
- 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. Mr. Grismer. (Alternates with 115-116-117. Not offered in 1946-47.)
- 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. Mr. Pattison. (Alternates with 110-111-112. Not offered in 1946-47.)
- 241f-242w-243s.* Old Spanish Philology. 2 cred. per quarter. (Not offered in 1946-47.)
- 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 1946-47.)
- 250f-251w-252s.* Spanish Seminar. 2 cred. per quarter. Mr. Pattison.
- 253f-254w-255s. Seminar in Spanish-American Literature. 2 cred. per quarter. Ar.

SCANDINAVIAN

Associate Professor Alrik Gustafson, Chairman; Professor Konstantin Reichardt.

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.

COURSES

- 113f-114w.* Gothic. (The same as German 113-114.)
- 113f. Gothic. Introduction to Germanic Linguistics. 4 cred. Mr. Reichardt.
- 114w. Gothic Texts. Prereq.: Course 113. 2 cred. Mr. Reichardt.
- 153s. The Modern Scandinavian Home as an Expression of Northern Art. (The same as ArtEd. 153.) Knowledge of Scandinavian not required. 3 cred. Miss Lien.
- 161f. The Modern Scandinavian Novel: from 1870 to Our Day. Knowledge of Scandinavian not required. Prereq.: Course 4-5-6 or 10-11-12 or 8 cred. in literature. 3 cred. Mr. Gustafson.
- 171s. The Modern Scandinavian Drama: from Ibsen and Strindberg to the Present Day. Knowledge of Scandinavian not required: Prereq.: Course 4-5-6 or 10-11-12 or 8 cred. in literature. 3 cred. Mr. Gustafson.
- 180.* Old Norse Literature. (The same as German 196a.) 4 cred. Mr. Reichardt. (Not offered in 1946-47.)
- 182.* Germanic Mythology. (The same as German 119.) Mr. Reichardt. (Not offered in 1946-47.)
- 183.* Germanic Heroic Poetry. (The same as German 183.) Prereq.: 8 cred. in literature. 3 cred. Mr. Reichardt. (Not offered in 1946-47.)
- 185.* History of the Scandinavian Languages. Prereq.: Course 4-5-6 or 10-11-12 or at least one Germanic language. 3 cred. Mr. Reichardt. (Not offered in 1946-47.)
- 195.* Introduction to Old Norse Language and Literature. (The same as German 195.) Prereq.: Course 113. 4 cred. Mr. Reichardt. (Not offered in 1946-47.)
196. Eddic Poetry. (The same as German 196.) 3 cred. Mr. Reichardt. (Not offered in 1946-47.)

- 215-216-217. Studies in Scandinavian Romanticism. 3 cred. per quarter. Mr. Gustafson. (Not offered in 1946-47.)
- 218f-219w-220s. Studies in Late Nineteenth-Century Scandinavian Literature. 3 cred. per quarter. Mr. Gustafson.
- 221f-222w-223s. Biographical Problems in Strindberg. 3 cred. per quarter. Mr. 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. Mr. Reichardt.

SOCIAL WORK

Professors F. Stuart Chapin, Anne F. Fenlason; Associate Professors Alice Clendening, Monica K. Doyle, John C. Kidneigh, Alice Leahy Shea; Assistant Professors Richard G. Guilford, Lyndell Scott.

Prerequisites—A candidate for admission must hold a Bachelor's degree from an accredited college or university. He must present 39 quarter credits in social sciences, including a minimum of 12 quarter credits in sociology. In addition, he should present some credits in physiology or biology. However, if the candidate is otherwise eligible for admission but lacks some prerequisites he may be permitted to enter but will be required to complete such prerequisites during his first year.

The number of beginning students is limited with preference given to students wishing to enroll in the fall quarter. Persons with previous training and experience may be admitted any quarter. The application for admission is considered first by a departmental committee of major advisers in social work which makes recommendations to the dean of the Graduate School upon whose approval the candidate is admitted. Acceptance of applicants is based on the following criteria: evidence of ability to meet standards of graduate work, usually indicated by grades of superior quality; psychological tests when available; letters of reference indicating personal aptitude for social work.

Language requirement—Knowledge of a foreign language is not required, but is strongly recommended.

Master's degree—The M.A. degree may be secured under Plan A or Plan B. The difference between the research studies in the two plans is in scope rather than in quality. Plan B, involving a shorter research study or the presentation of seminar papers, allows more opportunity for study in related fields. Two years of graduate work are required for this degree.

Attention is directed to the following fields: protection, guidance, and placement of children; family adjustment and rehabilitation; group relationships; medical social work; psychiatric social work; rural social work; and public welfare.

In view of the 90 quarter credit requirement for the Master's degree in social work, advanced standing in technical class and field courses may be granted for work done in other approved schools of social work. No transfer of graduate credits from other institutions will modify the minimum requirement of one academic year in residence as a graduate student in this University.

REQUIREMENTS FOR MASTER OF ARTS DEGREE IN SOCIAL WORK

	Credits	
	Plan A	Plan B
Class courses	42	51
Field Work courses	30	30
Thesis	18	—
or		
Special Study	—	9
	—	—
Total	90	90

The proportion of credit between technical social work courses and related fields may be determined by the social work advisers within the requirements of the Graduate School and the policies of the School of Social Work.

Doctor's degree—The Ph.D. degree in social work is a three-year program based upon the general requirements for this degree as outlined on page 11 of this bulletin.

Applications should be made directly to the School of Social Work, Jones Hall, not later than three months before date of desired entrance.

[NOTE—Students may be awarded a certificate in social work on the completion of 60 quarter credits distributed as follows:

	Credits
Technical social work (class)	36
Field work in social work (450 hours)	15
Related fields	9
	—
Total	60

For detailed information consult the *Bulletin of the School of Social Work.*]

COURSES

- 109f,w,§ The Field of Social Work. A study of the historical development of social work, including fields of specialization, functions of agencies, and contributions made by outstanding leaders. Prereq.: Sociology 1 and 15 cred. in social science, child welfare, education, philosophy, psychiatry, or permission of instructor. 3 cred. Mrs. Doyle.
- 122f. Statistical Methods. (The same as Sociology 122.) Prereq.: Sociology 1 and 15 cred. in social science, child welfare, education, philosophy, psychiatry, or permission of instructor. 3 cred. Mr. Chapin.
- 124f,s. Community Organization. An analysis of the process by which groups and individuals within a community work toward a social goal. This study is implemented by a critical examination of selected community organization projects. Prereq.: Course 109 or equiv. 3 cred. Mr. Kidneigh.
- 125f,s. Principles of Group Work. An analysis of the group work process including the study of group behavior, the use of the group in terms of individual development and social usefulness, and leadership techniques in working toward those ends. Prereq.: Course 109, which may be taken simultaneously, or equiv. 3 cred. Miss Blake.
- 126s. Problems of Supervision in Group Work. A study of the methods of supervision of groups and group leaders with special emphasis on the use of individual and group conference, group records, and observation as supervisory tools; an analysis of the administrative functions of the group work supervisor. Prereq.: Courses 125, 156. 3 cred. Ar.
- 127w. Legal Aspects of Social Work. A selected group of legal problems treated from the viewpoint of the social worker; the court system; legal process; protection and enforcement of the legal rights of indigent persons; problems of the small wage earner—garnishment, small loans, eviction; problems in domestic relations. Not designed to teach technical law, but to furnish background for understanding social problems having legal implications. Prereq.: Course 109, which may be taken simultaneously. 3 cred. Mr. Bachelder.
- 128w. Principles of Administration, Publicity, and Finance Applied to Social Work. A technical study of methods of organizing social agencies, of financing them, and of making the public aware of their work. Lect. and practice work. Prereq.: Sociology 1 and 15 cred. in social science, child welfare, education, philosophy, psychology, or permission of instructor. Course 109 or equiv. must be included. 2 cred. Mr. Kidneigh.

§ This course is for mature students who have not had Courses 49 and 50-51.

- 129f-130w.† Principles of Social Case Work. A study of the purposes, problems, and processes of generic social case work, including a study of the relationships between the individual and the social worker and community as contributory to the treatment of the problems presented. Prereq.: Courses 109 and 153 or equiv., which may be taken simultaneously. 3 cred. per quarter. Mrs. Scott.
- 129f,w-130w,s.† Principles of Social Case Work. (See 129f-130w.)
- 131s. Social Work in Rural Communities. A study of the relation of the attitudes and social resources of the community to the problems and processes of social work especially in rural communities. Prereq.: Courses 129, 153, 114 or equiv. 3 cred. Mr. Guilford. (Not offered 1946-47.)
- 132f. Juvenile Courts and Probation. (The same as Sociology 132.) Prereq.: Course 53. 3 cred. Mr. Monachesi.
- 133f. Social Case Work in Health Problems. Discussion of the meaning of illness in a case work situation with a correlation of the medical and social needs of an individual and his family. Prereq.: Courses 129, 136. 3 cred. Mrs. Clendening.
- 134f. 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 109 or equiv. 3 cred. Mr. Guilford.
- 135f. Survey of Social Work for Children. A course dealing with social movements and social agencies which have developed as a response to the needs of children. Public and private programs of care will be presented and evaluated. Case materials are used extensively. Prereq.: Course 109, which may be taken simultaneously, or equiv. 2 cred. (Not offered in 1946-47.)
- 136s. 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. Mrs. Clendening and U. Hosp. Med. Staff.
- 137s. 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. Mrs. Doyle.
- 138f,s. Case Work with Children. This course deals with substitute parental care. Principles and methods of child placement, including the selection of foster home or institution, are considered. Case materials reflecting current theories and practices are used throughout the course. Prereq.: Courses 130, 154. 3 cred. Mr. Guilford.
- 139w,s. Personality Development as It Affects Case Work Practice. A consideration of factors involved in personality development and how these factors aid case work practice. Prereq.: Course 170 or equiv. and permission of instructor. 4 cred. Mrs. Shea.
- 151f-152w†,151w-152s.† Public Welfare. First quarter deals with the history and functions of public welfare administration, with special emphasis on public assistance. Second quarter deals with special problems of state and county administration of public welfare activities. Prereq.: Course 109 or equiv. 3 cred. per quarter. Mr. Guilford.
- 153f,w,s‡-154f,w,s‡-155f,w,s.‡ Field Training in Case Work. First year students are placed in special training centers under university instructors. Prereq.: Course 129, which may be taken simultaneously, or equiv. Cred. ar. Staff.
- 156f,w,s‡-157f,w,s‡-158f,w,s.‡ Field Training in Group Work. Prereq.: Course 125, which may be taken simultaneously. 2 to 6 cred. per quarter to be determined by the adviser in social work. Ar.

‡ A fee of \$3.50 per quarter is charged for this course.

- 161w. Social Aspects of Housing and Standards of Living. (The same as Sociology 161.) Prereq.: Sociology 1 and 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Mr. Chapin.
- 170f. 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. Dr. Hinckley.
- 171w. Descriptive Neuropsychiatry. (The same as Med. 171.) 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 170 or equiv. 3 cred. Dr. Baker.
- 172s. Advanced Considerations in Psychiatry. (The same as Med. 172.) A case discussion course designed to give the advanced student an opportunity to study and discuss cause and effect relationships in human behavior; the approach and methods of treating maladjusted individuals; society's provision for their study and care. Prereq.: Course 171 or equiv. 1 cred. Ar.
- 173Af. Behavior Problems in Younger Children. (The same as C.W. 140.) Prereq.: 12 cred. in psychology, educational psychology, or sociology. 3 cred. Miss Goodenough.
- 173Bw. Behavior Problems in Older Children. (The same as C.W. 141.) Prereq.: 12 cred. in psychology, educational psychology, or sociology. 2 cred. Miss Goodenough.
- 174s. Seminar in Psychiatric Social Work. Prereq.: Courses 130, 139 or equiv., 170. 2 cred. Dr. Hinckley.
- 175f. Advanced Medical Information for Social Workers. Medical lectures with discussion of social problems. Primarily for medical social workers, covering selected medical and surgical conditions not included in the previous course, such as genito-urinary conditions, gynecology, paralysis, the eye and ear, epidemiology, endocrine health and disease, etc. Prereq.: Course 136. 2 cred. Mrs. Clendening and U. Hosp. Med. Staff.
- 197f-198w-199s. Special Topics in Social Work. Cred. ar. Staff.
- 217s. Advanced Case Work. Mrs. Fenlason.
- 218f-w-s.* Seminar in Family Case Work. Mrs. Fenlason.
- 219f-w-s.* Seminar in Case Work with Children. Mr. Guilford.
- 220f-w-s.* Seminar in Medical Social Work. Mrs. Clendening.
- 221f†-222w†-223s.‡ Graduate Field Training. Staff.
- 224f-225w-226s.* Advanced Medical Social Work. 3 cred. per quarter. Mrs. Clendening.
- 227f†-228w†-229s.‡ Advanced Field Training. Staff.
- 230f-w-s.* Seminar in Public Welfare. Mr. Kidneigh.
- 231f-w-s.* Seminar in Group Work. Ar.
- 232f-w-s.* Seminar in Rural Social Work. Mr. Guilford.
- 233f-w-s.* Seminar in Social Agencies and Social Institutions. Mrs. Doyle.
- 234f-w-s. Seminar in Juvenile Delinquency and Treatment. (The same as Sociology 234.) Mr. Monachesi.
- 235f-w-s. Seminar in Psychiatric Social Work. Mrs. Shea.
- 236f-w-s.* Special Studies in Social Work. Staff.
- 237f-w-s. Recent Research in Social Work. Mrs. Shea.
- 240f,w,s. General Seminar in Social Work. Staff.

SOCIOLOGY

Professors F. Stuart Chapin, Clifford Kirkpatrick, Elio D. Monachesi, Lowry Nelson, George B. Vold, Malcolm M. Willey; Associate Professor Raymond F. Sletto; Assistant Professors Douglass Marshall, Joseph Schneider.

‡ A fee of \$3.50 per quarter is charged for this course.

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 p. 21.

1. SOCIAL PROBLEMS AND SOCIAL POLICY

- 102s. 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.: Course 1 and 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Mr. Vold.
- 103w. Sociology of Conflict. Prereq.: Course 1 and 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Mr. Vold.
- 104f. City Planning. (The same as Architecture 104, Economics 111, and Political Science 124.) General survey of the economic, governmental, social, and technical phases of city planning and group housing. 3 cred. Mr. Jones, Mr. Sletto.
- 105f. Criminological Theories—Historical and Contemporary. Prereq.: Course 1 and 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Mr. Vold.
106. 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.: Course 1 and 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. (Not offered in 1946-47.)
- 107w. Adult Parole and Probation. A critical examination of problems and practices in the supervision of adult criminals. Prereq.: Course 1 and 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Mr. Vold.
- 132s. 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. Mr. Monachesi.
- 146.¶ Community Organization and the Social Setting of Recreation. A study of objectives, methods, and program material. Prereq.: for Arts College students, 3 courses in sociology; for students in Education, 3 courses in social science. 3 cred. (Not offered in 1946-47.)
- 147.¶ Group Leadership and Organization. A study of program material, objectives, and procedures. Prereq.: Course 146 or equiv. 3 cred. (Not offered in 1946-47.)
- 148.¶ Supervisory Problems in Recreation. A seminar for professional students with emphasis on organization and supervision. Prereq.: Course 147 or equiv. 3 cred. (Not offered in 1946-47.)
- 160f. Population Trends and Policies. The major quantitative and qualitative problems of population in our contemporary society, including: population theories and doctrines since Malthus; the growth and distribution of population; changes in population composition and their social consequences; problems of human migration; urbanization and the ecology of the city; trends in mortality and morbidity; the quality of
- ¶ Open only to majors in sociology and social work or recreation.

the population, significance of differential birth rates, heredity, and environment.

Prereq.: Course 1 and 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Mr. Marshall.

- 161w. 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 and 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Mr. Chapin.

2. SOCIAL PSYCHOLOGY AND SOCIAL PROCESSES

100f. Social Psychology. Primarily for sociology students. The social attitudes: their development and modification under social pressure; the interactions of individuals and groups. Prereq.: Course 1 and 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Mr. Kirkpatrick.

103w. Sociology of Conflict. Types of social conflict and their role in social life. Prereq.: Course 1 and 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Mr. Topping, Mr. Vold.

118w. 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 and 15 cred. in social science, child welfare, education, philosophy, or psychology or permission of instructor. 3 cred. Mr. Kirkpatrick.

3. SOCIAL ORGANIZATION AND SOCIAL INSTITUTIONS

101s. 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 and 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Mr. Chapin.

115. Religion as a Social Institution. The origin and function of religion viewed as a culture pattern in relation to social processes and social organization. Prereq.: Course 1 and 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Mr. Kirkpatrick. (Not offered in 1946-47.)

116. The Newspaper as a Social Institution. A study of the social role of the newspaper in the United States, with special reference to the social changes that have influenced the press, and the corresponding influences of the press upon social life. Prereq.: Course 1 and 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. (Not offered in 1946-47.)

119w,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 and 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Mr. Kirkpatrick.

4. RURAL LIFE AND WELFARE

110f. Rural Community Organization. A study of social organization as it affects living conditions in small towns and rural districts. Especially designed for rural social workers and specialists in rural sociology or agricultural economics. Prereq.: Course 1 and 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Mr. Nelson.

114w. Rural Social Institutions. A detailed study of the problems of organization and efficiency of selected rural institutions, especially religious, educational, civic, and recreational. Lect., discussions, reports. Prereq.: Course 1 and 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Mr. Nelson.

5. THEORIES OF SOCIAL CHANGE AND SOCIAL ORDER

120f. Social Life and Cultural Change. A history of the theories of progress and a critique of the idea of progress. Prereq.: Course 1 and 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Mr. Schneider.

140w. 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. Christianity and social order. Prereq.: Course 1 and 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Mr. Schneider.

145s. 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 and 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Mr. Schneider.

6. RESEARCH METHODS AND TECHNIQUES

(See also graduate seminars)

112s. Methods of Rural Social Research. A course dealing with the methods and content of rural social research. All methods of investigation are analyzed. Especially designed for those interested in social research under Purnell or similar funds. Prereq.: Course 1 and 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 2 cred. Mr. Nelson.

122f. Statistical Methods. Selected problems of social relationship described, analyzed, and interpreted by means of the common statistical methods. Prereq.: Course 1 and 15 cred. in social science, child welfare, education, philosophy, or psychology, or permission of instructor. 3 cred. Mr. Chapin.

123f. Methods of Social Research. The nature of scientific method; the problems of sociology; specific methods of investigation of social phenomena. Prereq.: Course 45 or equiv. 3 cred. Mr. Sletto.

141w. Problems in Social Measurement. Prereq.: Course 45 or 122 or equiv. 3 cred. Mr. Sletto.

162f-163w-164s. Field Work and Laboratory Training in Social Research. Prereq.: Course 45 or 122, which may be taken simultaneously. 2 cred. per quarter. Mr. Sletto.

7. SEMINAR COURSES

200f-w-s. Seminar: Topics in Criminology. Mr. Vold.

201f-w-s. Seminar: Social Psychology of Family Relationships. (Not offered in 1946-47.)

202f-w-s. Seminar: Topics in Urban Sociology. Mr. Sletto.

203f-204w-205s. Seminar in Social Theory. Staff (Not offered in 1946-47.)

206f-207w-208s. Seminar: Statistical Theory in Relation to Social Theory and Practice. (Not offered in 1946-47.)

209f-210w-211s. Seminar: The Theory of Social Evolution. Staff. (Not offered in 1946-47.)

215f. Seminar in Rural Sociology: Rural Life in Latin America. Mr. Nelson.

- 216w. Seminar in Rural Sociology: Rural Life in Selected Countries of Europe. Mr. Nelson.
- 217s. Seminar in Rural Sociology: Current Rural Social Problems in the United States. Mr. Nelson.
- 234f,w,s. Seminar in Juvenile Delinquency and Treatment. Mr. Monachesi.
- 238w-239s. Principles of Sociology. 6 cred. Mr. Monachesi.

SOILS

Professor Clayton O. Rost; Associate Professor Paul R. McMiller; Assistant Professors Alfred C. Caldwell, 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. Mr. MacGregor.
- 104su.* Soil Mapping. Practice in identification of soil profiles and in the mapping of soil types in the field; preparation of soil maps and gathering of field data. Students will be assigned to areas in Minnesota where soil surveys are in progress. Arrangements must be made in advance. Prereq.: Courses 108, 109. 3 cred. Mr. 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. Mr. MacGregor.
- 108w. Physical Properties of Soils. The determination of physical constants of soils, including mechanical composition. Lect. and lab. Prereq.: Course 4. 3 cred. Mr. 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 associations with special reference to Minnesota conditions; factors affecting soil productivity ratings. Prereq.: Courses 4, 108. 3 cred. Mr. 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. Mr. Rost, Mr. McMiller, Mr. Caldwell, Mr. MacGregor.
- 203f,w,s. Seminar in Soils. Assigned reading, reports, and discussions on soils topics. 1 cred. Mr. 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. Mr. Caldwell.
- 206w. Soil Physics. Mechanical composition of soils, physical characteristics of soil colloids; soil consistency, structure, water, air, temperature, tillage; physical properties of soils in relation to runoff and erosion. Prereq.: Course 108. 3 cred. Mr. Caldwell.
- 207w. Advanced Soils. The principles of soil genesis and classification; 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. Mr. 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. Mr. Rost.

SPEECH

Professors Frank M. Rarig, Bryng Bryngelson; Associate Professor Howard Gilkinson; Assistant Professors Frank M. Whiting, William S. Howell.

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.

Examination—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.: Courses 1-2-3 or 5-6, Psy. 1-2, 10 cred. in social science. 3 cred. per quarter. Mr. 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. Mr. Rarig. (Offered in alternate years. Offered in 1946-47.)

- 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. Mr. Rarig. (Not offered in 1946-47.)
- 109.* Classical Rhetoric. Prereq.: Course 101-102-103, Psy. 140. 3 cred. (Offered in alternate years. Not offered in 1946-47.)
- 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. Mr. Whiting.
- 115f-116w-117s. Playwriting and Production. Theory and practice of writing and producing plays. Composition of the play from the elementary scenario to the completed dialog. Prereq.: Course 31 and permission of instructor. 1 to 3 cred. per quarter. Mr. Whiting, Mr. Dusenbury.
- 121s.* Advanced Speech Problems. Advanced study of the problems of teaching speech. Investigation of current theories. Prereq.: Courses 1-2-3 or 5-6, Psy. 1-2. 3 cred. Mr. Gilkinson.
- 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. Mr. Gilkinson.
- 131su.‡‡ Community Dramatics. The cultural values of community and children's theaters. Dramatic, educational, and critical literature of the field. Specimen projects, reports, term papers. Prereq.: Courses 91-92-93, 111-112-113, Psy. 1-2 or permission of instructor. 3 cred. (Not offered in 1946-47.)
- 141f-142w-143s. Voice Science. The study of the voice mechanism and of vocal sound; methods of analysis and synthesis. The study of hearing. Experimental methods applied in individual research projects. Readings, reports, experiments. Prereq.: Courses 1-2-3 or 5-6, Psy. 1-2 and 4-5. 3 cred. per quarter. (Offered in alternate years. Not offered 1946-47.) Mr. Hedgecock.
- 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. Mr. Gilkinson.
- 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. Mr. Hedgecock. (Offered in alternate years. Offered in 1946-47.)
- 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.: Courses 1-2-3 or 5-6; Psy. 1-2; or permission of instructor. 3 cred. Mr. Hedgecock. (Offered in alternate years. Not offered in 1946-47.)
- 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.: Course 1-2-3 or 5-6, 61, 67, and permission of instructor. 3 cred. per quarter. Mr. Bryngelson.

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

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

- 164f-165w-166s.* Clinical Methods and Practice in Speech Pathology. Study of cases and practice in clinical diagnosis and remedial treatment. Prereq.: Courses 1-2-3; 61, 67, 162, and Ed.Psy. 142. May be taken simultaneously with Course 163. 3 cred. per quarter. Mr. Bryngelson.
- 171f-172w-173s.* History of the Theater. A study and an analysis 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. Mr. Whiting, Mr. Thompson. (Offered in alternate years. Offered in 1946-47.)
- 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. (Offered in alternate years. Not offered in 1946-47.)
- 181f-182w-183s. Readings in Speech. Directed reading and the preparation of reports on selected subjects. Prereq.: Courses 1-2-3 or 5-6 and 6 additional cred., permission of instructor. Cred. ar. Mr. Rarig, Mr. Bryngelson, Mr. Gilkinson, Mr. Whiting, Mr. Howell.
- 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. Mr. 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. Mr. Howell.
- 211f-212w-213s.* Seminar in Dramatic Theory. An evaluation and 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. Mr. Whiting.
- 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. Mr. Rarig.
- 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. Mr. Gilkinson.
- 261f-262w-263s.* Seminar in Speech Pathology. A study and critical analysis of current literature in the field of speech pathology. Thesis problems. New theories and clinical procedures. Specific cases for group study. Prereq.: Courses 1-2-3 or 5-6, 61, 67, 122, 162-163, Psy. 1-2. 3 cred. per quarter. Mr. Bryngelson.
- 291f-292w-293s.* Research. Open to graduate students who are engaged in research on special problems. Cred. ar. Mr. Rarig, Mr. Bryngelson, Mr. Gilkinson, Mr. Whiting, Mr. Howell.

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

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.

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

- 103w. Advanced Anatomy of Domestic Animals. Advanced study of the structures involved in the type, conformation, and nutrition of the common farm animals. Dissection of farm animals, including a study of the osseous, muscular, and other principal anatomical structures. 4 cred. Mr. Kernkamp.
- 107f-108w.† Comparative Pathology. Elementary gross and microscopic studies of the more common diseases of animals. Prereq.: comparative anatomy, comparative physiology, and Zool. 149-150. 6 cred. Staff.
- 201f,w,s. Advanced Animal and Poultry Pathology. Studies of clinical material, collateral reading, and conferences. Prereq.: permission of instructor. Cred. ar. Mr. Boyd, Mr. Kernkamp, Mr. Fenstermacher, Mr. Pomeroy.
- 205f,w,s. Advanced Animal Bacteriology. Studies on clinical material, collateral reading, and conferences. Prereq.: permission of instructor. Cred. ar. Mr. Boyd, Mr. Kernkamp, Mr. Fenstermacher, Mr. 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. Mr. Boyd, Mr. Kernkamp, Mr. Fenstermacher, Mr. 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. Mr. Boyd.
- 217f,w,s. Seminar in Veterinary Medicine. Special assignments and review of research problems in veterinary medicine. 1 cred. Mr. Boyd, Mr. Roepke, Mr. Kernkamp, Mr. Fenstermacher, Mr. Pomeroy.
- 230f,w,s,su. Research in Veterinary Medicine. Cred. ar. Mr. Boyd, Mr. Kernkamp, Mr. Roepke, Mr. Fenstermacher, Mr. Pomeroy.

ZOOLOGY

Professors Dwight E. Minnich, Samuel Eddy, Clarence E. Mickel, Adolph R. Ringoen, Jerry E. Wodsedalek; Associate Professors Alexander C. Hodson, 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.

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.
- 107w‡-108s.‡ Protozoology. A survey of the Protozoa, with special reference to their structure, physiology, and life histories. Lect., lab., reading. Prereq.: 15 cred. 3 cred. per quarter. Mr. Osterud.
- 109ff-110w‡-111s.‡ General Physiology of Animal Reactions. A survey of animal behavior from the physiological viewpoint including the physiology of sense organs, nervous systems, muscles, glands, etc. Lect., lab., reading. Prereq.: 15 cred. 3 cred. per quarter. Mr. Minnich.
- 112f. Advanced Comparative Physiology. General and comparative physiology of absorption, osmoregulation, distribution, excretion, and secretion of salts, fluids, and some nutrients. Prereq.: 15 cred. with permission of instructor. 3 cred. Ar.
- 113w.‡ Laboratory Methods in General Physiology of Absorption and Secretion. Original problems assigned under supervision to capable graduate students. Prereq.: Course 112 and permission of instructor. 3 to 5 cred. Ar.
- 117ff-118w‡-119s.‡¶ Animal Ecology. Principles of terrestrial and aquatic animal ecology, including general studies of land and aquatic communities with field and laboratory studies of animal populations and environmental factors. Lect., lab., assigned reading, and field trips. Prereq.: 15 cred. 3 cred. per quarter. Mr. Eddy, Mr. Hodson.
- 120s.¶¶ General Ecology of Insects. General ecology with special emphasis on its application in insect control. Prereq.: 15 cred. 3 cred. Mr. Hodson.
- 121f.‡ Ichthyology. A study of the taxonomy and habits of the northern fresh-water fishes. Prereq.: 15 cred. 3 cred. Mr. Eddy.
- 125ff-126w‡-127s.‡ Advanced Entomology. Morphology and classification of insects, with lectures on the history of entomology. Prereq.: 15 cred. 3 cred. Mr. 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. is recommended. 4 cred. per quarter. Mr. Richards.
- 132w.‡ General Physiology of Development. A general survey of physico-chemical aspects of fertilization, cleavage, differentiation, growth, and development of form. Particular emphasis is placed on the energy exchanges and chemical kinetics involved in the phenomena of organic development. Lect. and lab. Prereq.: Courses 50 and 180 or permission of instructor. 3 cred. Ar.
- 133s. Genetics of Development. Contributions to theories on the function, time of action, and manner of action of genes, and on the nature of the gene. Lect., assigned readings, and discussions. Prereq.: proper preparation in advanced genetics or permission of instructor. 3 cred. Ar.

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

¶ Either 119s or 120s or both may be taken to complete Course 117f-118w.

- 144w‡-145s‡-146s‡ Animal Parasites and Parasitism. Lectures and laboratory work. Origin and biological significance of parasitism; the structure, life history, and economic relations of representative parasites. Prereq.: 15 cred. 3 cred. per quarter. Mr. Wallace.
- 144w. Parasitic protozoa.
- 145s. Helminths.
- 146s. Medical entomology.
- 149w‡-150s‡ Histology and Organology. Comparative study of the microscopic structure of tissues and organs. Textbook, lect., demonstrations, and lab. Prereq.: 15 cred. in zoology. 3 cred. per quarter. Mr. Ringoen.
- 155w‡ Physiology in Relation to Physics. Application of the principles of physics to the investigation and interpretation of physiological phenomena. Lect. and demonstration. Prereq.: 15 cred. in biological science and permission of instructor. 3 cred. Ar.
- 160f‡-161w‡ Cytology. A survey of cell structure and behavior with special reference to genetic cytology. Lect., reading, and lab. work. Prereq.: 15 cred. with permission of instructor. 3 cred. per quarter. Mr. Wodsedalek.
- 170f‡-171w‡ Advanced Genetics. General laws involved in heredity and variation, with deviations from the practical applications of the laws. Textbooks, lect., lab. Prereq.: 15 cred. including Course 83, or permission of instructor. 3 cred. per quarter. Ar.
- 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. Mr. Ringoen.
- 181f. Endocrines and Reproduction. Lectures and readings on the endocrines with special reference to those concerned with the physiology or reproduction. Prereq.: 15 cred. including Course 21 or equiv. 3 cred. Mr. 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. Mr. 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. Mr. Mickel.
- 211-213.* Research in Ecology. Mr. Eddy.
- 217-219.* Research in Physiology. Mr. Minnich.
- 221-223.* Research in Biophysics. Mr. Schmitt.
- 229-231.* Research in Histology. Mr. Ringoen.
- 233-235.* Research in Embryology. Mr. Ringoen.
- 237-239.* Research in Cytology. Mr. Wodsedalek.
- 241-243.* Research in Protozoology. Mr. Osterud.
- 251-253.* Research in Genetics. Ar.
- 261-263.* Research in Parasitology. Mr. Wallace.
- 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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The attractiveness of careers for capable, well-trained young people in governmental administration has been enhanced by the establishment of positions such as administrative assistant, administrative analyst, and research assistant at entrance levels, by the filling of such positions through open competitive examinations or other merit system procedures, and by the payment of salaries comparable to those offered by private employment. Preference provisions in national and state laws offer added inducements to men and women who have served in the armed forces during World War II.

Education for Public Administration

Universities and colleges in the United States have responded in increasing number to the demand for young men and women with special training in public administration. In January, 1946, some eighty educational institutions reported a departmental major or an interdepartmental training program in this field. The significance of this educational development led to the making of a study of graduate instruction in public administration at sixteen leading institutions under the auspices of the Committee on Public Administration of the Social Science Research Council.¹

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Though considerable instruction in public administration is being given at the undergraduate level at Minnesota and elsewhere, the desirability of a broad, general education or a professional education as a background for public administrative work, the value of determining both intellectual and personal aptitudes for administrative service before specialized training is undertaken, and the importance of limiting the number of students to the probable employment opportunities, have led most of the leading institutions to establish specialized public administration training programs at the graduate level.

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The graduate training program in public administration at the University of Minnesota was established in the fall of 1936, though instruction in this field had been given both at the undergraduate and graduate levels for a number of years prior to that time. The program was conducted from 1936 to 1945 with the financial assistance of the Rockefeller Foundation. The program is the major activity of the Public Administration Center of the Department of Political Science. The faculty of that department is aided and advised in the conduct of the program by an all-university faculty committee representing the colleges, schools, and departments most immediately concerned. The chairman of the Department of Political Science is chairman of this committee, and the professor of public administration in that department is secretary of the committee and director of the project.

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Admission to the training program is open to two classes of students. Graduates of accredited colleges and universities who have high scholastic ability and personal aptitude for administrative work but are without previous government employment experience are admitted as *pre-service* students.

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11. Cost accounting
12. Measurement of performance
13. Public reporting

Part IV. Personnel Administration

1. Public personnel problems
2. Historical background
3. Personnel agencies
4. Classification of positions
5. Salary standardization
6. Recruitment and examinations
7. Training
8. Employment policies and management
9. Organization of government employees
10. Retirement systems

Part V. Responsible Administration

1. The problem of control
2. The agencies and methods of control

For information concerning other courses open to graduate students in public administration write to the Office of Admissions and Records, University of Minnesota, Minneapolis 14, and request the Announcement of the Graduate School.

Research Projects

Each student enrolled in the training program who is a candidate for the Master's degree, Plan A, is required to undertake a research project dealing with some government administrative problem. Pre-service students may pursue their research projects in connection with their internship training or in residence. In-service students undertake their research in residence but preferably with reference to some problem of interest to their respective governmental employers. The results of these research projects are submitted in the form of graduate theses in partial fulfillment of the requirements for the Master's degree.

Illustrative of the type of research projects undertaken by students in previous years are the following thesis titles: "Budgetary Administration in the U. S. Department of Agriculture;" "The Co-ordination and Issuance of Policies and Procedures;" "Governmental Cost Accounting;" "Administrative Adjudication of Unemployment Compensation Claims in Minnesota;" "The Administrative Districts and Field Offices of the Minnesota State Government;" "Putting Departmental Administrative Reports To Work for the City Manager;" "Federal Supervision and Control of Municipal Public Works Construction."

Internship Training

For those pre-service students who desire them, internships in appropriate governmental departments or agencies—national, state, or local—will be arranged by the University through negotiations with suitable internship supervisors. Students who are especially interested in national administration may make application for internship appointments with the National Institute of Public Affairs, an organization established in Washington, D.C., in 1934 for the specific purpose of providing internship training for a limited number of exceptionally well-qualified college and university graduates. In prior years, internships have been arranged by the University in a wide variety of national and state departments and with several city managers. With few exceptions, such internships are unpaid.

The purpose of the internship is to provide the student an opportunity to observe and to participate in administrative organization and operations in a governmental agency under careful supervision to the end that he may achieve an integration of theory and practice in public administration. The research projects of pre-service students, mentioned above, may be undertaken as a part of the internship training period.

Degrees

MASTER'S DEGREE

Normally, the special graduate training program in public administration leads to the degree of master of arts in public administration. The requirements for this degree are the same as for the general master of arts degree, Plan A or B, in the Graduate School with the following exceptions:

- (a) A single integrated course of study is substituted for the customary major and minor fields of work.
- (b) A working knowledge of statistics or accounting may be substituted for the required reading knowledge of one foreign language.
- (c) Candidates for the degree, 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.

For detailed information concerning the requirements for the Master's degree, Plans A and B, write to the Office of Admissions and Records, University of Minnesota, Minneapolis 14, and request the current Graduate School announcement.

DOCTOR'S DEGREE

The University does not offer a doctorate in public administration. However, advanced graduate students who are interested in majoring in this field with a view to careers in teaching or in government service are advised to become candidates for the doctorate in political science, with public adminis-

tration as the major field of study and with a minor or minors in closely related social science departments.

Facilities for Study and Research

The University has provided a study room for graduate students in public administration in the University Library Building. This room also houses the office of the Public Administration Center and a portion of the special joint reference library which contains an excellent collection of some 35,000 books, documents, pamphlets, periodicals, and other materials covering every field of public administration. The room is adjacent to the Municipal Reference Bureau, the League of Minnesota Municipalities, and a social science seminar reading room which furnishes reserve book reading material for many of the courses in which the students are enrolled. The University Library provides ready access to, and special facilities for the use of, its approximately 1,300,000 volumes, a large proportion of which are in the social sciences, including extensive serial document and periodical collections. The Law Library also is immediately adjacent to the main University Library.

The University of Minnesota is situated in the midst of an important area of governmental activity, with the regional offices of many of the national departments and agencies located in both of the Twin Cities, with the state capitol in St. Paul, and with county and municipal offices in each city. The numerous and varied governmental units provide an unexcelled opportunity for research and field trips, and a source of experienced public administrators who generously serve as lecturers and luncheon speakers from time to time. A Minnesota Chapter of the American Society for Public Administration holds quarterly meetings which are open to the students in the training program.

Information Concerning Former Students

The 64 pre-service students (45 men and 19 women) who had been enrolled in the graduate training program prior to 1945-46 came from 20 states and from 36 different colleges and universities. As undergraduates, they majored in 13 different fields of study, with political science, economics, and business administration predominating. They have served internships in 16 different national departments and agencies, in 2 state departments, in 4 city manager cities, and in 4 governmental research or service bureaus. Their present positions or the ones held prior to entering military service also represent all levels of government, but with national agencies predominating. There are now 26 in some branch of the armed forces. Of the 38 others, all but 12 are currently employed in governmental positions.

The 39 in-service students (32 men and 7 women) who have been enrolled during the same period came from 13 states and were graduates of 29 different colleges and universities. Of the 39, 23 were from Minnesota, and 8 were graduates of the University of Minnesota. As undergraduates, they had majored in 20 different fields of study. Business administration, sociology, economics and mathematics head the list of majors. These students came on leaves of absence from 14 national departments and agencies, principally field offices, from 14 state departments, from 4 county and 5 municipal offices. Their present positions or the ones held prior to entering military service are located at 15 national agencies, 8 state departments, 4 county or municipal offices, and 2 governmental research bureaus. Seventeen are now in military service. Of the remaining 22, all but 3 are now employed in governmental positions.

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1. The problem of control
2. The agencies and methods of control

For information concerning other courses open to graduate students in public administration write to the Office of Admissions and Records, University of Minnesota, Minneapolis 14, and request the Announcement of the Graduate School.

Research Projects

Each student enrolled in the training program who is a candidate for the Master's degree, Plan A, is required to undertake a research project dealing with some government administrative problem. Pre-service students may pursue their research projects in connection with their internship training or in residence. In-service students undertake their research in residence but preferably with reference to some problem of interest to their respective governmental employers. The results of these research projects are submitted in the form of graduate theses in partial fulfillment of the requirements for the Master's degree.

Illustrative of the type of research projects undertaken by students in previous years are the following thesis titles: "Budgetary Administration in the U. S. Department of Agriculture;" "The Co-ordination and Issuance of Policies and Procedures;" "Governmental Cost Accounting;" "Administrative Adjudication of Unemployment Compensation Claims in Minnesota;" "The Administrative Districts and Field Offices of the Minnesota State Government;" "Putting Departmental Administrative Reports To Work for the City Manager;" "Federal Supervision and Control of Municipal Public Works Construction."

Internship Training

For those pre-service students who desire them, internships in appropriate governmental departments or agencies—national, state, or local—will be arranged by the University through negotiations with suitable internship supervisors. Students who are especially interested in national administration may make application for internship appointments with the National Institute of Public Affairs, an organization established in Washington, D.C., in 1934 for the specific purpose of providing internship training for a limited number of exceptionally well-qualified college and university graduates. In prior years, internships have been arranged by the University in a wide variety of national and state departments and with several city managers. With few exceptions, such internships are unpaid.

The purpose of the internship is to provide the student an opportunity to observe and to participate in administrative organization and operations in a governmental agency under careful supervision to the end that he may achieve an integration of theory and practice in public administration. The research projects of pre-service students, mentioned above, may be undertaken as a part of the internship training period.

Degrees

MASTER'S DEGREE

Normally, the special graduate training program in public administration leads to the degree of master of arts in public administration. The requirements for this degree are the same as for the general master of arts degree, Plan A or B, in the Graduate School with the following exceptions:

(a) A single integrated course of study is substituted for the customary major and minor fields of work.

(b) A working knowledge of statistics or accounting may be substituted for the required reading knowledge of one foreign language.

(c) Candidates for the degree, 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.

For detailed information concerning the requirements for the Master's degree, Plans A and B, write to the Office of Admissions and Records, University of Minnesota, Minneapolis 14, and request the current Graduate School announcement.

DOCTOR'S DEGREE

The University does not offer a doctorate in public administration. However, advanced graduate students who are interested in majoring in this field with a view to careers in teaching or in government service are advised to become candidates for the doctorate in political science, with public adminis-

tration as the major field of study and with a minor or minors in closely related social science departments.

Facilities for Study and Research

The University has provided a study room for graduate students in public administration in the University Library Building. This room also houses the office of the Public Administration Center and a portion of the special joint reference library which contains an excellent collection of some 35,000 books, documents, pamphlets, periodicals, and other materials covering every field of public administration. The room is adjacent to the Municipal Reference Bureau, the League of Minnesota Municipalities, and a social science seminar reading room which furnishes reserve book reading material for many of the courses in which the students are enrolled. The University Library provides ready access to, and special facilities for the use of, its approximately 1,300,000 volumes, a large proportion of which are in the social sciences, including extensive serial document and periodical collections. The Law Library also is immediately adjacent to the main University Library.

The University of Minnesota is situated in the midst of an important area of governmental activity, with the regional offices of many of the national departments and agencies located in both of the Twin Cities, with the state capitol in St. Paul, and with county and municipal offices in each city. These numerous and varied governmental units provide an unexcelled opportunity for research and field trips, and a source of experienced public administrators who generously serve as lecturers and luncheon speakers from time to time. A Minnesota Chapter of the American Society for Public Administration holds quarterly meetings which are open to the students in the training program.

Information Concerning Former Students

The 64 pre-service students (45 men and 19 women) who had been enrolled in the graduate training program prior to 1945-46 came from 20 states and from 36 different colleges and universities. As undergraduates, they had majored in 13 different fields of study, with political science, economics, and business administration predominating. They have served internships in 16 different national departments and agencies, in 2 state departments, in 4 city manager cities, and in 4 governmental research or service bureaus. Their present positions or the ones held prior to entering military service also represent all levels of government, but with national agencies predominating. There are now 26 in some branch of the armed forces. Of the 38 others, all but 12 are currently employed in governmental positions.

The 39 in-service students (32 men and 7 women) who have been enrolled during the same period came from 13 states and were graduates of 29 different colleges and universities. Of the 39, 23 were from Minnesota, and 8 were graduates of the University of Minnesota. As undergraduates, they had majored in 20 different fields of study. Business administration, sociology, economics, and mathematics head the list of majors. These students came on leaves of absence from 14 national departments and agencies, principally field offices, from 14 state departments, from 4 county and 5 municipal offices. Their present positions or the ones held prior to entering military service are located in 15 national agencies, 8 state departments, 4 county or municipal offices, and 2 governmental research bureaus. Seventeen are now in military service. Of the remaining 22, all but 3 are now employed in governmental positions.

The Bulletin of the
UNIVERSITY of MINNESOTA

The Graduate School
General Announcement, 1946-1947



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This bulletin should be used by the graduate student in conjunction with the Combined Class Schedule and other bulletins announcing courses offered in the individual colleges of the University. Students are requested also to consult with graduate advisers in their major departments before planning details of their programs. A comprehensive announcement of departments and courses in the Graduate School is in preparation.

UNIVERSITY CALENDAR

Fall Quarter

1946			
Aug. 5-Oct. 5			Registration for graduate students
September	30	Monday	Fall quarter classes begin, 8:00 a.m. ¹
October	10	Thursday	Language examinations
November	7	Thursday	Last day for filing Ph.D. theses for the fall quarter
November	22	Friday	Last day for filing Master's theses for the fall quarter
December	19	Thursday	Commencement, 8:00 p.m. Fall quarter ends, 6:00 p.m.

Winter Quarter

1947			
January	6-11		Registration for graduate students
January	6	Monday	Winter quarter classes begin, 8:00 a.m. ¹
January	16	Thursday	Language examinations
February	6	Thursday	Last day for filing Ph.D. theses for the winter quarter
February	20	Thursday	Last day for filing Master's theses for the winter quarter
March	20	Thursday	Commencement, 8:00 p.m. Winter quarter ends, 6:00 p.m.

Spring Quarter

March 31-April 5			Registration for graduate students
March	31	Monday	Spring quarter classes begin, 8:00 a.m. ¹
April	10	Thursday	Language examinations
May	2	Friday	Last day for filing Ph.D. theses for the spring quarter
May	9	Friday	Last day for filing Master's theses for the spring quarter
June	13	Friday	Seventy-fifth annual commencement, 8:00 p.m. Spring quarter ends, 6:00 p.m.

Summer Session

June	16-17		Registration, first term. First term fees due
June	18	Wednesday	First term Summer Session classes begin, 8:00 a.m. ¹
June	26	Thursday	Language examinations Last day for filing theses for first term of Summer Session
July	24	Thursday	Commencement, 8:00 p.m.
July	25	Friday	First term closes
July	28	Monday	Registration, second term. Second term fees due
July	29	Tuesday	Second term classes begin, 8:00 a.m. ¹
August	7	Thursday	Last day for filing theses for second term of Summer Session
August	29	Friday	Second term closes

¹ First hour classes begin at 7:45 at University Farm.

THE GRADUATE SCHOOL

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 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 simply desire 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 register as special students in the college giving the work.

The results of the Graduate Record Examination when available will be considered as supplementary information in determining the admission of students. 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 to the Graduate School should be addressed to the dean. 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 two weeks before matriculation.

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 candi-

dacy 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 CREDIT

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 25 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 5, "From other institutions to apply toward the Master's degree," and Requirements for the Doctor's Degree, page 25 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.

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 for 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.

ASSISTANTSHIPS

More than 200 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 enrolment 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 \$1,575 for full-time service for the academic year of nine months. In general they vary from approximately \$400 for 25 per cent of full-time service to approximately \$800 for half-time service for the academic year.

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

Applications are due March 1 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.

FELLOWSHIPS

Shevlin Fellowships—Four graduate fellowships of \$500 each per annum have been established by the late Thomas H. Shevlin of Minneapolis. These are awarded annually in each of the following colleges: the College of Agriculture, Forestry, and Home Economics; the School of Chemistry; the Medical School; and the College of Science, Literature, and the Arts. These fellowships carry exemption from tuition.

Shevlin fellows 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.

Administrative and Clinical Fellowships—Four fellowships in the Student Counseling Bureau, one in the Speech Clinic, one in the Bureau of Student Loans and Scholarships, four in the Bureau of Veterans' Affairs, five in the Housing Bureau, and three in the Student Activities Bureau, are available in 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, 213 Administration Building, University of Minnesota, Minneapolis 14, Minnesota.

Foreign Student Scholarships—Thirty tuition scholarships open in any department or college are offered to qualified foreign graduate and undergraduate students. These offer no stipend, but grant exemption from tuition only. Applications are to be made on or before June 1 of each year, to the Office of the Dean of Students, 213 Administration Building, University of Minnesota, Minneapolis 14, Minnesota.

Minnesota State Division of the American Association of University Women Fellowship—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 1947-48.

Grace Ellis Ford Fellowship of the Minneapolis College Women's Club—This carries a stipend of \$750, open in alternate years to a graduate woman student without restriction as to major field. Offered for 1946-47.

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. 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.

Peavey-Van Dusen-Harrington Fellowship—This fellowship of \$1,000 a year for a three-year period is offered by the University of Minnesota to a qualified Chinese graduate student who wishes to major in some field of agriculture, forestry, or home economics.

It includes exemption from tuition and affords an excellent opportunity for either a man or a woman to pursue advanced studies.

American Potash Institute Research Fellowship—This fellowship of \$1,000 is open to a qualified graduate student for the purpose of conducting experiments relative to the function of boron in plant nutrition. This applies to the fiscal year from July 1 to June 30.

Firestone Fellowship—This fellowship of \$990, requiring at least half time in service for a twelve-month year, is open to a qualified graduate student for the purpose of conducting experiments relating to the propagation, protection, and collection of plantation rubber.

Albert Howard Fellowship—This fellowship affords a stipend of \$240 annually, and is awarded 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 are open to graduates of the University of Minnesota who major in botanical and zoological science.

Thomas F. Andrews Fellowship in Geology—A small fund varying from \$250 to \$400, with exemption from tuition, is available at intervals of two or three years to a graduate student majoring in geology.

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 fees.

In-service fellowships in public administration—Two fellowships with stipends varying from \$1,000 to \$1,200 and with exemption from tuition are offered by the University of Minnesota each year to graduates of recognized universities and colleges who have had not less than three years of experience in government service, and who wish further to prepare themselves for positions of administrative responsibility. Preference is given to employees of Minnesota state and local governments.

Application blanks and additional information concerning these fellowships may be secured from the secretary of the Committee on Training for Public Administration, 13 University Library.

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.

Several Red Cross Fellowships at \$65 per month and tuition are available in medical social work for second year students, and in home service work for first and second year students. Students who accept these fellowships are committed to accept Red Cross employment for one year.

A limited number of fellowships are made available by the Board of Charities of the American Lutheran Church, with a stipend up to \$800, conditioned by the students' financial need. These are available to Lutheran students with acceptable scholarship standards. They do not grant exemption from tuition. Students accepting these fellowships are committed to accept employment approved by the Lutheran Board of Charities.

Sigerfoos Fellowship in Zoology—This fellowship offers a small sum of money annually to graduate students in the field of zoology to enable them to forward their studies primarily by a period of work at marine or tropical laboratories.

Class of 1890 Fellowship—Whenever sufficient funds have accumulated, this fellowship of approximately \$250 is open to a graduate of the College of Science, Literature, and the Arts, or the College of Engineering and Architecture.

Arthur Andersen Fellowship—This fellowship of \$500 in accounting or related fields is open to men students holding a Bachelor's degree.

Abbott Laboratories Fellowship—This fellowship of \$750 is open to graduate students majoring in the field of organic chemistry under Dr. Walter M. Lauer.

Allied Chemical and Dye Corporation Fellowships—Two fellowships of \$750 each are available, one in chemistry and one in chemical engineering.

du Pont Fellowship—The amount of \$1,000, for research in the field of chemistry or chemical engineering, is available to a qualified graduate student. Tuition and fees will also be paid by the fund.

Hormel Research Foundation Fellowship—One fellowship in chemistry and one in chemical engineering, paying \$750 each, are made available through this fund. Further information may be secured by writing the dean of the Institute of Technology.

Aluminum Research Institute Fellowship—This fellowship of \$1,200 is open to a graduate student for research under Dr. Izaak Kolthoff in some modern phase of analytical chemistry.

Negotiations are at present under way for a number of other commercial fellowships in chemistry and chemical engineering. Further information may be obtained by writing to the dean of the Institute of Technology or the dean of the Graduate School.

Lederle Fellowship—Three fellowships in pharmaceutical chemistry, at \$600 each, without exemption from tuition, are offered annually for research work in the field of pharmaceutical chemistry.

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.

Minnesota State Pharmaceutical Association Fellowship—This fellowship of \$500 with exemption from tuition is available to a qualified graduate of the College of Pharmacy of the University of Minnesota.

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, and applications should be made on or before March 1.

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 \$200 during any one year or a maximum of \$400. All applications should be made to the Bureau of Student Loans and Scholarships, 207 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.

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 and whose family income does not exceed \$2,000. Residence is limited to one year. 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 subletting, 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.

REGISTRATION

Full directions concerning registration are given in a booklet issued by the office of admissions and records for the information of new students. The essential documents for a graduate student are an official transcript in duplicate of the student's undergraduate record, and a single copy of an official transcript of graduate work.

Registration in the Graduate School includes the making out of the program, which 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	\$32.00
Tuition fee for nonresidents per quarter	56.00
Tuition fee per credit hour for students carrying less than full work	
Residents	2.75
Nonresidents	4.75
Tuition fee for graduate study <i>in absentia</i> for the professional engineer degrees (to be paid but once for each degree)	96.00
Tuition fee for thesis registration only per quarter	5.00
Incidental fee	10.65
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	1.50
Fee for publication of Ph.D. thesis summary	25.00

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.

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 pages 19-21), 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 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 *four weeks* before the end of the session in which they take the degree. (See pages 20-21.)

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 22.)

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. Several 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.

GRADUATE WORK IN CANCER BIOLOGY

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. 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.

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.

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.

GRADUATE WORK IN DENTISTRY

Graduate work for a limited number of students is offered in certain fields of dental research and dental specialties. The work is under the direction of a joint committee in dentistry and medicine in the Graduate School. Candidates for admission must be graduates of an acceptable dental school with at least two years of preliminary general college work. 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 on 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. Altho a reading knowledge of German is recommended as highly desirable, candidates for the Master's degree in dentistry are exempted from the foreign language requirements. Qualified students who give full time to their studies and absolve the requirements, including a satisfactory thesis, will normally require three years for the degree of master of science in dentistry.

The fields of research and specialization in which work will be directed are: oral pathology, oral surgery, orthodontia, periodontia, restorative dentistry.

PROGRAM FOR THE MASTER OF ARTS DEGREE IN AMERICAN STUDIES

The Graduate School offers to mature students, through its program for the M.A. in American Studies, an opportunity to investigate American civilization from a variety of viewpoints. The curriculum is designed particularly for teachers of history, English, fine arts, and social sciences, and for journalists and other writers.

The prerequisite to graduate work in this curriculum is an undergraduate major in American Studies, or a major in one of the departments included in the program (History, Literature, Fine Arts and Philosophy, Social Sciences), or other preparation which the Committee on American Studies agrees is adequate.

Further information may be secured by addressing Professor Tremaine McDowell, Chairman, Program in American Studies, University of Minnesota, Minneapolis 14, Minnesota.

GRADUATE WORK IN LAW

Under certain properly approved conditions graduate students may offer courses in law as a minor for an advanced degree when their major work is in political science or economics.

A course leading to the degree of master of laws may be taken under the direction of the Graduate School of the University. Candidates must have completed two years of college work, and the work required for the first law degree in a school which is a member of the Association of American Law Schools. No specific course of study is required, but the course elected must be approved by an adviser. Subjects in the cur-

riculum of the Law School not counted towards the first degree and additional work in subjects already studied may be elected. The candidate may also elect studies in the social sciences in the College of Science, Literature, and the Arts, and in the School of Business Administration. The candidate must complete the usual course requirements for the Master's degree and prepare a thesis that will be accepted for publication in the *Minnesota Law Review*. The course may be shaped to secure a more extensive survey of the law and related subjects, or to give a more thoro training in some special branch.

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 Committee on Training for Public Administration.

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 committee. They will be expected to fulfill the general requirements of the Graduate School for the Master's degree under Plan A 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 several departments, will be planned for each student, in consultation with members of the staff, which must be approved by the Committee on Training for Public Administration. All candidates, however, must enroll in the graduate seminar in public administration. They must secure a grade of not less than B 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.

Residence—Pre-service students must spend one academic year in residence at the University and six months of internship in some governmental department. With the approval of the committee, paid employment experience may be substituted for the internship training. In-service students must spend one academic year and one Summer Session in residence at the University.

Thesis—Pre-service students will be required to submit a thesis at the close of their internship which normally will take the form of a report upon some administrative problem assigned by the governmental supervisor and approved by the training staff. In-service students will be required to submit a thesis upon some administrative problem of interest to their governmental employer and approved by the training staff.

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.

INTERNATIONAL RELATIONS

For the degrees of master of arts and doctor of philosophy in international relations, it is recommended that candidates combine a major in political science with a minor in either economics or history. Under Plan B for the Master's degree, the minor should be divided between economics and history.

* Major adviser, Lloyd M. Short, director of training program.

In political science the fields of international law, international relations, comparative government, and colonial government are recommended to such candidates. In history, the recommended fields, from which two should be selected, are American, European, Far Eastern, Canadian, and Latin-American diplomatic history. In economics, they are the various subdivisions of the field of international economic relations. Candidates will be expected to have a good grounding in American government, political and economic theory, history, and geography. Requirements as to prerequisites, foreign languages, theses, and research courses are identical with those for other major and minor work in the departments concerned. Professors H. S. Quigley, A. L. Burt, and R. S. Vaile are advisers in political science, history, and economics, respectively, for candidates in international relations.

A committee of the faculty under the chairmanship of Professor H. S. Quigley has prepared a graduate program of foreign area studies. This program will enable a student to combine preparation for a profession with studies in the language, geography, history, and culture of a selected foreign area. For further information on the program, see a special bulletin now in process of publication. Meanwhile it is suggested that students consult the following advisers: Professor L. D. Steffel (history), Western Europe, Central Europe, and Russia; Professor E. C. Le Fort (Romance languages), Latin America; and Professor H. S. Quigley (political science), Far East.

GRADUATE SOCIAL WORK

The degrees of master of arts in social work, requiring two years of graduate work, and of doctor of philosophy, requiring at least three years of graduate work, are awarded to candidates who complete special curricula in the various branches of social work. Attention is directed to the following fields: protection, guidance, and placement of children; family adjustment and rehabilitation; group relationships; medical social work; psychiatric social work; rural social work; and public welfare.

A candidate for admission must hold a Bachelor's degree from an accredited college or university. He must present 39 quarter credits in social sciences, including a minimum of 12 quarter credits in sociology. In addition, the candidate should present some credits in physiology or biology. However, if the candidate is otherwise eligible for admission but lacks some prerequisites he may be permitted to enter the curriculum but will be required to complete such prerequisites before he is eligible for a degree. Knowledge of a foreign language is not required, but is strongly recommended.

The number of beginning students is limited to fifty, with preference given to students wishing to enroll in the fall quarter. Persons with previous training and experience may be admitted at any quarter. The application for admission is considered first by a departmental committee of major advisers in social work which makes recommendations to the dean of the Graduate School upon whose approval the candidate is admitted. Acceptance of applicants is based on the following criteria: evidence of ability to meet standards of graduate work, usually indicated by grades of superior quality; psychological tests when available; letters of reference indicating personal aptitude for social work.

In view of the 90 quarter credit requirement for the Master's degree in social work, advanced standing in technical class and field courses may be granted for work done in other approved schools of social work. No transfer of graduate credits from other institutions will modify the minimum requirement of one academic year in residence as a graduate student in this University.

The M.A. degree may be secured under Plan A or Plan B. The difference between the research studies in the two plans is in scope rather than in quality. Plan B, involving a shorter research study or the presentation of seminar papers, allows more opportunity for study in related fields.

Since the M.A. in social work requires two years of graduate work and the M.A. in other fields usually assumes one year of graduate work, some combinations can be made. Work done in related fields and applying toward another Master's degree may be included in the social work requirement up to a maximum of 18 credits and credits from the social work requirement may be included as a minor in another field. But the student must present at least 45 graduate credits beyond the credits presented for an M.A. in another field in order to qualify for an M.A. in social work and the program must fulfill the requirements stated below.

REQUIREMENTS FOR MASTER OF ARTS DEGREE IN SOCIAL WORK

	Credits	
	Plan A	Plan B
Class courses	42	51
Field Work courses	30	30
Thesis	18
or		
Special Study	9
	—	—
Total	90	90

The proportion of credit between technical social work courses and related fields may be determined by the social work advisers within the requirements of the Graduate School and the policies of the School of Social Work.

The Ph.D. degree in social work is a three-year program based upon the general requirements for this degree as outlined on page 25 of this bulletin.

Students may be awarded a certificate in social work on the completion of 60 quarter credits distributed as follows:

	Credits
Technical social work (class)	36
Field work in social work (450 hours)	15
Related fields	9
	—
Total	60

For detailed information consult the Bulletin of the School of Social Work.

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 Florence L. Goodenough (Child Welfare), Walter W. Cook (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 STATISTICS

The Graduate School recently authorized a program of study leading to the degree of doctor of philosophy with a major in statistics and 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, F. R. Immer, Dunham Jackson, P. O. Johnson, B. D. Mudgett, W. C. Waite; Associate Professor A. E. Treloar.

MAJOR IN STATISTICS

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

Major—The course work for the major should normally include a minimum of 50 credits chosen from the courses listed below or their equivalent. 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 include a minimum of 24 credits in 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 group committee representing the candidate's major adviser.

Language requirement—A reading knowledge of French and German is required. With the approval of the Executive Committee of the Graduate School another foreign language may be substituted for one of them.

MINOR IN STATISTICS

A student whose major for the Ph.D. is in another field and who looks forward to research requiring statistical techniques may take a minor in statistics. The minimum number of credits for this minor will be 24, and 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

Credits

P.H. 150	Life Tables	3
P.H. 200	Research in Biometry	Ar.
P.H. 211	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, because there is considerable evidence that the need for rehabilitation counselors is going to be great, has set up a flexible program to train students for the particular types of rehabilitation counseling work they plan to enter.

At the graduate level a certificate will be issued to students who complete an approved program but who do not fulfill the requirements for the Master's degree.

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 19-23 of this bulletin.)

Programs should be formulated in conference with an adviser selected after consultation with the co-ordinator, Professor H. P. Longstaff, 193 Psychology Building.

A special bulletin, *Vocational Diagnosis and Counseling for Rehabilitation Workers, 1944-46*, may be obtained from the Office of Admissions and Records, University of Minnesota, Minneapolis 14, Minnesota.

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.

§ Under specified conditions a limited number of graduate students of 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 tho 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.

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 things 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 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 a 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 choice of 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.

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

† Students should consult departments with respect to their policy as to the use of Plan B.

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.

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 and 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 four weeks* (in the spring quarter, *five 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, one dollar 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	Four weeks before graduation (in June, five weeks)
Approval of thesis	Thesis committee	Before admission to final oral examination
Final written examination in major	Major department members of the graduate faculty	Not later than three weeks before commencement and 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 28) 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 12.) 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. In so far 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, credit hours should be in a single field of concentration. 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 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 and the president of the University.

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, or petroleum engineering, or architecture will correspond to those outlined for this degree in other subjects. The major subject and, under Plan A, the thesis will lie 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. The language requirement is waived in all of these cases except chemical engineering, in which German is required. §

REQUIREMENTS FOR THE ENGINEER DEGREES

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 18) 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 special cases approved by the department, French may be substituted.

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 18.

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 towards 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.

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.

FEE\$

A fee of \$96, to be paid in advance, is required for the year of graduate study towards the professional Engineer degrees if taken *in absentia*. Students in residence are charged the regular Graduate School fees. In addition the regular graduation fee of \$10 must be paid for each degree obtained, at the time of qualifying for the degree. The student must also pay \$1.50 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 tho 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 dean normally four weeks (in the case of the June commencement, five weeks) before the commencement at which the degree is to be obtained. The deposit of one dollar and a half 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, or college, 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 ..	Four weeks before graduation (five, in June)
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 and the president of the University, the candidate must be present in person to receive the degree.

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.

[§] This time requirement will be met in three years only by those students who devote all their time to graduate study. Students who merely 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.

PROGRAM OF STUDY

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

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 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 program is then to be submitted to the dean for final approval. During the second quarter of the second year he shall 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. The student's adviser, or his representative at his option, may attend the oral language examinations and provide literature in the major field from which the test passages are selected. 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.

THE MAJOR WORK

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

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.

¶ 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.

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

Not less than one sixth of the total work of the three years shall be devoted to the minor subject and all of this work shall be completed and certified to by the department in which the minor is taken 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, which 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 which 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 which 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* (four 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 \$25 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.

Directions for Preparing the Summary

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

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 doctoral 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.

No preliminary examination will be given during the month of May.

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 the examination shall be open to any member of the graduate faculty. 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 and the president of the University.

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 \$25	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

UNIVERSITY OF MINNESOTA

AGRICULTURAL CAMPUS

SAINT PAUL

